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Teleradiology & Telemedicine

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TELERADIOLOGY

Teleradiology and telemedicine are the focus of our cover story. Teleradiology is a growing business, and whether you think it is the solution to uneven provision or part of the problem of commoditisation of radiology, it certainly deserves attention. Provision and regulation of teleradiology vary widely across Europe and across the world. However, quality is paramount. Neelam Dugar (page 8) explains the need in teleradiology for radiology reporting standards, and evaluation by referring doctors and patients. Jan Schillebeeckx (page 10) outlines the legal aspects of telemedicine in Europe, and observes that existing European regulation is complex but clear. Mark-Christopher Spoerl and colleagues (page 14) write about a telemedicine project in the Euroregion Pomerania. Their analysis compared the costs of physicians travelling physically to another hospital for a tumour board with the costs of teleconferences. Roberto Grassi and Francesca Iacobellis (page 18) delineate the key aspects of quality assurance in teleradiology. Nadine Koff and David Koff (page 20) look at the opportunities and barriers to teleradiology in Canada and the development of collaborative and quality control solutions.

Our IMAGING Insights section focuses on several key areas for radiologists: decision support, breast imaging, workload, redesigning services and peer review. The innovative Khresmoi project, detailed by Dimitris Markonis and colleagues, has developed a visual search engine, which also searches the open access medical literature for immediate decision support (page 23). Stephen Baker (page 25) considers the advantages of onsite radiology consultation. Oguz Dicle writes about workload in radiology on page 26. Dan Conley reviews the clinical applications of ShearWave™ elastography on page 29.

Frost & Sullivan provide an overview of breast imaging modalities on page 30. Mathias Goyen (page 32) discusses the promise of automated breast ultrasound as a adjunct to mammography for detecting cancers in dense breasts in particular.

Laura Coombs describes the American College of Radiology's Dose Index Registry (page 33), a key tool for improving patient care. Denis Remedios (page 36) provides an update on international initiatives on referral guidelines. Hans-Peter Busch (page 38) explains the role of clinical treatment processes in optimising effectiveness of the radiology service. On page 42 Stephen Brown and Thomas Gallagher are the interviewees on error disclosure in radiology. Daniel Boxer (page 43) recounts the introduction of a dedicated radiology service for acute hospital care. David Koff and Nadine Koff (page 44) explain the Canadian response to a 'perfect storm' of radiology reviews, which crossed Canada when errors in radiology reports were discovered.

In our IT Intelligence section (page 46) Ortiga et al. examine the use of electronic health records (EHR) in Spain. The three most cited facilitators for EHR implementation were the possibility to hire technical support during the implementation and afterwards, security certification warranty and objective third-party evaluations of EHR products.

In Management Matters, Axel Fudickar (page 49) describes the WHO Surgical Safety Checklist, which has proven value as a risk management tool in the perioperative setting. Fudickar argues that it goes beyond checking of important items, but has ramifications for communication, leadership, teambuilding and more. Agnete Nielsen and colleagues (page 50) write about the purpose and success of plastic organic groups in reshaping and making radiology services more efficient in their hospital.

In Interventions, Jonathan Moss (page 51) looks at the great promise of renal denervation. Leo Lawler and colleagues (page 53) explain two interventional radiology therapies for stroke – direct intra-arterial thrombolysis and intra-arterial mechanical thrombectomy.

In Perspectives, the focus begins with nuclear medicine (page 55) and an interview with the President of the European Association of Nuclear Medicine, Professor Fred Verzijlbergen and 2013 Congress President Professor Dominique Le Guludec. In addition, Editorial Board member Udo Sechtem is interviewed about cardiac imaging.

Our Country Focus (page 57) visits Russia, with an interview with prominent Russian radiologist and President of the European Congress of Radiology 2014 Chair Valentin Sinitsyn. This is followed by a look at radiology in South Korea.

Finally Datebook (page 62) includes a review of the recent highly successful Cardiovascular and Interventional Radiological Society of Europe congress and lists forthcoming congresses of interest.

You will notice that some articles in this issue are continued online. Please visit the link given to access the full articles, images and tables. ■

If you have any comments or suggestions, please get in touch at: letters@healthmanagement.org

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Section Editor-in-Chief – IMAGING

Prof. Lluís Donoso Bach

Erratum

The article Radiology Cares™ Campaign Combats "Invisibility" Factor in HealthManagement Vol. 13 No. 2 2013, pp. 28-29 omitted the following note: Reprinted by express permission from the Radiological Society of North America (RSNA), RSNA News, April 2013.

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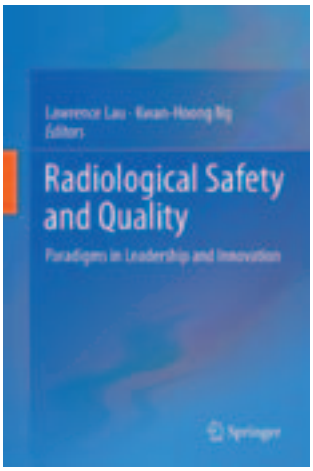
New Book Addresses Radiological Safety and Quality



A new publication from Springer, Radiological Safety and Quality - Paradigms in Leadership and Innovation is a multidisciplinary collaboration by international experts. Contributions cover all aspects of the relationship between safety and quality, such as dose assessment, monitoring radiation exposure, referral guidelines, developing evidence-based policies, imaging appropriateness criteria, team approaches, technology advances, reporting and analysing incidents and public awareness.

The common theme is that there is no single panacea to improve radiological safety and quality. It requires ongoing leadership, innovation, collaboration, and stakeholder participation.

Radiological Safety and Quality - Paradigms in Leadership and Innovation. Edited by Lawrence Lau and Kwan-Hoong Ng. Springer. ISBN 978-94-007-7255-7. The publication is available as hardback or an ebook.

More information is available at *http://www.springer.com/medicine/radiology/book/978-94-007-7255-7*

Survey Finds Americans Rate Kindness as Top Factor in Healthcare

Dignity Health, one of the five largest health systems in the U.S., has announced the findings of a nationwide survey on the power of human kindness in healthcare and the perception of kindness in our society.

According to the survey by Wakefield Research for Dignity Health, 87 percent of Americans feel kind treatment by a physician is more important than other key considerations in choosing a healthcare provider, including average wait time before appointments, distance from home, and the cost of care. Yet, 64 percent have experienced unkind behaviour in a healthcare setting, including the failure of a caregiver to connect on a personal level (38 percent), staff rudeness (36 percent), and poor listening skills (35 percent).

"At Dignity Health, we have long believed that human kindness has the potential to heal and this survey confirms that the vast majority of patients feel the same way," said Lloyd H. Dean, president and CEO of Dignity Health. "We are committed to providing our patients with experiences where they feel welcomed, respected, and cared for by fostering stronger connections with our doctors, nurses, and caregivers."

While 95 percent of Americans feel that they themselves are kind, the survey also found that nearly half (48 percent) of Americans feel society is unkind and that a majority of Americans (58 percent) feel that U.S. culture, including media, public figures and their community, does not place a high value on kindness.

"In the midst of a divisive debate on the future of healthcare, we as an industry have a unique opportunity to focus on the issues that matter to our patients most - listening, healing, and reinforcing the importance of human connection," continued Dean.

The survey found that when people experience unkindness in a healthcare setting, a majority feel that their quality of care is negatively affected (93 percent) and withhold information from their physician (54 percent) when speaking with health care professionals. Other key findings include:

- 90 percent of Americans would feel like switching healthcare providers or physicians after receiving unkind treatment.
- 72 percent of Americans would be willing to pay more for a physician who emphasised kindness when treating patients.
- 88 percent would be willing to travel further to see a healthcare provider or physician who emphasised kindness when treating patients.

"As someone who has been a physician for more than 20 years, I have seen numerous occasions where acts of kindness enhanced a patient's quality of life, helping him or her cope with a diagnosis more effectively," said Robert L. Wiebe, M.D., chief medical officer for Dignity Health. "This survey should encourage all of us to focus on how we treat people, not just what we treat them for."

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TELERADIOLOGY: MEASURING QUALITY ASPECTS

Introduction

Radiology today is integral to modern day patient care. Most patients will have some form of images or scans taken for a diagnosis to be confirmed or excluded. However, patients often do not really know that there are doctors who are qualified in image interpretation, ie radiologists who review the scan images and issue a report.

Radiology reports are a type of medical record, which is formal communication between the referring doctor and the radiologist. Radiology reports are opinions expressed based on the findings on medical images, clinical history provided on the request card, review of previous images and blood/pathology results available to radiologists. Radiologists also provide recommendations about further management of the patient when appropriate, including further investigations or referral to another specialty. Radiology reporting is performed by medically qualified personnel and is regarded as a "medical act" in many countries. Both referring doctors and patients should evaluate the quality of radiology reporting services.

Teleradiology means distant reporting, ie radiologists who are remote from where the images were originally acquired. Measuring quality aspects of teleradiology should be identical to those used for assessment of the local radiology services.

Radiology Report Quality Expectations

Requesting doctors expect the following content within a radiology report:

a. The clinical question put on the request card should be answered.
b. Language and terminology used by the reporter should be clear and understandable by the report reader (the reporter should remain mindful of the specialisation and language of person who will read the report).
c. When an abnormality is detected on the images, the following must be provided:
  i. A tentative radiological diagnosis (or differential diagnosis);
  ii. Advice on further investigations — radiology or non-radiological or follow-up examinations should be included—to achieve a definitive diagnosis;
  iii. Advice on further management/ referral to a different speciality where appropriate, based on local set-up of clinical services (the reporting radiologist must understand the local services).
d. Requesting doctors want reports presented in a logical manner, with report contents structured in a familiar format that can be easily read. Subheadings should include clinical history, findings, conclusion, and advice.
e. Unexpected findings should be highlighted and critical findings should be communicated by telephone call.
f. The contact telephone number of the radiologist should be included.

Jan Bosmans and his colleagues reflect on radiology reports in the large COVER study, Clinicians' Opinions, Views, and Expectations Concerning the Radiology Report (COVER) (Keen 2011).

Professional Dialogue Between Doctors

Modern medicine is very fragmented due to high specialisation. Clinical sub-specialisation itself improves provision of quality of service delivered by an organisation. However, care fragmentation is an inevitable side effect of sub-specialisation. Good communication between professionals is critical to high quality integrated care to the patient as an individual. This is fairly evident in the success of multidisciplinary team meetings (MDTMs) in improving the quality of cancer care in the UK. Below are the types of communication between human beings living in a modern world:

a. Face to face discussions (e.g MDTMS);
b. Video conferencing (e.g. MDTMS);
c. Audio dialogue (telephone);
d. Digital dialogue based written communication—email, text etc.;
e. Written communication (does not support a natural two way dialogue).

On the one hand face to face communication is the best form of communication as it is aided by facial and verbal emotions and emphasis. On the other hand written communication is important to ensure that a long term record is maintained.

When we analyse the majority of radiology reporting, we find that it falls into the worst form of written communication, which does not encourage a natural two way dialogue. There can be misunderstanding of the written report, which can delay and be detrimental to patient management. It is vital that radiologists and referrers are not limited to a one way written communication. Hence, radiology report communication must be supplemented by two way dialogue such as face-to-face (e.g. MDTM) and audio (e.g. phone call) communications. It is often said that a radiology report should be considered to be an invitation to a verbal dialogue. Hence, it is vital that the phone number of the reporting radiologist is included in the report.

Access to Investigation Results

Modern medicine is very dependent on supporting investigations such as blood tests, microscopy, cytology/histology, endoscopy etc. For radiologists to make good and accurate tentative and differential diagnoses, they must have access to recent investigation results with one mouse click or less. Without access to supporting information, radiologists are more likely to be non-committal and provide an ambiguous report with a large number of irrelevant differential diagnoses. Clinical radiologists working in MDTMs do recognise the importance of blood tests, microscopy, cytology/ histology and the role it plays in improving diagnostic acumen. Large irrelevant differential diagnoses can be confusing for the referring doctor and delay patient management due to unnecessary tests.

Radiology Report Quality Dependencies

The quality of radiology reports is dependent on many factors. These include:

a. Qualifications and Training of the Reporter

Medically qualified doctors with further qualifications in radiology image interpretation, ie radiologists, normally provide radiology

reports. Medical qualifications are important for understanding disease processes and patient management. Postgraduate training and qualifications to become a radiologist require multi-modality and multi-speciality training in image interpretation. This is important for reporters to understand the correct imaging procedures for the clinical conditions. Skill mix is the term used to define non-medically qualified staff issuing radiology reports. Non-medically qualified reporters are limited in their knowledge of disease processes, and their ability to interpret blood tests and histopathology reports. Often they are unable to provide a robust tentative and differential diagnosis. Mechanisms like double reporting, and team working with radiologists should be in place to ensure that the quality to patients is not compromised by skill mix.

b. Radiologists with Special Interests (Working in Clinical Teams)

With the increasing complexity of modern medicine sub-specialisation has been happening in all fields of medicine. Increasingly radiologists work in clinical/multidisciplinary teams with physicians and surgeons, including breast, gastro-intestinal, chest, gynaecology, ENT (ear, nose and throat), urology, haemato-oncology etc. Whilst sub-specialisation can lead to fragmentation of care for an individual patient, team working through participation in weekly multidisciplinary meetings with frontline doctors ensures that patients get personalised care by a team of doctors (including radiologists and referring doctors). This also ensures that radiologists remain aware of how patients are managed in the speciality, and they retain their clinical focus. This is reflected in their ability to report appropriately, providing suitable advice on management and further investigations.

Multidisciplinary team working allows radiologists to get feedback from their reports, which is essential for maintaining their own quality. Clinical team working is critical to safe and qualitative radiological practice. Through clinical team working, radiologists are aware of how patients are managed, and thus are able to advise on the next step in the management of patients.

c. Access to Clinical Information

This is critical for radiologists' ability to give good quality reports. The required information includes the following:

i. A well written request card/letter, which provides a summary of the patient's clinical history and asks the clinical question, is absolutely essential for a reporting radiologist. If the clinical information is inadequate, the radiologist should be able to contact the referring doctor with ease by a phone call or electronic communication.

ii. Previous imaging history: previous radiological images and reports must be available to a reporting radiologist on the PACS used for reporting.

iii. Access to recent blood tests, histopathology, endoscopy, microscopy etc. must be available via a single mouse click from RIS/PACS.

iv: The radiologist must also have access to previous clinical history, such as hospital discharge letters, clinic referral or review letters, operation notes etc. with one mouse click.

d. Involvement in the Image Acquisition

Technicians or radiographers are mostly responsible for acquiring the images, whilst radiologists issue the radiology report. Radiologists need to ensure that the scan protocols used by the technical staff are robust enough to allow them to deliver a high quality report. They must be able to have a dialogue (face-to-face or via telephone,) and suggest any additional sequences for MRI or additional scans (contrast enhancement for CT) etc. that may be required in individual cases. This is important for radiologists to enable them to issue a high quality report, rather than ambiguous and non-committal reports blaming inadequate technical acquisition.

Measuring Radiology Reporting Quality by Referring Doctors

Quality measures by referring doctors have two aspects. The first is the quality of individual reports. The second is the quality of the reporting service. It is important that standards or measures for radiology reports or a reporting service apply to both teleradiology and local radiology.

Objective Measures of Radiology Report Quality

This can be obtained by one of the following:

1. A questionnaire sent to referring doctors along with each report;

2. Audits of reports conducted by independent auditors (which should include a radiologist and a referring doctor).

1. Radiology Report Evaluation Questionnaire

Simple questionnaires containing the following six questions can be used for assessment of radiology report quality:

a. Can the report be read and understood in isolation—without images?

b. Are the language and terms used understandable by the referring doctor?

c. Does the report answer the clinical question?

d. If an abnormality is seen, does the report give a tentative or differential diagnosis?

e. If an abnormality is seen, is there advice on appropriate further investigations for a definitive diagnosis?

f. If an abnormality is seen, is appropriate advice (appropriate for the local clinical practice) on further management or referral to a different speciality given?

"unless the patients themselves demand high quality of radiology, there will be little desire from radiology service providers to deliver quality"

2. Radiology Reporting Service Evaluation

Audits should include evaluation of the following:

a. Is the referring doctor able to contact the reporting radiologist with ease to discuss a report? If yes, how long would it take to make the contact?

b. Are unexpected or critical reports communicated verbally to the referring team?

c. How long did it take for the report to be available to the referring doctors from the

time the images were taken?

d. Is the patient provided with a copy of the report?

Measuring Radiology Reporting Quality by Patients

Radiologists remain invisible to patients. However, a high quality radiology report supplemented by a two way dialogue between a radiologist and a referring doctor is the cornerstone of high quality diagnostic care for patients. Unless the patients themselves demand high quality of radiology, there will be little desire from radiology service providers to deliver quality, especially in times where cost is an important criterion and cheapest is considered best.

The following eight questions should be asked by patients for them to evaluate a radiology reporting service:

1. Will I be given my radiology report if I ask for it?
2. Will I be able to discuss my report with the radiologist, if I wish to?
3. Will the doctor who has referred me be able to discuss the exam easily with the radiologist who is reporting my exam?
4. Does the radiologist reporting my exam work in a clinical team, which deals with my type of problem?
5. Does my radiologist work in a radiological team, where he/she can refer to the appropriate clinical radiologist, if required?
6. Will my radiologist have easy access to my blood tests and other relevant information?
7. When will my report be available after the scan is done?
8. Will my radiologist(s) be working with the technical staff to ensure that the scans are correctly taken?

Conclusion

With technological advances, it is no longer necessary for radiologists to be based in the same geographical area as the patient to issue a radiology report. There is increasing use of teleradiology. However, it is important that quality of patient care is not compromised and that any radiology reporting service – local or distant (teleradiology) is measured using the same standards. ■

Key Points

- *Radiology report quality is integral to patient care;*
- *Standards of radiology report quality must be defined;*
- *Teleradiology and local radiology should be measured using the same qualitative standards;*
- *Both referring doctors and patients are important in measuring quality.*

References

Keen CE (2011) What clinicians want from radiology reports. AuntMinnieEurope. [Accessed 3 September 2013] Available at: http://www.auntminnieeurope.com/index.aspx?sec=sup_n&sub=ris&pag=dis&ItemID=605367

LEGAL ASPECTS OF TELEMEDICINE

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The European Union has a vision for telemedicine. The *Ehealth action plan 2012-2020* is part of the EU's Digital Agenda for Europe. The goal is that by 2020 every European citizen has access to, and can use a computer, regardless of education, age and income. The goal is that there will be a widespread deployment of telemedicine services, with personal health services available for every European citizen and patient by 2020. This should be one response to the imbalance of growing health needs and sparse resources in health and social care.

There is some misunderstanding and misconception of the legal aspects of telemedicine, which includes teleradiology. Even at the government level, member states are sometimes not well informed, and still believe there are some limitations. In practice there are almost no limitations on telemedicine. That is why the EU compiled the Staff Working Document (European Commission 2012), which took three years to compile, to bring clarity to this area. It takes into account advice from various Directorates-General (DGs), among them DG Connect, DG Sanco and others and legal advisers. Some will say that a Staff Working Document is not a legally binding document. By definition that is true, but the content is legal, as it refers to existing directives and regulations, which are legally binding. Of course, in a trial, it is for the judge to decide.

We need to differentiate in telemedicine between two types of telemedicine services. Firstly, those considered as a medical act, this means that it is an extension of the existing practice of medicine, performed by healthcare professionals – the 'teleologies' such as teleradiology, teleneurology, telecardiology and so on. By default these are services provided by medical doctors or other healthcare professionals. Secondly are telemonitoring services, these services are remote monitoring technologies that provide health professionals or call centre personnel with biological parameters of the patient/citizen. The analysis of the data can even be done by computers. The European Society of Radiology (ESR) is looking at applications of telemedicine as a medical act.

EC Staff Working Document on the Legal Framework

The European Commission last year published the Commission staff working document on the applicability of the existing EU legal framework to telemedicine services (European Commission 2012). There is European regulation, which is complex but clear. The so-called subsidiarity principle means that telemedicine is the responsibility of the national government when undertaken within the borders of that country and subject to legal constraints

within that country. It changes when you talk about cross-border telemedicine, when EU regulations are involved. Many member states (MS) do not even have legal instruments dealing specifically with telemedicine in their own country, and only a few have regulations or guidelines.

The basic principle is that telemedicine is both a health service and an information society service. The patient is free to seek telemedicine services from any other European MS. The patient can choose where to go for treatment, whether that's a physical or a telemedical service. It is also an information society service, which is a service provided for renumeration, normally provided by electronic means at the individual request of a patient. Patient rights on cross-border health also apply when being treated by a 'teleologist'. The teleologist does not need the authority of the MS of residence of the patient when delivering services from his/her country of residence. Many are not aware of this or even have some doubts, but it is sure. It is only in cases when physicians provide physically services in another MS, then they might need to request authorisation from another country.

Licensing

For example, you are a teleradiologist in country X, doing services in country Y. You are registered in country X, but then the teleradiologist moves physically to country Y, and he then needs to be registered in country Y. Where you as a teleradiologist physically are, and are working out of, you need to be registered in that country. If the teleradiologist complies with the legislation and regulations of his own MS in principle you are free to provide services in all other MS. So for example, a Spanish radiologist does not need to be registered in the UK to provide teleradiology services to the UK, but if he moves to Portugal, he would need to be registered in Portugal.

There is the country of origin principle – only paperwork is needed to change the country.

Patients' Rights

Patients have three main rights when it comes to telemedicine: the right to be reimbursed, the right of access to the report and the opportunity to check the quality of services. The same as if they were going to their own local healthcare facility.

Patients have the right to receive treatment in another MS and to be reimbursed. If you are reimbursed in your own country for that service, you will also be reimbursed if you seek healthcare in another country. If you are not reimbursed in your own country for teleradiology, which is the case in the majority of MS, then you cannot be reiumbursed for teleradiology services in another country. That is why most telepathology/ teleradiology companies are contracted on a stipend basis. There is no governmental reiumbursement.

Processing of Health Data

The EU legal framework on the protection of personal data is being revised. There will be a new regulation to apply to all MS once accepted. The Commission's reform proposals were passed by the Committee for Civil Liberties, Justice and Home Affairs of the EU Parliament in October 2013. The next stage is adoption by the European Parliament and by the Member States in the Council with a view to the legislative reform being agreed before the May 2014 European Parliament elections. The reform proposals include rights such as the right to be forgotten, that data needs to be minimal, not anonymised. People have the right to demand that all personal data will be erased. Today healthcare/ sensitive personal data can only be processed/ transferred with patient consent, for the benefit of the patient, if there is a medical need and if the data controller falls under professional secrecy.

Other Issues

The teleologist has to inform the patient of his/her identity. The patient must be able to verify the quality of the service and be able to contact the doctor who delivered the service. The name of the teleradiologist and his/her contact details must be included on the report and also details of the professional registration in the MS where the service is based.

Liability

Liability can be of a professional nature or relate to defective equipment. EU legislation only harmonises rules relating to liability and defective equipment, and it does not relate to medical liability. The liability regime of teleology is not consistent across the MS, but the patient has always the possibility of suing the healthcare professional in his or own country of residence.

Conclusion

The staff working document is clear and complete. There will not be a new directive on telemedicine. Existing directives such as those on information society services (including e-commerce), the directive on patients' rights in cross-border healthcare, directives on consumer protection, data protection, medical devices and medicinal products already apply. Only two things will change. The changes will be in a new regulation on data transmission and privacy There is also planned an update on professional qualifications – for the 7 professions named (architects, dentists, doctors, nurses, midwives, pharmacists and veterinary surgeons), it will be even easier to move to another country to practise and to deliver their professional services and practise their profession within the EU. It will be voluntary and involve a card – the European Professional Card. ■

Key Points

- *Telemedicine is high on the European political agenda;*
- *By 2020 telemedicine will be widely available across the EU;*
- *There are two types of telemedicine – as a medical act, and telemonitoring (e.g. for home care);*
- *Existing EU legislation is complex but clear.*

Further reading

European Commission (2012). Commission staff working document on the applicability of the existing EU legal framework to telemedicine services. Brussels: European Commission. Available at: *http://ec.europa.eu/digital-agenda/en/news/commission-staff-working-document-applicability-existing-eu-legal-framework-telemedicine*

European Society of Radiology. EU Affairs. Available at: *http://www.myesr.org/cms/website.php?id=/en/eu_affairs.htm*

Carestream MyVue

Patient Portal Enables Viewing, Downloading and Sharing

What do the cities of Ferrara, Italy and Houston, USA, have in common? Patients in those cities were the first to trial Carestream's MyVue portal to access, manage and share their images and radiology reports.

Traditionally, medical images have been available by the time-consuming and inefficient process of downloading on to CDs. The CDs then had to be transported to the health professional or hospital to view. Even then the image might not be compatible with the PACS in the other hospital. Due to difficulty in accessing previous imaging exams, there has also been concern that imaging exams may be repeated unnecessarily, thus exposing patients to additional radiation.

Carestream's MyVue patient portal is a secure, web-based service which offers easy, intuitive secure access to the patient's image and report

How it Works

After their imaging exam, patients are emailed a unique and secure login. Then patients can choose who they share information with (physician or non-physician), which images to share and whether to hide patient details. They also have the option to include a message with shared images.

Stand-alone or Embedded in EMR/HIS

MyVue is a flexible addition to the hospital's services. It can be a stand-alone patient portal as part of Vue PACS or Vue Archive, or embedded within an existing HIS or EMR patient portal.

Houston Trial: Cost Savings Without Added Support

Houston Medical Imaging (HMI) installed the MyVue patient portal to provide better service to referring physicians and patients, in a highly competitive environment.

In the first three months after MyVue was installed, more than 50% of referred patients signed up to use the portal.

The financial benefit of MyVue became apparent just a month after implementation.

HMI estimated cost savings of over US$14,000 per year using MyVue compared to the old system, which included the time and costs of burning CDs, posting and delivering them and disrupting workflow to process the requests. HMI estimated that they would save US$7.69 per CD request by using MyVue. Front desk staff also expressed satisfaction from registering patients to use MyVue and showing them how to use it.

A survey of the HMI patients who activated their accounts showed that 90.9% said MyVue was easy to use. Overall less than 2% support was required, mostly for password reset, as patients were able to pick up the technology easily.

The survey also found that 88.3% said they would like to continue accessing images through the Web and to share exams with others – 3.9% said they would not, and the remaining 7.8% stated no preference. Of the calls to the IT team for assistance with MyVue, most concerned password resets.

Patient Engagement Study Results for MyVue

3 Months Case Study (August - October 2012) with a Total of 6,142 Patients Seen

31%

of Patients needed a CD

50%

of Patients activated MyVue

less than 2%

of Patients needed Help Desk Support

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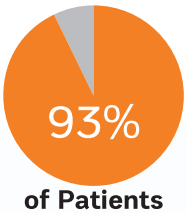
Empowering Patients

MyVue: Ferrara Trate Trial

3 Months Duration with 424 Patients Involved
Mean Age of 48 • Predominantly Female • 233 Surveyed

98%

of Patients found MyVue Easy to Use



of Patients found MyVue Easy to Access

only

of Patients needed Help Desk Support

99%

of Patients wanted to use MyVue Easy for Future Exams

Italian Trial: Improve Patient Satisfaction and Referral

Del Delta Hospital in Ferrara, northern Italy, which conducts 150,000 imaging exams a year, also trialled MyVue. Dr. Giorgio Benea, Head of Diagnostic Imaging, found that the portal promoted a closer connection for patients to their procedures and clinical pathway through immediate access to their reports and images in their own homes. In this trial 98% of patients were fully satisfied with MyVue.

Benefits for patients

- Convenient
- Easy-to-use
- Saves time
- Engages and empowers in own healthcare
- Enables dialogue with healthcare providers
- Access via PC, smartphone, tablet

Benefits for Healthcare Providers

- Saves time
- Supports earlier diagnosis
- Enhances care
- Reduces cost
- Zero footprint technology – no software installation needed
- Reduces duplicate exams and radiation exposure for patients
- Requires minimal administrative support

Technology benefits

- Zero-footprint
- No downloads required
- No training required
- Intuitive easy-to-use interface

Carestream

EVALUATION OF MEDICAL TELECONFERENCE SETUPS:

TELEMEDICINE IN THE EUROREGION POMERANIA

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Introduction

Due to a lack of medical personnel, ensuring excellent medical care in regions with a low population density is a challenge that requires innovative solutions. The Telemedizin Pomerania project is a European Union-promoted international project initiated to address this problem by applying telemedical solutions. The adjacent areas of north-eastern Germany, north-western Poland and southern Sweden belong to the Euroregion Pomerania, and cooperate in the fields of telepathology, teleradiology, telestroke, teleotolaryngology, telemonitoring and teleconferences.

Teleconferences especially provide a tool to secure high standards in patient care by making interdisciplinary tumour boards available to smaller community hospitals that cannot afford their own specialists such as oncologists, radiologists, nuclear medicine specialists and pathologists.

A tumour teleconference project has been set up in the north-eastern German federal state of Brandenburg (see Image 1), an area consisting of three administrative districts (Barnim, Märkisch-Oderland and Uckermark), which have between one-third and one-tenth of the population density compared to urban areas such as Berlin (see Table 1).

Such rural areas lack medical personnel, not especially in relation to the number of inhabitants, but in relation to the area they cover. Berlin has roughly 690 physicians per 1000 square kilometres whereas the north-eastern Brandenburg districts of Barnim, Märkisch-Oderland and Uckermark vary between 4.6 and 1.2 physicians per 1000 square kilometres (see Table 1).

The central stage of the weekly tumour board is the community hospital in Eberswalde (see image page 16), a small city of about 40,000 inhabitants in northeastern Brandenburg. Eberswalde provides oncologists, internal medicine specialists, general surgeons, gynaecologists, urologists, paediatricians, otolaryngologists, oral and maxillofacial surgeons, neurosurgeons, radiologists and radiotherapists. A thoracic surgery specialist from Berlin is present as well. The conference takes place in a room with a telemedical setup consisting of cameras, microphones and numerous large screens for broadcasting video, audio and remote presentations (see Image 2).

The five smaller community hospitals in Angermünde, Prenzlau, Schwedt, Strausberg and Wriezen participate through videoconference access as well as pathologists from either Neubrandenburg or the University Medicine in Greifswald, situated at 131 and 182 kilometres distance respectively in the northern German federal state of Mecklenburg-Vorpommern (Image 1).

Apart from acquisition costs for telemedical equipment, the consequences for personnel resources and therefore on the operating costs need to be taken into account when being asked to decide on implementation or participation in a teleconference setup. Making use of the teleconference example mentioned above, the authors' primary aim is a comparative cost analysis for scenario 1 – teleconference implementation – and scenario 2 – physicians travelling to personally take part in a tumour board distant to their own facility. The analysis is intended to identify the least cost-intensive scenario and conditions from the perspective of a small external hospital. As a secondary objective it is aimed at determining the lower price limit for the conducting facility to perform cost-effective practice when charging for the consultation service.

Methods

To compare the two scenarios, the authors performed an original cost analysis for both settings. The total costs in each scenario comprised relevant variable and fixed costs and therefore also depend on the number of cases that need to be presented to the specialists.

Scenario 1: Remote Tumour Conference

The fixed costs mainly consist of the depreciation costs of the teleconference equipment. Each of the five external hospitals is responsible for one-fifth of the total acquisition costs of the technical equipment, which is used in the external sites, the teleconference conducting hospital in Eberswalde as well as by integrated external specialists. As it holds the tumour conference anyway, the Eberswalde site implements techniques to transfer the relevant data and to audio-visually connect with the external hospitals only for the purpose of having the external hospitals taking part in the conference. The expected depreciation period of five years finally determines the depreciation costs.

The variable costs primarily consist of the personnel costs of the physicians. In order to calculate the personnel costs, information about the personnel cost per minute (net factor cost) and the working time that can be allocated to the presentation and discussion of one case is needed for all physicians participating. The calculation of the personnel cost per minute is based on TV-Ärzte/VKA valid for 2012. The annual gross salary for a specialist doctor (group II level 2) is extended by indirect labour costs of 26.85%. Additionally, the productive labour time per year has been calculated by deducting 30 days leave, ten days time off for sickness, five days off for training and 10% for unproductive times from the annual gross working time based on 42 hours a week. As for the working time a medical case conference consumes and the number of physicians involved, an analysis was conducted measuring and calculating mean times for preparation, presentation and discussion of all cases dealt with in a conference as well as the number of cases (from external hospitals) and physicians per conference on average. These data were collected in 13 tumour conferences held in Eberswalde. The authors assumed that, after having discussed his/her relevant cases, the physician from the external hospital disconnects from the teleconference. Furthermore, the time for one case conference has to be multiplied by the number of physicians involved (those present at the tumour conference in Eberswalde and the specialists from external hospitals) to receive the lowest price limit for compensation of the teleconference service. The annual number of cases an external hospital might come up with at

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Image 1.

the teleconference was extrapolated on the basis of the collected data.

Scenario 2: Physician Travelling to Take Part in Tumour Conference in Person

The calculation of the costs incurring in scenario 2 does not include any variable costs. The authors applied the same methods as in scenario 1 when calculating the personnel costs per minute, the working time for preparation, presentation and discussion for each case and participant. The compensation for the specialists attending the tumour conference in Eberswalde was the same as in scenario 1. In contrast to scenario 1, the external physician attends the tumour conference for the full length. The average time and money spent on travelling was considered by calculating the mean distance between the five external hospitals and the place where the tumour conference is held. The average distance determines the travel time of the external physician and the fuel consumption. The latter is assessed by a mileage allowance of €0.3 per kilometre. The travel costs (personnel and fuel) for one journey (bi-directional) are divided by the mean number of cases the external physician presents at the tumour conference at a time to receive the travel costs per case. Material costs were estimated assuming that the external physician makes use of a CD as a data carrier for each case. The number of cases presented at the tumour conference were the same as in scenario 1.

The calculation of the critical mass that represents the number of cases at which one scenario becomes advantageous over the other (due to lower total costs) completes the cost comparison.

Results

The network uses telemedical hard- and software, either installed in conference rooms or in the specialists' offices. The acquisition costs of the telemedical equipment amount to €367,435 for all eight facilities. This leads to annual depreciation costs of €14,697 in an external hospital. Based on annual labour costs of €83,710 for a specialist doctor and €97,524 underlying productive working minutes, the net factor costs for a physician minute come to €0.86. The distance between an external hospital and the teleconference site averages 41.4 kilometres resulting in an average travel time of 41 minutes and a travel allowance of €9.94.

The teleconference takes place three times a week with an average of 7.9 specialist doctors present at the tumour conference in Eberswalde, 1.4 external specialists and 1.7 physicians from external hospitals attending via videoconference. They cover an average of 16.4 cases in 59 minutes, which results in a mean duration of 3.58 minutes per case. 12.9 cases per conference are presented making use of radiological imaging. An external physician presents 2.5 cases per conference on average. Considering the external physician's probability of taking part in a conference of 0.42 and a total of 156 conferences a year held in Eberswalde leads to 163.61 cases a year, which an external hospital presents at the tumour conference.

Consuming almost 4 minutes per case of the working time of 9.3 specialists on average produces costs of approximately €28 in both scenarios. These costs represent the lower price limit for a compensation fee the tumour conference holding hospital might charge for every case conference.

Table 2 (see p.18) shows the results of the cost comparison between the two scenarios. At 163.61 cases a year, having the physicians travel to the tumour conference implicates lower total costs since its variable costs are below the variable costs that are caused by the teleconference scenario. Furthermore, having no fixed costs privileges scenario 2, at least with such a relatively low number of cases. Figure 1 therefore presents the cost functions revealing the critical mass at the intersection of 272 cases. At this point the total annual costs are €26,758.31.

Discussion

Since interdisciplinarity means quality, the cooperation of multiple disciplines within a tumour board increasingly is a baseline quality measure in the treatment of cancer patients. Large hospitals are generally able to organise such therapeutic conferences without any problems, as the clinical representatives from all involved disciplines are on site. This is clearly more difficult to attain in areas with low population and hospital density. With the help of telemedicine, conferences can easily bridge distances, bringing medicine at university level to the peripheries. Not only is the quality of care improved, but also continuous training of the physicians in rural areas is achieved. In times of information and communication technologies, teleconferences appear to be the method of choice in comparison with having the physicians travel to the conference. Small hospitals in particular have to carefully consider the consequences for personnel and costs that are caused by taking part in such teleconferences.

Under the assumptions made in this study and with 164 cases annually, the result of the cost comparison clearly favours the scenario with the physicians travelling to the conference. The result shifts towards the teleconference at an annual number of cases of 272, which is

Table 1.
Population and Physician Density of the Northwestern Districts in Brandenburg Compared to Berlin.

	Area [km2]	Population	Density [/km²]	Physicians /1,000 Inhabitants	Physicians /1,000 km²
Barnim	1494.33	176.982	118	4.1	4.61
Märkisch Oderland	2127.99	189.613	89	2.8	2.35
Uckermark	3058.08	127.957	42	3.2	1.25
Berlin	891.85	3,531,201	396	5.3	689.99

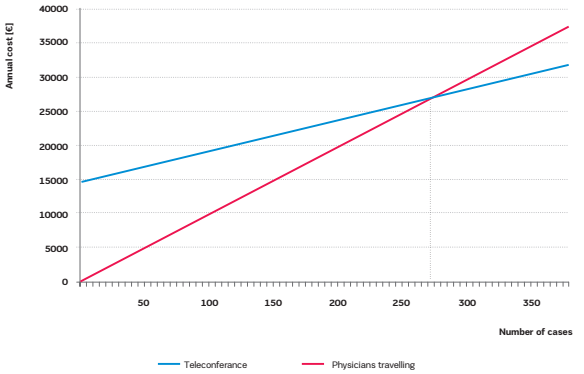

Table 2.
Break-even-analysis

Image 2.

not an unrealistic figure due to increasing standardisation of tumour therapy procedures with the necessity of tumour board presentation.

Nevertheless, the results presented have to be regarded as a preliminary attempt to compare the costs of the two scenarios. Further costs have to be included, and the assumptions made have to be expanded. The total costs of scenario 1, for example, have to consider maintenance costs for the technical equipment as well as costs for data transfer and telephone costs. Furthermore, the price for the case conference service might be raised by the proportional depreciation costs of the technical equipment in Eberswalde that is needed for the teleconference. At the same time the depreciation costs for the technical equipment decrease as a result of the extraction of the equipment of Eberswalde from these costs, which leads to lower fixed costs for scenario 1.

Finally, to realise the training aspect of teleconferences, the time an external physician spends on taking part in the tumour conference has to be broadened. He does not disconnect after the presentation of his hospital's cases, but attends the whole conference, and the benefit of qualification and advanced training within the tumour conference has to be taken into account too.

As for the costs of scenario 2, it has to be revised whether a mileage allowance adequately represents the actual consumption of resources produced by driving by car. Beyond that, the number of external hospitals participating in the teleconference, the distance between the hospitals, the depreciation period of the telemedical equipment and the number of cases presented by an external hospital have an influence on the total costs of both scenarios and therefore on the advantageousness of one scenario over the other. Future calculations need to consider these aspects. ■

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QUALITY ASSURANCE IN TELERADIOLOGY

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Teleradiology consists of the electronic transmission of radiologic images from one location to another for interpretation and/or consultation (Ranschaert et al. 2012). Its goal should not be to optimise the cost / benefit ratio, but to ensure throughout the national territory accessibility to the diagnostic imaging investigation and a correct diagnosis.

Teleradiology should not be considered only as an electronic transmission of images to other locations. To assume a diagnostic role, it must ensure adequate image quality and align with the principles of the medical-radiological act. (Dalla Palma and Tamburrini 2004). Therefore it is necessary to define the different areas of application, and to establish specific requirements for its implementation as a high-potential resource in order to avoid being transformed into a risk for the population.

To perform a diagnostic role teleradiology should preserve radiodiagnostic quality standards, and the methods must be in compliance with the principles of radiological care. Furthermore it requires rigorous organisation under the responsibility of a radiologist, based on defined rules known by all operators, formalised by protocols drawn up by radiologists, and achieved with the help of other healthcare professionals and involved facilities (Lagalla 2001).

Teleradiology represents a medical procedure which can be carried out in different situations: tele-didactics, teleconference, tele-distribution, tele-consultation, tele-consultancy, tele-management (Guidelines for quality assurance in teleradiology 2010).

For clinical diagnostic purposes teleconsultation, tele-consultancy and telemanagement are the modalities of implementation of the medical x-ray that use the technology for remote transmission of images and use the interaction between the most dedicated professionals in communication with each other.

Tele-consultation consists of collective activities among physicians who communicate using informatics/telematics networks to provide patients in remote locations with healthcare services including evaluation, diagnosis and treatment. Teleconsultancy is a professional service by which the physician transfers the patient's data through the Internet to an expert (consultant) for a second opinion that is formalised by a written report signed by the consultant and by the specialist who requested the consultancy.

The tele-consultancy can be synchronous (interactive) or asynchronous (not interactive); regarding modalities, it can be between two specialists or in a team (eventually multidisciplinary).

The tele-consultation, allowing you to take advantage of specific expertise in certain areas, can be considered as the optimal application of teleradiology to compensate for the uneven geographical distribution of the resources and skills necessary for the achievement of excellence.

Tele-management is the administration of a radiological diagnostic

examination by a radiologist, far from the place of the test, who collaborates with the requesting physician and radiographer, on the site of the test, in real time, by telephone and / or electronically.

Tele-management is completed with a remote diagnosis formalised by the report with a digital signature validated by the radiologist responsible for remote management.

The digital signature is the legally recognised computer equivalent of a handwritten signature. The digital signature ensures: that the report is certainly ascribable to the person who has signed; the authenticity of the content, that is the exact correspondence to what was signed; and the 'non-repudiation', that is when it is impossible for the author to deny the subscription or the contents of the document.

Pending the enactment of specific laws, the remote radiological diagnosis must find specific justification and should be performed only if the following safety and quality criteria have been respected:

a) privacy of the patients;
b) acquisition of consent;
c) assurance that the images received are related to the patient for whom the examination is required;
d) assurance that pre-established protocols have been applied;
e) assurance that the images were displayed without loss of quality;
f) complete and formalised clinical-anamnestic information about the indication and consensus on the examination, the clinical status of the patient, the diagnostic question;
g) easy and immediate communication with the centre in which the investigation was carried out.

To obtain this, is necessary to continuously maintenance or upgrade both the software and hardware in accordance with the quality criteria (Guidelines for quality assurance in teleradiology 2010).

Obviously tele-management can be performed only for diagnostic imaging examinations which do not require the administration of contrast media by vascular access or catheters in emergency conditions. For these conditions the physical presence of a radiologist is requested.

The clinical-radiological act in teleradiology is no different from the traditional one, and must therefore refer to the behavioural patterns of the latter, which are already well codified and partly regulated.

It is possible to identify in teleradiology some 'moments' that constitute rings of a process: Justification, Consent, Execution and Sending images, Report and Storage (Dalla Palma and Tamburrini 2004).

Consent

The use of teleradiology requires preliminary information to be given to the patient to obtain valid consent. The examination subject therefore must be informed, also in accordance with current law, that the iconography is transmitted electronically to another location and should have clearly spelled out all the reasons for the use of teleradiology.

The Report

The interpreting physician is responsible for the quality of the images being reviewed. The use of teleradiology does not reduce the responsibilities for the management and supervision of radiologic medicine. Potential liability may result from erroneous interpretation, incomplete or faulty transmission of images, incomplete or faulty communication of radiologic reports, misinterpretation, or faulty communication of over-reads.

In Italian emergency departments and Level I and II trauma centres, the presence of the radiologist is mandatory 24/24 hours. In the emergency department, the radiologist could have enough time to properly set up the diagnostic management and it could be prudent or necessary to use teleradiology (teleconsultation) in selected cases.

In these cases the telematic support for an opinion from a more experienced colleague could help to reduce the number of errors (value added of teleradiology).

In the emergency department, the use of teleradiology between different hospitals has the only value of consultation (the radiologist may request an opinion, if the procedure is formalised, to a radiologist working in a different emergency department) pursuant to Art. 60 of the Italian Medical Ethics Code.

In addition, the plenary session of the National Bioethics Committee, on April 21st 2006, expressly states that the diagnosis should always be made by the radiologist, physically visiting the patient (radiological-medical procedure) and that tele-medicine involves the only consultation activity, becoming necessary for a particular case (e.g. having more qualified information and decision support).

Regarding the arrangement of teleradiology systems, the management of the RIS-PACS requires the redefinition of specific tasks for the involved professional figures in which we can list radiologist, technician, medical physicist, computer expert, administrative support, system administrator of the radiological area, head of corporate records (Guidelines for quality assurance in teleradiology 2010).

Together with the requesting physician the radiologist is responsible for the indication and the appropriateness of the exam. The justification for the examination and the validation that it is necessary remain under the control of the radiologist. In fact, the reporting takes the value of validation of the whole process from the justification through to the radiological examination.

The radiology report, as a public act, has a medicolegal impact. The tele-reporting of tests, carried out at a distance, requires the radiologist to report in addition to the data normally reported, also: place of the test, name of requesting physician and/or in situ with clinical information and clinical question, names of the technologists responsible for the transmission and examination, number of pictures received for telematic support and used for reporting, the qualified digital signature and timestamp of the radiologist and technician.

For all professionals involved in teleradiology can be configured responsibilities for professional incompetence, recklessness and negligence (White 2002).

Conclusion

Teleradiology has the advantages of avoiding unnecessary transfers of patients to other emergency departments (Stormo et al. 2004; Hazebroucq and Fery-Lemonnier 2004), ensuring proper treatment for patients' management (Kalyanpur et al. 2004) and reducing costs (Kalyanpur et al. 2004).

The disadvantages and the risk of poor management are represented by depersonalisation of the radiological procedure, lack of responsibility of the health staff, use to compensate for a lack of radiologists, especially in some peripheral contests, the risk that the presence of the radiologist in the emergency department could be supplanted by a distant reporting centre. Teleradiology should be used to enhance one's practice, not to invade the practice of another radiologist (Lee 1996). ■

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AN EXPERIENCE IN TELERADIOLOGY

A CANADIAN SOLUTION FOR COLLABORATION AND QUALITY ASSURANCE IN RADIOLOGY

In a country as vast as Canada, it is natural that telemedicine and teleradiology in particular are essential components of the healthcare system. Although the majority of the population lives on a border strip 200km wide in the south, residents of remote communities are often several hours away from a specialist.

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The Opportunity For Teleradiology

Since the first point-to-point communication by Dr. Albert Jutras in Montreal in 1959, the evolution of technology and the spread of the Internet have greatly facilitated the development of teleradiology.

Another dominant factor in the rapid growth of teleradiology services was the Canadian strategy for electronic patient records, with the creation of Canada Health Infoway (CHI) (https://www.infoway-inforoute.ca) in 2001 by the ten provinces and three territories of Canada in the form of a non-profit society. The objective of Canada Health Infoway is to promote and accelerate the development and adoption of Electronic Health Records (EHR) based on standards and compatible communication technologies. One of the first tasks of Infoway was to make information available in a digital format, starting with radiology. All imaging exams from hospitals, and later, private practices must be stored in regional image databases and kept for life. The plan that called for the creation of eighteen image banks, DI-r Digital Images-repository, is nearing completion, most of the DI-r being now functional.

The eventual aim is to improve the quality of care for all Canadians by facilitating access by health professionals to essential medical data of their patients, especially images and reports, in the whole country and without delay.

The provincial governments' priority is to reduce wait times, and they have invested a lot of money to improve emergency services and accelerate the rotation of patients. Radiology has been identified as a bottleneck, because the reports are not available quickly enough or because of the lack of radiologists at night or on weekends. In addition, due to the shortage or unequal distribution of radiologists, some centres are late in delivering their interpretations, which creates delays in care and treatment.

One of the solutions proposed by the Canadian government was to use teleradiology to interpret exams. International teleradiology companies were then approached, and this is what prompted us to create a structure that would allow Canadian radiologists to control themselves the organisation of teleradiology before it started to be outsourced and imposed by the administration.

Thus started an initiative by Canadian radiologists willing to cooperate for their mutual benefit in order to facilitate their professional life by allowing them to share the workload, have more flexibility in how they work to better balance their professional and personal lives, while increasing their income and giving them the opportunity to benefit from the increased value of their shares in the company.

Some factors were immediately favourable to the adoption of teleradiology, such as a shortage of radiologists, a well established infrastructure of consultations, based on couriers, the early digitalisation of radiology equipment, the existence of a quotation for teleradiology acts, and of course, the size of the country, not to mention the travel expenses of the radiologist, covering multiple sites, and more recently improved access to good Internet connections and the increased availability of PACS.

Barriers to Entry

But it is also a healthcare system run by the governments of ten provinces, three territories and the federal government. Each province or territory has its own regulations: some do not even allow for the moment that the act is performed by a medical doctor based outside the province where the patient resides, even if the doctor is licensed and accredited in that province.

With regard to radiologists, we of course also clashed with the usual obstacles, whether fear of change, competition and loss of income, loss of quality of the reports, and even fear that the 'virtual locum' could be better appreciated by referring physicians than the radiologist being replaced.

It became important to deal only with onsite radiologists, and never to contact or respond to hospital administration demands when there is a radiologist or radiology department in the facility. A clause in our contracts with the site producer of images also specifies that the contract is only valid if accepted and signed by the site chief radiologist.

We also met with groups and associations of radiologists, who felt sometimes rightly that they have the monopoly of radiology in their province. As anyway we never intended to go against local radiologists, we limited then our contribution to the provision of software tools enabling the distribution of cases within their group or association, or allowing them to themselves provide a teleradiology service, irrespective of the location of their radiologists.

As odd as it may seem in retrospect, our biggest problem was then technological. Why a technological problem, at a time when more and more sites, 100% in Canada, are computerised and modalities are digital? The problem was not the digitalisation or remote reading but the organisation and automation of remote collaboration.

A Collaboration Solution

So, we developed a management and collaboration tool, a software solution that allows us to automate the distribution of exams among radiologists wishing to be replaced and those replacing them. The software had to be PACS vendors, modalities

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and RIS neutral. Radiologists had to be able to indicate their availabilities and requests for replacement in an online calendar, the software ensuring the distribution of work based on the agendas but also each of their specialties, their licences to practise in the province of the patient and their accreditations in the hospital or clinic. It had to be built expressly to automate and optimise all processes in multi-site, multi-PACS, multi-jurisdiction teleradiology networks, to be in compliance with local and national regulations and of course be bilingual.

After two years of development, our collaboration software was ready. We launched the service, first with ten Canadian radiologists based in different provinces.

In recent years, the team of radiologists has increased to more than sixty, covering all specialties, some working in academic centres, others in the private sector.

The demand for teleradiology services has considerably changed. We always give final interpretations, contrary to what has long been done in the United States. However, demand has evolved from night and weekend shifts to day and specialty shifts. Clearly, for many hospitals, clinics and groups of radiologists, it is not in their financial interests to have to hire a new radiology specialist full-time when the service could be provided by a remote specialist on-demand.

"our Canadian experience with teleradiology has rapidly evolved into the development of collaborative and quality control solutions allowing us to help our colleagues to establish their own teleradiology networks"

The Need for Quality

The second major change was the evolution toward quality control. Indeed teleradiology has often been criticised and considered as a commoditisation of radiology, a lower quality of radiology. We had to prove that we are as good or better, and thus add to our internal process quality control, hence the development of new software grafted on to our web platform and now an indispensable tool for teleradiology quality.

First used internally, it has proved to be useful later in other circumstances. On several occasions over the past years, Canadian radiologists have made newspaper headlines when the health authorities of their provinces questioned the quality of their work as a result of complaints arising from diagnostic errors (CBC 2009). Authorities wanted to review the reports of the radiologists and RealTime Medical won the tender to carry out some of these quality control reviews. For this purpose we used a different version of our software, meeting the demands of the Health Authorities of the provincial government responsible for the investigation, but still applied to remote readings.

Originally developed for providing through teleradiology retrospective control of quality of the radiologist's work, the software was later modified to enable pro-active controls of the reports' accuracy (Keen 2012). Our workflow-driven solution is easily integrated into the routine work of the radiologist without increasing or too much increasing the workload, whether the radiologist is a partner in a group, department or practising alone.

The original radiologist is immediately informed of diagnostic errors that may have implications in the treatment of patients so he/she may take the necessary steps, correct the report before it is sent to the referring physician or add an addendum if the report has already been signed, and inform in a timely fashion the referring physician or patient. Contrary to retroactive QA control programmes, it is not perceived as a punitive process but as a learning experience that helps identify areas of weakness.

Conclusion

Our Canadian experience with teleradiology has rapidly evolved into the development of collaborative and quality control solutions allowing us to help our colleagues to establish their own teleradiology networks. Moreover, as our platform was deliberately designed to be viewer agnostic, it is not only applicable to radiology but also cardiology, pathology, dermatology, ophthalmology, etc. This may in the future enable better collaboration between clinicians on a single platform. ■

Key Points

- *The government push for the deployment of countrywide electronic patient records has facilitated the adoption of teleradiology.*
- *A number of Canadian radiologists have joined forces to organise the provision of teleradiology services.*
- *Quality control is now a priority for radiologists and hospitals.*

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KHRESMOI FOR RADIOLOGISTS

VISUAL SEARCH IN RADIOLOGY ARCHIVES AND THE OPEN-ACCESS MEDICAL LITERATURE

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Introduction

Radiology is a field strongly linked to medical imaging. The size of visual data being produced in hospitals increases exponentially, and new imaging techniques are being introduced regularly. An EU report estimated medical imaging to occupy 30% of world storage in 2010 (High Level Expert Group 2010). However, after being used once for diagnosis, typically this enormous amount of visual information in hospitals remains unexploited. Recent studies have shown that, even though visual information search is a task performed daily, radiologists fail to find relevant images one out of four times using existing solutions (Markonis et al. 2012). Access to electronic records is often solely patient-based, while image search on the Internet is mostly performed using general-purpose search engines that return results of questionable quality.

The KHRESMOI Project

"Knowledge Helper for Medical and Other Information users" (KHRESMOI*) is a four-year European project funded since 2010 in the 7th Framework programme, consisting of 12 partners from academia and industry that originate from 9 European countries. KHRESMOI aims to create a multi-lingual, multi-modal search and access system for biomedical information and documents. Radiologists are among the three target user groups of the project (see Figure 1), as they often search for images during their clinical work, teaching duties and research activities. The system uses tools that exploit state-of-the-art techniques in information retrieval to assist radiologists in demanding information need scenarios. The two other user groups of patients and general practitioners concentrate rather on text and semantic search and prototypes have been developed for these groups. This article details the radiology search system.

User-Oriented Design

A user-oriented approach was followed to develop and evaluate the entire system. Following a user-centred design the system is more likely to correspond to realistic requirements of the target user groups. Observation of the radiology clinical workflow and interviews with radiologists assisted in identifying the information needs of radiologists and creating the portrait of an ideal system (Markonis et al. 2012). The development was performed in an iterative manner, having radiologists test the prototypes (Markonis et al. 2013), and modifying the system according to the feedback from the user tests. Currently, a new version of user tests is being prepared for obtaining additional feedback before the final prototypes are implemented.

Content-Based Image Retrieval

In clinical work in radiology, such as differential diagnosis or when an unknown abnormality is found in an image, search by keywords for finding answers to an unknown visual finding is not the optimal or even an applicable solution. Being able to mark a region of interest in an image can be much more efficient and effective than comparing an image on screen with images printed in books. Apart from conventional text-based search, the KHRESMOI system makes use of content-based image retrieval (CBIR) to address these common yet often unaddressed scenarios. CBIR is an information retrieval technique that allows querying by using an image example or image regions to retrieve visually similar results without the need of text. In some cases images are combined with text to leverage additional information available at query time. CBIR has been proposed as a promising field in medical applications (Müller et al. 2004; Aisen et al. 2003), but only a few applications have yet reached the clinical environment. Many of the problems are linked to low retrieval performance when only visual information is used and the combination of text with visual attributes seems most promising. In Figure 2, an example screenshot of an application developed in KHRESMOI can be seen.

Search in Hospital Imaging Databases

The KHRESMOI system allows for CBIR search in databases of radiology reports and imaging data such as magnetic resonance imaging (MRI) or computed tomography (CT) volumes (see Figure 3). A typical user assesses an individual case by analysing the imaging data (e.g., a lung CT) and uses basic image manipulation to improve visualisation (zoom, level window settings). If an unknown abnormality is found, he/she can mark a region of interest (ROI) and initiate a search. The system will automatically extract visual characteristics of the ROI and search the database for volumes of the same anatomic location that contain ROIs with similar visual features. The results are returned in the form of a ranked list, and the user can select individual result cases to be displayed in full size. In these cases ROIs that are similar to the query are highlighted in the images.

The radiology reports associated with the volumes are also available. Radlex terms (Langlox 2006) relating to anatomical regions, pathological observations and other aspects mentioned in the report are highlighted, while filtering of the results by Radlex terms is supported to focus search results. Finally, the system automatically analyses the top ranked results to find

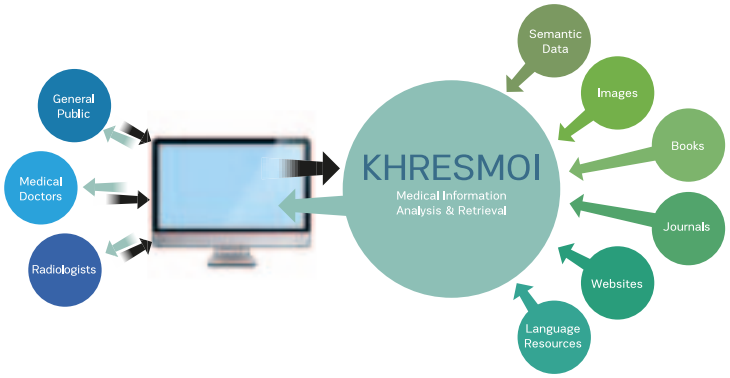

Figure 1.
Overview of the Khresmoi system that indexes large amounts of multilingual and multimodal medical data for better information retrieval applications.

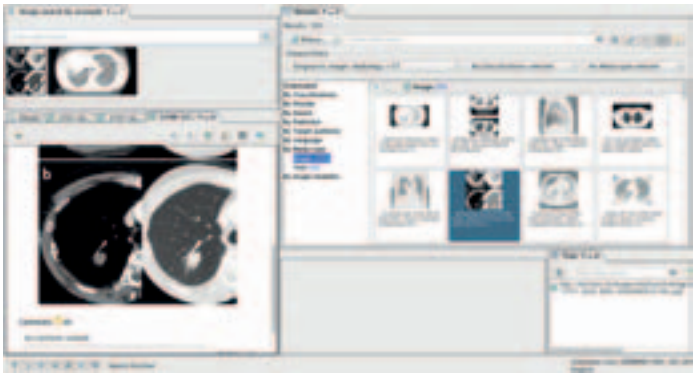

Figure 2.
Screenshot of a combined text and visual search interface that allows keyword search and a search for similar images to an example

diagnosis groupings relevant for differential diagnosis. The proposed diagnoses are then shown in decreasing order with the goal to help differential diagnosis. The physician is still taking decisions and creating the radiology report, but the system provides the expert with relevant information and possible pointers for difficult-to-diagnose abnormalities. The search can be extended to the open access medical literature using as queries the diagnosis terms and slices of interest. Again, visual information and textual data is used to provide specificity during an extended content-based information query.

The primary objective of the system is to provide radiologists with efficient access to information in the hospital image storage system (PACS) together with corresponding reports when preparing a new radiology report. This allows use of the knowledge of other physicians who described similar cases in the past. The system was demonstrated on a collection of 3876 volumes of CTs and MRIs extracted from the PACS of the General Hospital Vienna, and scalability has been taken into account in order to be able to handle larger datasets that occur in all big hospitals.

Assessing Images from the Open Access Medical Literature

The biomedical literature contains a large amount of academically interesting or rare cases. Apart from the obvious uses in teaching and research activities this information can also be used in differential diagnosis. The KHRESMOI system allows image search into the open access medical literature and straightforward connection with the corresponding articles (see Figure 2).

A search may be initiated by keywords and/or image examples or as a succession of the search in the internal hospital PACS described in the previous section. Filtering results by specifying the imaging modality is available, while a number of images in the result list can be marked as relevant or non relevant to quickly reformulate the query and obtain better results. Images can be selected from the results view to be displayed in full size along with their details. Once an image is selected, the system provides the user with easy access to the details of its corresponding article and also the figure caption to quickly see the context of a figure.

The goal of this functionality is to connect the search in hospital PACS to trustworthy (peer-reviewed) external sources, and exploit the visual information found in the open access medical literature. For this purpose, an image dataset of 1.7 million images included in PubMed Central articles was indexed, demonstrating also the scalability of the system. The reader may find the algorithmic methods used and technical details of the system in Khresmoi publications (Langs et al. 2012a; 2012b). A specific challenge in figures in the literature is compound figures that contain several sub-figures. For separating these sub-figures automatically while keeping the context, tools have also been developed to focus the search (Chhatkuli et al. 2013).

Conclusion

Search for visual information is a common task in radiology. As new imaging modalities and protocols emerge, and huge amounts of visual data are being produced in hospitals, finding relevant information for specific information needs becomes increasingly challenging. In particular, the need for retrieval triggered by visual information that is difficult to efficiently capture in search terms becomes a demanding task. By making use of advanced information retrieval techniques (including visual image analysis of image regions) and easy-to-use graphical user interfaces KHRESMOI aims to provide radiologists with a powerful tool that will allow quick and straightforward access to useful information. Prototypes of the interfaces using publically available information will be made available on the Khresmoi web page. ■

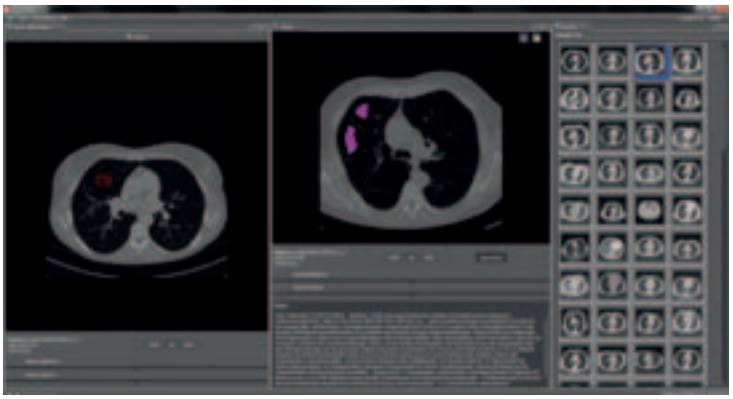

Figure 3.
3D search interface in images from a routine PACS and radiology reports

Key Points

- *Radiologists are overloaded with large amounts of visual data.*
- *Current searches for images often fail, or return results of questionable quality, particularly on the Internet where there is little control on quality.*
- *The KHRESMOI project is developing a medical visual information search engine for radiologists.*
- *The system contains novel information retrieval features such as search by image example and makes use of semantics to improve the retrieval performance.*
- *Search into internal hospital visual data by registered users is supported, and related cases from the open access medical literature are linked automatically.*
- *The project follows a user-oriented design process, and the prototypes are user-tested by radiologists.*

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35 YEARS OF RADIOLOGY CONSULTATION

TAKING IT PERSONALLY

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Background

The expansion of both the range and the volume of the various imaging studies and procedures under the purview of the radiologist has been a hallmark of the forty-year growth of imaging as a powerful means of securing diagnosis and effecting treatment. The continual introduction and implementation of technological advances in this period have been influential, if not controlling, in setting the means by which a radiologist's work is organised and by which a radiologist's value is measured.

But this upward slope has now reached an inflection point. Incremental improvements are lessening in scope and effect, and the volume of studies in the United States peaked recently, becoming stable in some cases and declining in others, with a realisation that the untoward consequences of cost and dose have reached public consciousness and now occupy the agendas of regulators. Each of these impingements are engendering a perhaps still inchoate, but nevertheless inevitable, reconsideration of the place of radiology and its practitioners within the normative context and constraints of suitable clinical practice in the near future.

Until now, many radiologists have been content to consider that their functions are to accurately detect normality and pathology on the images they inspect, and then render a report, detailing them often with recommendations for further imaging. Communication with the referring physician is conventionally unidirectional, from us to them, through the vehicle of the written word alone. In the United States, the impersonality of the process has been abetted by: 1) the prevailing fee-for-service model of reimbursement for which the impetus is to do more imaging, and 2) the spectre of malpractice, which impels the referring physician to heed a radiologist's suggestions as being tantamount to an order.

The need for change has now become apparent with the realisation that the present modus operandi will become unsustainable if allowed to remain uncorrected.

Reducing Overutilisation

Hence various innovations have been introduced to limit overutilisation. I consider four of them:

A. **Outright refusal by a third party to allow a test to be performed.** That party may be a government body or an insurance company. They have deemed that a certain imaging test in a certain clinical situation should not be done, or, if done, it should not be reimbursed. Such dicta may be based on economic considerations alone or on clinical studies, which have assessed moderate to large populations. But aggregate data alone ignores specific scenarios in which the test may actually be appropriate and alternative means less so.

B. **Clinical guidelines** - such as the Appropriateness Criteria Project of the American College of Radiology (ACR). The focus of these numerous clinically specific algorithms, constituted by committees of experts under the aegis of the ACR, has value for very narrow presentations of illness or injury. But for many clinical presentations, its recommendations generalise without reference to pertinent, often critical history, the availability of previous images, the impress of patient-voiced considerations, and other mitigating factors, which, when taken together, help determine what can in effect be more appropriate and even optimal even at variance with the preference of the stated appropriateness criteria. For example, the ACR algorithm for intestinal obstruction is heedless of such considerations (Baker 2007). In my experience, and that of my colleague, our impression is that by and large the ACR guidelines are mostly ignored as a work-up or organising mechanism.

C. **Radiology Benefit Managers (RBMs)** combine the characteristics of obligatory, across-the-board restrictive polices and algorithmic inferences to provide a more measured consideration of the value of a proposed imaging study. RBMs have the power to deny a proposed test. The decrease in utilisation they induce is one metric by which they are compensated. Generally, RBMs take a more focused look at specific clinical information, but they are still remote from the patient and clinician at the point of decision-making. Moreover, often the relevant details that inform a sophisticated assessment are beyond their reach or perhaps also their concern.

D. **Patient-focused computer-assisted decision support systems.** That approach, most fully formulated in the U.S. at Brigham and Women's Hospital, is much more intimate in its relation to individual clinical evaluations, as it assesses specific factors relative to each patient's injury or illness in respect to a manifest clinical question (Khorasani 2001). In its typical application, lab data and previous studies are considered, as they may be valuable to inform their recommendation for radiologic studies. But the advice rendered even with this mechanism of decision support is outward from the imaging expert to the treating physician team. It is not a reciprocal relationship. There is usually no in-person dialogue engendered, and therefore it is an example of communication of expertise but not of consultation with insight reached through conversation.

The Personal Approach

I have taken a different approach, beginning in 1979 when I entered academic practice as a junior attending. This was the time when CT and US were beginning to become part of the requisite armamentarium under the radiologist's proprietorship. New advances in interventional radiology and nuclear medicine had entered the mix. Back then even new conventional procedures such as advanced double contrast barium enema and enteroclysis had come on the scene.

I was aware of the befuddlement that this dizzying array of new tests caused my clinical colleagues. I set out, as a clinical and intellectual exercise, to make sense of when each was appropriate and when each was not, depending on the clinical story in toto as related to me by the referring physicians, instead of just a chief complaint registered in a written request for a specific test.

My Chairman of Radiology allowed me the time and discretion to conduct daily on-site rounds in Medicine and then later in Surgery to help their respective clinical teams (and also to further educate me) about the best way to conduct workups which would involve radiology studies. Daily rounds became part of

my everyday work in the wards. I brought the films with me - there was of course no PACS. Yet the process from the outset was mutually fulfilling, because not only did my physical presence and advice help them through our ongoing dialogues, but I too learned more clinical medicine and surgery from repeated interactions with them. I learned, also, about the unique consequences of drugs and procedures, some employed in Radiology and others from other disciplines, which helped me consider when further tests should be done and when they should be avoided. I also came to appreciate the capabilities, or lack thereof, of the various skills, limitations, and idiosyncrasies of the interpreting radiologists in my department. Over time I learned as well to change what constituted appropriateness when new tests came online and older ones became obsolete. Moreover, I accepted the idiosyncrasies inherent in this process occasioned by specific patient gender, ethnicity and habits.

We conducted three studies in the early 1980s, published respectively in AJR, Radiology and in JAMA - two in medicine and one in surgery, which demonstrated a collective reduction in the number of studies to reach a diagnosis (Baker 1982; 1984; 1986). In the surgical application of radiology consultations our endpoint was also length of days to reach a diagnosis before an operation was performed or regarded as not needed.

As my other duties increased, becoming first Program Director, and now for the past 29 years, as Chairman of Radiology as well, I have never abandoned my daily obligation to provide radiology consultations at or near the clinical department. Nowadays I do it exclusively in Internal Medicine. I have gained a deep appreciation for patient and family needs and predilections, their aspirations and limitations as informants of decision-making. I have gained as well appreciation of the presumptions and practices of the various ethnic groups in our heterogeneous patient population. I am aware of how an undue reliance on technology is inculcated into the mindset of medical students before they come to daily duty rounds. And I have recognised the value of information from previous studies, now more readily available with the emergence of the Electronic Medical Record. Furthermore, instruction in radiology consultation under my tutelage has become formalised as part of the curriculum for our residents in radiology.

Yet despite my long-standing involvement everyday in Internal Medicine as a consultant, I have refused their requests to gain a secondary appointment in their department. Why? Because if radiology must adjust to the new meaning of what constitutes its value, it must be recognised as a unique consultative function, which should be seen to be entirely within the demarcation of what we are expected to do as integral caregivers. That is how we have to now define ourselves if we are to maintain our ethos as essential members of the clinical enterprise. Imaging now has to become a specialty that discriminatively utilises its roster of resources instead of exploiting them primarily for their pictorial capabilities. ■

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Key Points

- *Value in radiology is being redefined from image interpretation to clinical integration.*
- *Traditional communication exercises still leave the radiologist remote and disembodied.*
- *For acute medical and surgical interpretation on-site personalised radiology consultation can be a win-win proposition.*

WORKLOAD IN RADIOLOGY

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Modern times promised humankind a great hope to lower the workload in every aspect of life. However, the story progressed entirely in a different way, and many professionals bemoan their jobs and lives due to increasing workloads. The workload of radiologists at least has been increasing for many years after the technology boom that started in the 1960s. The increasing and ageing world population, high demand for high quality healthcare and the practice of new medicine mostly depending on the techno-diagnosis have been the major factors in the workload increase. Health policies encouraging the commoditisation and privatisation of healthcare are enforcing this course.

This article aims to elaborate on the increasing workload in radiology, and deals with the issues related to this problem, including costing and quality.

Calculating Workload

Firstly workload should be defined, as there is confusion about the definition. In daily practice the understanding of workload is simple, and the amount of work done in a certain amount of time has been accepted as the workload of an individual. In radiology the crude number of examinations performed in a unit time has been used as the measure of the workload for many years. In small scale departments and single businesses it can be meaningful to an extent where it does not work in complex and sophisticated organizations.

Relative value scales have been developed to allow comparison of different studies on the basis of time expended, complexity of the examination or both. The degree of sophistication of these tables varies, and many of them separate the technical from the professional time-based components of a radiological procedure. Unfortunately, most of these scales have been developed for reimbursement processes. Non-reporting activities that are necessary for the quality of the process have not been taken into consideration in most current practices.

Factors Affecting Workload

Workload and quality in radiology is affected by both intrinsic and extrinsic factors. The number of radiologists

that share the workload, the amount of hours a radiologist works per day or week, the number of exams reported per day, the combination of the exams that have to be reported in a certain amount of time, the methods used for displaying the images, dictation and typing methods and the type of non-reporting duties are the intrinsic factors that directly affect the workload and its calculation.

In the real world there are several types of radiologists. Most of our colleagues work as a consultant radiologist in daily practice, or in academic positions, and none of them is identical. The type of work done and the configuration and complexity of responsibilities are totally different in different institutions and not factored into a common workload calculation. System- or organ-based work sharing has been becoming the choice of organisation in many departments. However the number of departments where the work share is planned according to the modalities is not so low, and this pragmatic approach is believed to increase the productivity.

The amount of time spent on each type of duty or task and the operating hours are also not standard and differ from country to country. In terms of working hours, national laws make for little discrepancies among the countries. The European standard is 40 hours per week. In Turkey the law limits the working time of radiologists to 35 hours/per week. However in practice most of us work over these limits. Soni and colleagues found that an American radiologist works 49.3 hours weekly. However, independent radiologists working alone may work up to 50.3 hours while a private radiologist works on average 50.4 hours per week (Soni et al. 2010).

The number of examinations, which is the most used parameter in calculation, dominates the workload related problems. The increase in radiological examinations since the 1970s is obvious. Bhargavan et al. found that the number of procedures in the US increased by seven fold between 2003 and 2007 (Bhargavan et al. 2005). They also found that radiologists' work increased by ten percent during that period. The procedures per full time equivalent (FTE) radiologist per year increased to 14,900 in 2007 from 13,950 in 2003 (Bhargavan et al. 2005). The increase rate of annual relative value units (RVUs) per FTE radiologist was parallel to the procedures. The trend had not changed since 1991. An international comparison gave the CT/MRI procedures per radiologist in different countries, with the average at 1440 but the deviation extremely high between nations (Nakajima et al. 2008). Japanese radiologists seemed to be the busiest of all the world's radiologists.

According to the findings of other research, which gives the growth change of each modality, between the years 2000-2005, brain MR imaging doubled while X-ray examinations fell (Miller 2005). This means that not only the number of procedures but the complexity and difficulty of imaging have increased gradually.

On the other hand the staffing to undertake this increased amount of work has not been stepped up accordingly. What is more, the distribution of radiologists in different countries varies starkly. For example, the EU average is 110 radiologists per million population. Greece comes top with 228, while Japan has the lowest distribution in the world with 40 radiologists per million population (OECD, 2007).

"staffing to undertake this increased amount of work has not been stepped up accordingly"

The workflow and the methods used for displaying the images, dictation and typing opportunities determine the time spent for each examination. Information systems, PACS and voice recognition systems have several effects on the individual workloads. In several articles that evaluate the effects of PACS on the workload the authors conclude that the transition to filmless operations was associated with increases in inpatient and outpatient use of radiological services. Evidence varies with regard to impact on reporting time, however. A number of the articles claim that PACS systems improve reporting times and productivity (Lepanto et al. 2006; Srinivason et al. 2006). As a PACS user for twelve years, in my experience PACS disciplines the workflow, increases productivity and reporting quality and enhances educational motivation. However, I have not observed any positive effect of PACS that lowers the workload of the department. Dictation method has been the focus of a few research articles. In these studies speech recognition systems were found to be time consuming, as they increased individual time expenditure for reporting by 30 percent (Gale et al. 2001; Langer 2002).

Non-reporting duties have been accepted to be an important part of a radiologist's daily workload in recent years. A radiologist is not only responsible for reporting an examination, but also takes care of the appropriateness of the exam, deals with the clinical and lab data and is responsible for the patient medication and preparation. He or she prepares protocols and sets out the examination method when it is needed. After reporting, the radiologist explains and discusses the results with the patient and his or her colleagues. He or she performs these duties mostly in between the reporting activities. Depending on the department's organisation, a radiologist takes several other responsibilities such as a quality manager, administrative staff or advisor, educator, researcher, technical or scientific consultant, supervisor or expert. These intrinsic factors directly affect the workload and its calculation.

Some of the most important extrinsic factors that affect the workload in radiology are the increasing role of imaging for screening and follow-up, imaging as part of the physical examination, clinical utilisation of radiology to avoid malpractice issues, widespread use of teleradiology and health policies.

Imaging for screening and follow-up

has increased the number of examinations in medical practice. Diagnostic and treatment guidelines have also contributed to heavier workloads. Compounding these factors, changing health policies, which promote imaging as a means to curb long-term medical costs across the population, have been accompanied by falling reimbursement for imaging in tandem with a move towards privatisation.

One of the most important challenges today is the increasing and ageing world population. The proportion of people over 80 will increase rapidly after 2020 according to many research papers (United Nations, 2010; Palacios 2002). An ageing and increasing population demands high quality healthcare systems. In the context of limited finances and staffing, classical medicine has consequently become a technology-dependent business. Radiology has many challenges to overcome, in part due to economic and cultural globalisation, and because of the increasing complexity of the specialty with evolving technology. A Medicare report given to the USA congress in 2011 revealed that the volume of physician services per beneficiary grew between 2000-2009 (Medicare Payment Advisory Commission 2011). Imaging was the highest of all due to diagnostic tests. Payment policies slowed this to an extent. However, it is still the main cost to the health system.

Due to its easy accessibility, high sensitivity and specificity, radiological imaging has replaced the physical examination such as abdominal palpation for liver and spleen enlargement. Too little time is spent on physical examination of a patient with intervertebral disc hernia. Imaging also has been used as a tool of protection from malpractice.

Health Policy

Health policies have direct influences on workloads. The economy has been steering processes, and many countries have been changing their health systems with reference to the new global economy, which forces a dropping in reimbursement rates. Turkey is an interesting example of the boom in radiological examinations as a result of a healthcare system transformation. The targets of this change were to increase access to the system, to centralise the insurance bodies, to achieve total coverage of the population and to promote private health services. Family medicine has been encouraged. And the payment has been done according to the performance of the physicians. The result was amazing, and the level of procedures overtook the OECD mean in a couple of years. For example, the number of MRI scans per thousand patients was 41 before the transition. It jumped up to 76.5 compared to the European average of 46.4 by 2010. The most striking result was that overall the prices of examinations dropped to a unbelievable level where a brain MRI scan was priced at 15 Euros (which was about 45 Euro before) by private service providers almost in every state hospital.

Teleradiology brings with it new challenges. Centres using teleradiology to compensate for the shortage in radiologist numbers may see workload lessen. However, for the centres on the receiving end, working hours will be expanded.

Whatever the factor is, across the world radiologists in general came across with a heavy workload in the last decades. In a paper concerning burnout and satisfaction of U.S. physicians, radiologists were ranked ninth among specialists, their score being above the mean value. More than 50 percent of the radiologists questioned declared that they experienced burnout due to responsibilities and workload (Shanafelt et al. 2012).

In order to compensate for increasing workload, people have to work rapidly. Heavier workloads not only encourage the use of speed, but the fatigue of a heavier workload itself might blunt perceptive skills even if appropriate time is used per case. This has been evaluated in detail in an article by Jasinski (Jasinski 2004). However, the reality of "speed promotes mistakes" is neither a standard nor a reference in lawsuits. On the other hand, radiology societies recommend 16-22 thousand procedures per full time equivalent (Royal College of Radiologists 2012).

"efforts to control imaging demand and efficient use of teleradiology may play a role in reduction of future workload"

Conclusion

Discussing the workload merely with the use of crude study numbers will not reflect the real workload. If an optimum workload could be designed, its components of time, money and quality would have to be taken into consideration (Brady 2011; Sunshine and Burkhardt 2000). To keep the workload and quality constant you have to limit the number of procedures and share the rest of the work. Efforts to control imaging demand and efficient use of teleradiology may play a role in reduction of future workload. Guidelines, if utilised properly, will help to control the overuse of imaging modalities. In addition a new type of radiological worker may emerge: radiographers may be educated to interpret x-rays or ultrasonographers' sole remit may be responsibility for all ultrasound exams. However new imaging techniques and technology would inevitably multiply the workload. ■

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CLINICAL APPLICATIONS OF SHEARWAVE™ ELASTOGRAPHY

Correspondent

Dan Conley

Introduction

Because of the correlation between stiffness of tissue and pathological status, medical imaging modalities that assess stiffness can be instrumental in staging diseases of the liver, breast, prostate, and kidney. One such modality, ultrasound elastography, has traditionally relied on soft compression of the target tissue to achieve this evaluation, previously performed by clinical palpation. This traditional approach, called 'strain' elastography, relies on applied deformation of the target tissue and an estimate of the differential displacement before and after that deformation; this approach is limited, however, by the location of the target tissue and the experience of its users. ShearWave™ Elastography (SWE™), introduced in the early 2000s, is a faster, automated alternative to strain elastography, and has been shown to aid in the characterisation of focal and diffuse diseases, as well as in the guidance of tissue biopsies and in the monitoring of therapeutic applications.

How does ShearWave™ Elastography work?

SWE measures the velocity of shear waves (or transverse waves) moving through tissue. Because shear waves travel from 1 to 10 metres per second, extremely high-speed acquisition is necessary for capturing and interpreting them. The French company SuperSonic Imagine has pioneered the UltraFast™ ultrasound technology that acquires images 200 times faster than conventional ultrasound systems, thus being able to capitalise on the high-speed shear waves. These data are displayed in a two-dimensional map, which overlays the colour-coded tissue elasticity information, measured in kilopascals, onto the B-mode image for anatomical correlation. The two-dimensional SWE image shows the extent and variations of tissue stiffness—yielding crucial information for disease management and patient care.

The clinical efficacy of SWE was established through a two year multicentre breast clinical study conducted in 17 American and European sites. The goal of this study, which enrolled 1800 cases, was to determine whether SWE could improve the accuracy of sonographic characterisation of breast masses, and therefore better orient patients towards short-term follow-up or biopsy. This data was analysed to identify how each SWE criteria, when added to greyscale criteria, could improve lesion characterisation (in sensitivity and specificity when compared to greyscale alone) and eventually improve the BI-RADS® score. The first main result of this clinical study was that SWE features are reproducible. Reproducibility assures the physician of a reliable evaluation of the lesion during an exam and for follow-up exams. The second result was that SWE features increased diagnostic accuracy and improved lesion characterisation, thereby each individual feature when added to the grayscale criteria improved the BI-RADS® classification of lesions.

Several studies on SWE have also focused on the liver, where SWE features several advantages over more conventional imaging modalities and other types of non-invasive liver stiffness assessments. As liver biopsies are associated with a non-negligible morbidity rate, and can lead to complications including infection, damage to viscera, and haemorrhaging, techniques for a non-invasive liver stiffness assessment are currently highly investigated.

SWE is a non-invasive and non-ionising modality that can be used to assess liver fibrosis. This has four major advantages that were recently demonstrated by publications on patients with viral Hepatitis:

- First, SWE is diagnostically sensitive, so it can be used to optimise the indications for biopsy, and to overcome several of its sampling limitations. The ability to survey and quantify an entire region of interest in real time minimises the need for second or third biopsies, and reduces follow-ups due to variability in sampling.
- Two, SWE can be used iteratively to follow stiffness changes over time. These qualities make it an attractive option for monitoring evolving liver injuries, including cases of biliary atresia.
- Third, the excellent sensitivity and specificity of SWE can help identify cases of low-grade fibrosis, when the disease is in its earliest stages. (Early identification of liver fibrosis in children, for instance, is critical for the swift, appropriate treatment of the disease.)
- Fourth, on liver nodules, the qualities of SWE can help differentiate two benign types of nodules, which deserve different treatment: adenomas from atypical fibrous nodular hyperplasia. It can also distinguish hepatocellular carcinomas from cholangiocarcinomas, and more accurately identify hepatocellular carcinomas in cirrhotic livers.

From a broad efficiency perspective, the first and second of these advantages are the most compelling; eliminating biopsy-related complications not only reduces unnecessary suffering, it reduces the additional and financial costs (hospitalisation; additional interventions) associated with them.

Reducing the need for liver biopsies is one of the signal benefits of SWE. But the technology can assist in other clinical areas to similar effect. Prostate cancer, for instance, is the most common cancer in males worldwide—yet with early detection, it is also one of the most treatable. SWE has been shown to improve identification and visualisation of prostate cancer, which in turn may help target necessary biopsies. SWE is easy to use and renders quantifiable, high quality stiffness imaging with reproducible results.

Additionally, as SWE imaging is real time and extremely accurate, it can also be useful in peadiatric imaging applications, wherein patients are often difficult to keep still long enough to image.. (Non-invasiveness is of course also paramount for this population.)

SWE has proven useful in many applications, including, thyroid, breast, musculoskeletal and gynaecological imaging.

Further information

A case image is available on our website at http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013

Key Points

- *Strain elastography vs. ShearWave™ elastography*
- *Non-invasive alternative to biopsy*
- *Measure tissue stiffness in kilopascals*
- *Appropriate for detection, characterisation, biopsy guidance, therapeutic monitoring*

BREAST IMAGING

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Breast cancer is the most common form of cancer in women, and the second leading cause of cancer death in women around the world, after lung cancer. The incidence of breast cancer in women increases dramatically with age, with most breast cancer cases reported in women over the age of 40. Recently, the number of cases reported in women under the age of 40 has been on the rise, although the most common reasons for breast cancer in younger women may be credited to genetic disposition. The main indicator of breast cancer is lumps in the breasts that can be located physically. But the cancer is formed even before it can be felt physically, and the abnormality can be detected using different imaging procedures, most commonly mammography. Early detection of breast cancer and efficient diagnosis of the severity not only enable more appropriate treatment, but also reduce mortality from the cancer.

The most important criterion that defines the standard of the breast imaging workflow is its efficiency. Higher efficiency of breast imaging procedures, along with rapid reporting times, allows the physician to provide excellent quality of care to the patient. The most commonly performed breast imaging procedure is mammography. With advances in technology, many novel techniques of imaging have risen over time, although mammography is still considered the 'Gold Standard' in breast imaging.

Mammography

The primary and most cost-effective imaging modality for breast screening is mammography. It functions as an X-ray imaging of breasts that is capable of detecting tumours and abnormalities. The technology has been consistently advancing, thereby improving the performance quality and reporting of studies. As imaging shifted from analogue systems to digital systems, it has become easier to record breast images electronically. Mammography also provides the ability to alter contrast and brightness of images to ensure effective evaluation of abnormalities. Mammography can identify and demonstrate microcalcifications, sometimes lower than 100 microns. Hence, a mammogram can report anomalies in the breast long before it can be identified by clinical breast examination (CBE). A mammography image is interpreted on the basis of standardised guidelines set by the Breast Imaging Reporting and Data System (BI-RADS®). These guidelines help in analysing and indicating the potential risk of malignancy for a patient. Recent times have seen many developments in technology with the introduction of three-dimensional imaging mammography, lower dose radiation mammography, contrast enhancement imaging and computer-assisted diagnosis.

There are two types of mammography techniques commonly used:

a. **Screening Mammography:** Screening mammography is a technique that enables detection of changes in the breasts of women with no physical symptoms. The main purpose of this technique is to screen and detect cancer before any physical signs are noticed. Screening mammography is done by collecting two mammogram images from different angles for each breast, which are analysed for lesions or abnormalities.

b. **Diagnostic Mammography:** Diagnostic mammography is generally used to determine whether an identified lesion or lump is malignant. The technique allows the physician to screen all the surrounding tissue to check if the disease has spread. Diagnostic mammography is performed to investigate any symptoms that involve breast changes like lumps, pain, abnormal nipple pigmentation and discharge. The technique is also used to confirm and evaluate any abnormalities that were identified on screening mammography.

Limitations of Mammography

Though mammography is considered the best population-based breast imaging method for cancer screening, there are some issues that the technique faces which take a toll on the efficiency of diagnosis. The mean sensitivity of a mammography technique is about 68%, which is not ideal. The sensitivity of the technique falls largely as the density of the breasts being scanned increases, and it is well known that dense breasts have a greater risk of breast cancer. This reduced sensitivity while diagnosing radiological dense breasts may lead to false negatives, where an existing tumour may go undetected. Breasts generally contain fibro-glandular tissue and adipose tissue, and the density of the breasts is generally a result of increased fibro-glandular tissue. On a mammogram, adipose tissue appears black in colour, while the fibro-glandular tissue appears white on the scan. As the density of fibro-glandular tissue and the tumour are similar, the tumour may be ignored by the radiologist as fibro-glandular tissue, leading to false negative results and delay in treatment.

Sometimes mammography could misdiagnose a non-malignancy as a tumour, putting immense psychological pressure on patients. These patients who receive false positive mammograms generally undergo worries, anxiety and stress-related issues that are normally common in breast cancer patients. The trauma that results from false positives may continue over time even after the cancer has been ruled out. Issues such as this generally require the radiologist to verify the test results using other modes in order to confirm the presence of a tumour. Along with these issues related to sensitivity, the mammography technique uses low dose ionising radiations for imaging, and these radiations may sometimes have harmful effects on the patient. ■

The complete article is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***
References are available on request from Claire Pillar, Managing Editor, HealthManagement, email: ***cp@healthmanagement.org***

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AUTOMATED BREAST ULTRASOUND (ABUS)

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Clinical Challenge

In 2013 the American Cancer Society estimates that there will be about 232,340 new cases of invasive breast cancer diagnosed in the United States alone. In 2013 about 39,620 women in the U.S. will die from breast cancer, exceeded only by lung cancer (American Cancer Society 2013). Survival rates in women with breast cancer are much higher when the cancer is detected at an early stage, and this is why routine screening mammograms are recommended by the American Cancer Society for women 40 years of age and older (American Cancer Society 2013; Duffy et al. 2002).

Breast Density

Screening mammography has long been the mainstay in detecting non-palpable breast cancer while it is the most curable. However, while the accuracy of mammography is high in fatty breasts, breast density is a major limitation to the sensitivity of mammographic screening, prompting researchers to look for alternative methods to improve detection in these women. Breast density is a strong independent risk factor for the development of breast cancer. In several studies, women with the highest levels of breast density were found to have a four- to six-fold increased risk of breast cancer compared with women with the lowest density classification (Boyd et al. 2007).

Breast density has also been shown to increase a women's lifetime risk for developing breast cancer. About 40% of women have some dense breast tissue, and visualisation of cancers in dense breast tissue with mammography is sometimes limited, as radiographic images of dense breast tissue appear similar to cancer (American Cancer Society 2013; Boyd et al. 2007; Kolb et al. 1998; Brubaker 2013). The result is missed cancers or the discovery of later-stage cancers in women which may require more aggressive treatment options (Duffy et al. 2002). According to a peer-reviewed study by Boyd et al., published in the New England Journal of Medicine, "Women with dense tissue in 75% or more of the breast have a risk of breast cancer four to six times as great as the risk among women with little or no dense tissue" (Boyd et al. 2007).

Automated Breast Ultrasound (ABUS)

While mammography remains the gold standard for breast cancer screening, clinical studies have shown improved early detection of breast cancer when ultrasound is used as an adjunct to mammography for women with dense breast tissue. However, like mammography, ultrasound has its own set of limitations, as the process is very user dependent and scanning the breast is difficult, inconsistent and time-consuming. These issues led to the development of a new ultrasound technology that addressed some of the limitations, leading to the birth of automated breast ultrasound (ABUS). Advantages with the ABUS technology include a reduction in the time of procedure and operator dependency, as the equipment utilises transducer technology that automatically scans the breast in several seconds, acquiring volumetric image data that can address the issue of dense breast tissue.

This is different than routine ultrasound of the breasts since the images from ABUS allow you to see in projections that routine ultrasound cannot, which results in detecting more breast cancers and less false negatives. After the exam the 3D ultrasound images are sent to a workstation where the radiologist interprets the ABUS scan along with the women's mammogram and clinical history. All together, the result is a more accurate way of detecting breast cancer in women with dense breasts. Even women with prior cancer, breast surgery or implants benefit from the additional information ABUS offers.

Several vendors market ABUS Systems, including Siemens with the S2000 ABUS, U-Systems with the somo-v ABUS and SonoCine. However, while there is an increased growth of traditional ultrasound systems dedicated to women's healthcare and for breast imaging applications over the years, the healthcare community is taking a 'wait and see' approach to the ABUS technology. This is mainly due to questions related to the expense associated with having an ultrasound system dedicated solely to breast imaging, workflow adaptations and issues of reimbursement for this application (Brubaker 2013).

In 2012, U-Systems' somo-v ABUS-device was approved by the FDA as an adjunct to mammography for breast cancer screening in asymptomatic women for whom screening mammography findings are normal or benign (BI-RADS® Assessment Category 1 or 2), with dense breast parenchyma (BI-RADS® Composition/Density 3 or 4), and have not had previous clinical breast intervention (U.S. Food and Drug Administration 2012). Part of the data-gathering process for FDA-clearance came from an ROC (Receiver Operating Characteristic) Reader Study conducted by the University of Chicago (Drukker et al. 2013; Giger et al. 2012).

The addition of ABUS demonstrated increased interreader agreement when used in combination with mammography compared to mammography alone for women with dense breasts, The addition of ABUS resulted in the discovery of about 30% more cancers in women who had a normal mammogram, a normal physical examination, and dense breasts. About 4% of lesions found were false-positives. 93% of the cases with cancers detected with mammography and ABUS were invasive cancers. These results suggest that the addition of ABUS to screening mammography is expected to yield a benefit to patients with dense tissue by providing earlier detection of breast cancers that might be missed by mammography alone.

As procedure volumes grow and issues of reimbursement become clear, investment in ABUS technology will become more economically feasible, resulting in increased ABUS activity in the market. ■

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BENCHMARKING RADIATION DOSE INDICES:

THE AMERICAN COLLEGE OF RADIOLOGY'S DOSE INDEX REGISTRY

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Concerns about the risks of radiation dose have received increasing attention from physicians, patients and the media over recent years. In the USA, initiatives such as Image Wisely® and Image Gently® have set out to guide referring physicians and radiologists to think carefully about the impact of radiation dose on patients. Appropriateness criteria also exist to ensure that imaging exams are carried out only when necessary, based on the best available evidence.

Benchmarking radiation dose is another tool to improve quality and patient care. The American College of Radiology (ACR) launched the Dose Index Registry (DIR) in May 2011. The DIR was established to allow facilities to compare their average dose indices for a given exam to that of other facilities.

To make accurate comparisons, the data that was being collected, especially the name of the exam being compared, had to be standardised. In addition, the data submission process had to be automated, or facilities would not have the time or resources to participate. Having solved these issues, the registry now aims to establish national benchmarks and practice patterns in CT dose indices by collecting and comparing dose index information across facilities.

As at January 2013 there are 619 registered facilities, with 328 of those actively providing data (see Figures 1-4). International facilities are eligible to participate: currently there are 13 facilities registered from outside the USA, with one facility from Canada actively participating.

The DIR is one component of the National Radiology Data Registry (NRDR), which also includes registries/databases for CT Colonography, General Radiology Improvement, IV Contrast Extravasation, National Oncology PET, National Mammography Database and Quality Improvement Registry for CT Scans in Children.

While there are other countries that monitor dose indices through different mechanisms, the DIR is currently the only dose-related registry that automatically collects data from each CT exam at participating facilities and provides comparison reports.

Registration Process

Participating facilities are required to sign a Participation Agreement, register on the NRDR website, pay a registration fee and an annual participation fee based on the number of radiologists in practice and number of sites.

The technical setup involves downloading the software to transmit data to the registry and configuring the scanner or PACS. Beyond the time for set up (approximately 2-4 weeks) the process is automated, so there is no additional time involved in participating.

Reports

Participating facilities can run reports on their own data at any time via the registry website. Facilities receive benchmark reports every six months comparing their data by body part and exam type to aggregate results (see Figures 5-6). The reports map facility procedure names to standard tags to facilitate meaningful comparisons between facilities.

Reports include include size specific dose estimates (SSDEs). Facilities transmit the localiser image to the DIR and an estimate of patient width is obtained from the localiser. The patient width is then used to calculate the SSDE. The SSDE is, therefore, a size-adjusted value so it takes into account that some facilities may have a larger-sized patient population than others.

The CT scanner automatically sends the appropriate DICOM SR object to the PC for every CT exam performed on the scanner. TRIAD is the software used to anonymise and transmit data to the registry. An algorithm measures patient thickness from the localiser, calculates the effective diameter and determines the normalised dose conversion factor using effective diameter and phantom size according to the American Association of Physicists in Medicine Task Group 204 methods. Then the conversion factor is applied to CTDIvol to get the SSDE. The current DIR reports include the SSDE for all body exams. Head exams are not size-adjusted since the difference in head sizes does not vary as much across patients.

Facilities can select by exam type (e.g. chest exam) and the SSDE value is already adjusted for patient size. For paediatric patients selection by age group is possible.

How it Works

DIR uses standard methods of data collection: DICOM structured reporting and the IHE Radiation Exposure Monitoring Profile (see Figure 7).

DIR has the ability to capture data from new and old scanners: a DICOM structured report is used for new scanners. For older scanners, optical character recognition is used to capture the data from the dose report or dose screen. The dose report is sent directly from the scanner or the PACS to a computer that has the ACR software installed. This software anonymises the data so that personal identifiers are removed, and sends the data to the DIR.

> ***"the goal of the DIR is to collect dose information from every facility that has a CT scanner"***

Exam names are mapped to Radlex Playbook. ACR used RadMapps, the web-based procedure mapping, classification and normalization service to map all exam names that were in the registry as of May 2012 (approximately 21,000). New facilities may choose to use RadMapps or the mapping tool on the website. In either case, the exam name at the facility is mapped to a term in the Radlex Playbook.

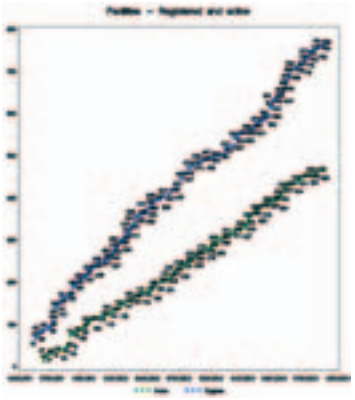

Figure 1.
DIR Registration Tracking

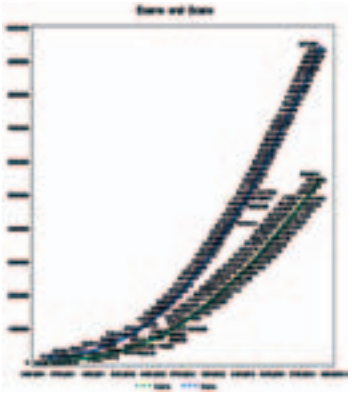

Figure 2.
DIR Tracking

Figure 3.
Map of DIR Facilities

Figure 4.
DIR Facility Characteristics - Spring 2013

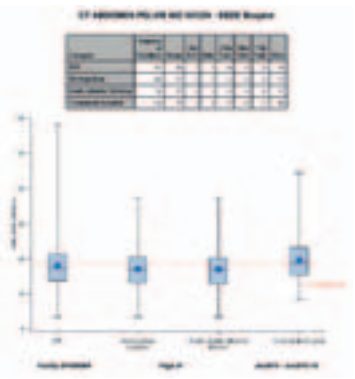

Figure 5.
Screen capture of report showing mean size specific dose estimate for abdominal pelvic CT without IV contrast. The red line shows the facility's median dose compared with medians for DIR as a whole, metropolitan facilities, regional facilities and freestanding centres

Challenges

Procedure names are not standardised across facilities. The decision was made to map procedure names to Radlex. However, the wide variation in procedure names was not anticipated. For example, we found over 4,000 different names for head exams across the registry and one facility had over 400 names within its own institutions.

Using the localiser to determine patient width is not perfect, with an estimated error rate of 5-10%. Ideally, a measure of patient width could be made by the scanner while the patient is on the table and automatically recorded into the DICOM structured report or header.

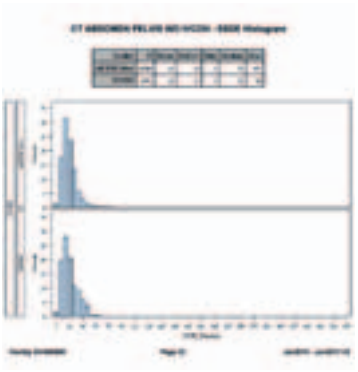

Figure 6.
Screen capture of report on size specific dose estimate (SSDE) for abdominal pelvic CT without IV Contrast. The histogram at the bottom shows the facility's data compared to all DIR sites

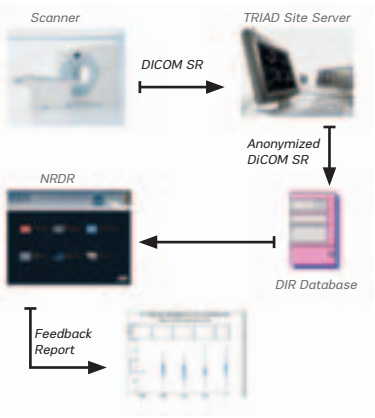

Figure 7.
How does the Dose Index Registry work?

The Future

The goal of the DIR is to collect dose information from every facility that has a CT scanner. In addition , the DIR is expanding to other modalities, with CR/DR coming in late 2013, followed by fluoroscopy. Benchmarks from the DIR are expected to be published this year. ■

Further information

Access to the DIR data for researchers can be requested by emailing nrdr@acr.org.

Ultrasound in Breast Biopsies - Research Aims to Improve Cost-Effectiveness

When performing breast biopsies doctors often need to combine MRI and ultrasound to obtain tissue samples with a fine needle, as around a third of tumours are invisible to ultrasound. Imaging takes place inside the MRI scanner, and the biopsy needle is inserted separately when the patient is outside the scanner. This process is often repeated several times before the sample is finally taken. This exhausts patients and is also costly in terms of scanner use.

In the MARIUS project (Magnetic Resonance Imaging Using Ultrasound – systems and processes for multimodal MR imaging), experts from the Fraunhofer Institute for Biomedical Engineering IBMT in St. Ingbert and the Fraunhofer Institute for Medical Image Computing MEVIS in Bremen are working towards a quicker and gentler alternative.

The new technique would require just one scan of the patient's entire chest, with the subsequent biopsy guided by ultrasound. Doctors would have both the live ultrasound scan and a corresponding MRI image available to guide the biopsy needle and display exactly where the tumour is located.

The biggest challenge is that the MRI is performed with the patient lying prone, while during the biopsy she lies on her back. This change of position alters the shape of the patient's breast and shifts the position of the tumour significantly. To track these changes accurately, researchers have found a novel solution. While the patient is in the MRI chamber, ultrasound probes attached to the patient's skin provide a succession of ultrasound images. This produces two comparable sets of data from the two separate imaging techniques. When the patient undergoes a biopsy, the ultrasound probes continually record volume data and track the changes to the shape of the breast. Special algorithms analyse these changes and update the MRI scan accordingly. The MR image changes analogously to the ultrasound scan. When the biopsy needle is inserted into the breast tissue, the doctor can see the reconciled MRI scan along with the ultrasound image on the screen, greatly improving the accuracy of needle guidance towards the tumour.

Fraunhofer researchers are developing a range of new components to realise this vision, including an ultrasound device that can be used in an MRI scanner, ultrasound probes that can be attached to the body to provide 3D ultrasound imaging and new software.

IMAGING REFERRAL GUIDELINES – UPDATE

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The Royal College of Radiologists (RCR) has published imaging referral guidelines for over 20 years. The current, 7th edition, iRefer: Making the Best Use of Clinical Radiology (Royal College of Radiologists 2012) was published in early 2012, and with over three hundred clinical scenarios gives evidence-based recommendations for the best test first, taking into consideration diagnostic/therapeutic efficacy, radiation safety and cost-effectiveness.

RCR guidelines have been translated into four languages and are destined for use in Austria, Croatia, Japan, Norway, Poland and the Middle East. The value is not just to the referrer, but also to the justifying practitioner (radiologist or radiographer) as well as to the healthcare organisation, department of health and, of course, the patient. In recent years many countries have accepted imaging referrals from non-medical healthcare practitioners such as chiropractors, physiotherapists and nurse practitioners. For low dose procedures e.g. plain radiographs the process of justification and assessment of benefit against radiation risk has been delegated increasingly to radiographers whose decisions are informed by referral guidelines. Responsibility for justification still rests firmly with the radiologist in consultation with the referring clinicians. The new international basic safety standards (International Atomic Energy Agency 2011) have promoted the shared concept for justification between radiologists, referrer and the patient. This is in line with the patient advocates' mantra Nihil de nobis, sine nobis (nothing about us without us) (Wagstaff 2004).

International Initiatives

International agencies have joined forces in advocating the availability, use and compliance with imaging referral guidelines. In December 2012, at the "International Conference on Radiation Protection in Medicine: Setting the Scene for the Next Decade" in Bonn, there was a clear call for imaging referral guidelines to be available globally with measures to aid implementation and monitoring (see Table 1) (International Atomic Energy Agency and World Health Organization 2013).

Over the last decade the momentum has gathered for appropriateness. Appropriateness goes beyond justification of a particular radiation procedure, and promotes the use of the best test first. For such advice to be acceptable allowance must be made for differences in provision of equipment, available expertise and acceptability by patients. These differences exist between countries and even within a country where differences in resources are prevalent.

The International Atomic Energy Agency (IAEA) has hosted a number of meetings to promote good practices, explore methods of monitoring and to ensure the correct stakeholders are involved. Following these there have been advances in agreeing a common methodology and essential stakeholder groups for referral guideline development. The need for patient group involvement is clear. The European Society of Radiology (ESR) supports this, and has established a Patient Advisory Group for Medical Imaging (PAGMI) (European Society of Radiology 2013). The World Health Organization (WHO) has for the last five years worked on the Global Initiative for Radiation Safety in Healthcare Settings (World Health Organization 2013), and has worked side-by-side with the IAEA in the promotion of good practices with regard to radiation safety in healthcare. At the recent meeting in Geneva in September 2013 there was a clear impetus for global guideline development, review and monitoring. Initially this could be done through adopting and adapting existing guidelines, as has been promoted by the ESR, but there is a clear wish globally to develop guidelines for the world, building on the principle that the best practice should still be promoted even in under-resourced countries, who may one day also have provision of imaging facilities to enable this. The same wishes have been made in Europe through the recent European Commission-sponsored project on availability of imaging referral guidelines in Europe where there is a clear recommendation for guidelines to be made available throughout the community and for monitoring mechanisms to be in place (see Table 1). The Global Summit for Radiological Quality and Safety (GSRQS), held in Washington DC in May 2013, combined the forces of the ESR, American College of Radiology (ACR) and International Society of Radiology (ISR) in the promotion of good practices, of which referral guidelines and monitoring through audit were high on the agenda. A second global summit is planned for Barcelona in 2015. Appropriate referral guidelines will also be a major focus for the Radiation Protection Medicine (RPM)

Table 1.
Action 1 from the Bonn Call-for-Action. The first of 10 main actions, and related sub-actions, which were identified as being essential for the strengthening of radiation protection in medicine over the next decade (International Atomic Energy Agency and World Health Organization 2013)

Enhance the implementation of the principle of justification

a) Introduce and apply the 3As (awareness, appropriateness and audit), which are seen as tools that are likely to facilitate and enhance justification in practice;
b) Develop harmonised evidence-based criteria to strengthen the appropriateness of clinical imaging, including diagnostic nuclear medicine and non-ionising radiation procedures, and involve all stakeholders in this development;
c) Implement clinical imaging referral guidelines globally, keeping local and regional variations in mind, and ensure regular updating, sustainability and availability of these guidelines;
d) Strengthen the application of clinical audit in relation to justification, ensuring that justification becomes an effective, transparent and accountable part of normal radiological practice;
e) Introduce information technology solutions, such as decision support tools in clinical imaging, and ensure that these are available and freely accessible at the point-of-care;
f) Further develop criteria for justification of health screening programmes for asymptomatic populations (e.g. mammography screening) and for medical imaging of asymptomatic individuals who are not participating in approved health screening programmes (e.g. use of CT for individual health surveillance).

meeting in Varna in 2014, supported by the European Commission and IAEA amongst others. Clearly, combining efforts and sharing the work of guidelines development will pay dividends.

Access & Distribution

There is still a problem of distribution of imaging referral guidelines to the intended users, primarily to general practitioners and doctors in training. This is evident from the recent RCR audit of appropriate imaging (Royal College of Radiologists in press), where distribution of guidelines to justifying practitioners is still limited to less than 70% and may be limited to as few as 50% of referrers in a country which has had guidelines for over 23 years. This audit highlighted the need even in the 21st century for a print copy as well as online access. 50% of justifying practitioners still use print copy to a greater or lesser extent. There is no doubt that online access is easier to use and to update, and an interactive format (as used by the French Society of Radiology (Société Française de Radiologie 2012)) does have value. Access to ehealth through smartphones and tablets has appeal to the peripatetic user e.g. in the community or on ward rounds. The RCR iRefer apps are in use in five continents including 14 countries in Europe, the Americas, Africa, Australia and Asia. The Société Française de Radiologie (SFR) is currently developing similar technology. Adopting, adapting and translating guidelines such as the SFR and RCR guidelines has been encouraged in Europe by the ESR.

Implementation

The challenge of implementation continues to be difficult with many new initiatives proposed and now being introduced. The American College, in conjunction with the National Decision Support Company (Andover, MA), has launched ACR Select (ACR Select n.d.), which has a clinical decision support system (CDS) aimed at promoting appropriate imaging at the time of referral based on ACR Appropriateness Criteria. For CDS systems to work they should be computer-based, take place within workflow and have an actionable endpoint, which is usually the formulation of the imaging request (Kawamoto et al. 2005). A European project along the same lines is taking place in Barcelona, and is at an early stage. The value of such systems to encourage appropriate imaging and for education is likely to be greater than the cost-saving, particularly in those environments where the best tests have been under-utilised. There will of course be clear savings where there is proven over-utilisation. In the United States CT over-utilisation, with typical estimates of 40% (Hadley et al. 2006), suggests that there will be a benefit in both radiation exposure and cost. It should be stressed that CDS should only support justification, and in Europe responsibility finally rests with the radiological medical practitioner.

Monitoring

Several models for monitoring guidelines usage and appropriateness of imaging have been used in Europe and abroad. Regulation is robust and effective but an expensive process, in those nations of the world in which such regulations exist. Soft regulation is of limited value. Licensing takes into account regulatory standards but only retrospectively. Clinical audit is a mandatory process under the European Council Directive 97/43 (European Commission 1997). This has been interpreted differently in various member states with a spectrum ranging from external audits (often used in Germany) to local internal audit, practised in the UK. Whereas a more objective and inclusive approach is afforded by external audit this is an expensive process, the funding for which is not always clear. Local internal audit is inexpensive, and can target perceived local issues sometimes with dramatic results (RCR National Audit of Appropriate Imaging). A further variation is the National Audit, which is often run by professional societies to promote good practices and which receives anonymised data from all or many facilities across the country.

The RCR performed an 'Audit of Appropriate Imaging' in early 2013. This received returns from 88 departments including 1700 of 2700 consultant radiologists in the UK. Benchmarking and statistical process control was used to identify departments with special cause for variation as identified through funnel plots (see Figure 1). The standards chosen took into account availability, use of guidelines and compliance with guidelines in order to achieve appropriate imaging. The standard of 100% availability of guidelines was driven by Ionising Radiation (Medical Exposure) Regulations 2000 (HMSO 2013), the UK transposition of Council Directive 97/43 (European Commission 1997). Difficulty in achieving this standard has since been helped by national distribution of guidelines by the UK Department of Health through the N3 wide area health network. The high target of 95% and 90% for evidence of vetting/justification of requests and for retrospectively-assessed appropriateness were achieved, and will add to examples of good practice in Europe.

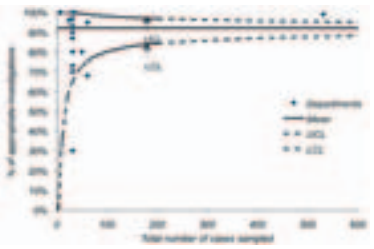

Figure 1.
Funnel plot to show the proportion of GP-requested CT investigations that were retrospectively appropriate. Data are from 44 radiology departments. The mean value is 92.1%. Most departments showed performance within the upper and lower control limits (UCL and LCL), with only 2 outliers below the LCL (Royal College of Radiologists in press). (Reproduced with permission from The Royal College of Radiologists)

The Future: Recommendations

In the recent European Commission-sponsored project regarding referral guidelines in Europe (European Society of Radiology 2012), the views and wishes of 30 countries were taken into consideration. Feedback from 28 member states, Switzerland and Norway was clear in the wish for European guidelines, which may initially be adopted and adapted; mechanisms for implementing clinical guidelines, including clinical decision support systems; educational initiatives such as Medical Radiation Protection Education and Training (MEDRAPET 2011-) and clear direction for monitoring, particularly by clinical audit. It would seem that these wishes are common to the other regions of the world through the Bonn call-for-action.

Imaging referral guidelines are of undoubted value, with growing distribution through smartphones and tablets, but for their full implementation with clinical decision support, are they affordable? ■

Key Points

- *Need for awareness that appropriate imaging goes beyond justification: the best test first.*
- *Global access to guidelines is aided by smartphone and tablet apps.*
- *Guideline implementation is challenging, but clinical decision support systems are promising.*
- *UK National Audit shows 90% appropriateness achievable for GP-requested CT.*

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CLINICAL TREATMENT PROCESSES

OPTIMISING EFFECTIVENESS

When there is an increasing oversupply of imaging examination methods, services which foreseeably do not influence further treatment of the patient are superfluous, present unjustified exposure, and are economically pointless. Such services can only be avoided if the optimisation of the overall treatment process for medical quality, service quality and profitability is the focus. This requires:

- a new definition of the processes (Imaging Pathway);
- a new organisational structure (Imaging Centre);
- and a new way of thinking by the staff involved.

The incentive and motivation system must change from rewarding volume to rewarding the service and process quality.

Practitioners are aware of allegedly urgent examinations, which were done and the findings never read, and requests for ultrasonography and CT or MRI examinations of the same region where the doctors did not wait for the results of one method.

Retrospective analyses of treatment processes are generally only undertaken in cases of problematic clinical outcome or sub-optimal encryption. Even when the clinical outcome is excellent and encryption is good, the treatment pathway may contain numerous unnecessary imaging examinations, which are economically pointless, and constitute additional exposure and risk for the patient. Critical retrospective analysis is still very unfamiliar to medical practitioners, but consequences for future processes must be drawn from this analysis.

Classification of the clinical value of examination methods is difficult in the context of the large number of quickly developing imaging procedures, as it requires continual review. Current medical request culture is geared towards ensuring that no diagnostic possibility is missed. Limits are set by examination capacity rather than critically assessing, retrospectively or prospectively, examinations according to their usefulness on the road to a diagnosis, and which examinations may be avoided in future.

Enhancements of the diagnostic quality of imaging methods have almost always led to "both ... and...", hardly ever to "instead of..." in the treatment process. Guidelines are helpful if they take the current state of diagnostic possibilities into account. In quality handbooks, the processes of CT and MRI examinations are described in detail, the undertaking of all examinations is requested in checklists, but it is rare that the necessity of an examination is questioned on the basis of evidence.

The Clinical Principal Point of View

Every additional parallel examination contains the possibility of a diagnostic surplus, even if repeated within a short time. If the probability of a pathological finding is not included in the indication, this means that to be on the safe side all methods of all areas are used in parallel. Especially with ultrasound, MRI and CT examinations, this uncritical parallel application leads to constantly increasing examination frequency per patient. Clinical principals believe, partly justly, that low quality of the findings of individual examinations is counter-balanced by the number of different examination methods. In this case, however, the solution is to increase the quality of the findings.

The number of examinations is frequently not limited by medical necessity but by equipment and staff capacity. Additional free capacity through new equipment or more personnel is generally directly taken up by additional diagnostic requests.

Clinical departments usually refuse to tolerate critical inquiries by the radiologist about the necessity of examinations. Recommendations by the radiologist on the further diagnostic approach are considered rather annoying, and the diagnostician is powerless in many cases. While the review of the justifying indication by the radiologist is a stipulation of the German X-Ray Regulation, there is probably hardly any radiologist who can remember a correction of the request by clinical colleagues. Thus one settled into a "both ... and ..." world until capacity is exhausted. Radiologists have enough examinations and the clinician is not required to make any hard decisions. This is the demand-oriented increase in examination numbers. The solution must be readiness to face a critical discussion under the criteria of medical quality, patient safety/patient exposure and profitability.

The Diagnostician Point of View

The demand-stimulated increase of examination numbers is driven by the zone of "both ... and ..." with the clinical practitioner as well, until capacity is exhausted

Generally, the view of the radiologist is geared to the requested individual examination. After implementation and diagnosis, the imaging is usually over. The task has been completed with the examination, or further imaging is recommended and undertaken. The target is to answer the question of the clinical practitioner to the imaging centre with high medical quality, service quality, but also profitability. For the diagnostician a continual reflection on findings and recommendations compared to the clinic and to other imaging methods is also required in this process.

The Solution

Where is the motivation and incentive for clinicians and diagnosticians to assume a higher degree of personal responsibility and thus risk in avoiding unnecessary examinations?

"the radiologist must assume the role of the guide in the imaging process under medical, organisational and economic aspects in close coordination with the clinical practitioners"

From an ethical point of view, a starting point could be the Hippocratic Oath, i.e. avoiding unnecessary exposure for the patient. From an economic point of view, the existence of the hospital in competition is a prerequisite for successful medical action.

Effective financial incentives (e.g. internal service netting) must lead to an optimised use of resources (number of necessary services). Experience with a bonus-oriented internal service netting at Krankenhaus der Barmherzigen Brüder Trier showed some surprising results. Requests were reduced dramatically, but there was no change in clinical outcome. A radiological department cannot be established on the basis of unnecessary service requests. In budget talks with hospital management, it is not requests for a volume limitation, but requests for a defined high productivity (costs per examination), which constitute the frame requirements for the service provider (imaging centre).

The future lies in netting of imaging processes, as already expressed in the calculation of diagnosis-related group (DRG) shares. For the modern strategy of thinking and acting in overall treatment processes, suitable processes must be defined, the corresponding structures created, and employees must be aligned with this target by means of systematic personnel development.

Cost-Sensitive, Evidence-Based Treatment Pathways i.e. Thinking, Managing and Optimising in Overall Processes

Treatment pathways make recommendations according to defined transparent rules on the basis of the best available knowledge. In optimisation strategies, treatment pathways constitute a technical and organisational grid, which makes processes on average describable, calculable and thus capable of optimisation.

The advantages of standardised treatment pathways have been discussed for at least 10 years, but there has never been wide adoption in everyday hospital life. Generally, developments and applications failed because of complexity and overly high expectations. Treatment pathways were supposed to depict the processes in great detail, to show the best medical way methodically (evidence-based), and to demonstrate all costs (process cost calculation). The result, at best, was a 'Model Treatment Pathway'. The personnel resources required for implementation, process cost calculation and monitoring did not exist.

The most frequent problems in developing treatment pathways are:

- A frenzy of descriptions, generally in the scope of certifications without any further consequences;
- Mono-disciplinary developments;
- 'GOBSAT': Good Old Boys Sitting Around The Table;
- Unstructured decision making;
- The loudest and most powerful person gets his/her way;
- Absent evidence base;
- Lack of monitoring (substantiation of deviations);
- Lack of cost sensitivity;
- No continuous documentation;
- No (regular) evaluation of the treatment pathway;
- No information concept.

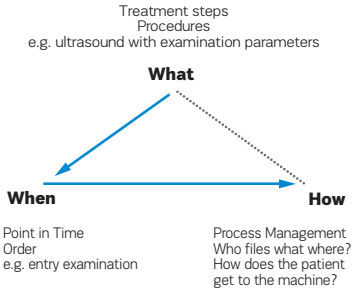


Figure 1.
Optimisation of Treatment Processes

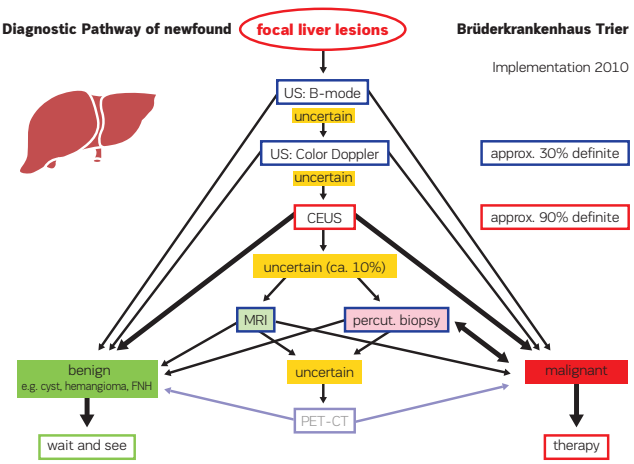


Figure 2.
The Treatment Pathway: Imaging Diagnostics of the Newly Discovered Liver Nodule (What, When)

Treatment pathways must be simple, clear, pragmatic and capable of being implemented and monitored with little effort.

The clinical treatment pathway can be structured into the following levels:

1. Preparation of the patient (reception);
2. Undertaking of the necessary diagnostics;
3. Therapy;
4. Diagnostic follow-up (discharge).

Imaging, as part of the diagnostics pathway, is a suitable starting point for the development of the overall treatment pathway. Expansion to the standardised clinical undertaking of examination (which reception parameters, which sequence, administration of contrast agents?) is important. The organisational implementation (how) comes at the end of development.

Figure 2 shows the clarification of a newly discovered liver nodule as treatment pathway "Imaging".

The use of resources for a treatment case is determined by the effectiveness and efficiency of the individual steps. In a fixed fee system, both aspects must be taken into consideration.

Described treatment pathways without continual monitoring may be useful for certification, but they are pointless for optimisation of daily treatment processes. A good radiology information system (RIS) allows for automatic monitoring of the imaging pathway. Figure 4 shows the imaging pathway of DRG G60B (Rectal Carcinoma) for a patient. When have which examinations been performed?

More differentiated evaluations can be undertaken: when has what been done on average? Were the recommendations of the diagnostician taken into consideration? Which deviations from the agreed treatment pathway took place?

If possible, the development of treatment pathways should be made on the basis of evidence. Cost sensitivity is generally sufficient, meaning that in case of equivalence of the medical results, the choice of the methods should take into account the scale of the use of resources (e.g., in case of equal medical informational value, ultrasound should be preferred to an MRI examination).

Standardised, evidence-based and cost sensitive treatment pathways are a prerequisite for a successful optimisation strategy under the frame conditions of the DRG world. They render processes definable and measureable, despite all substantiated

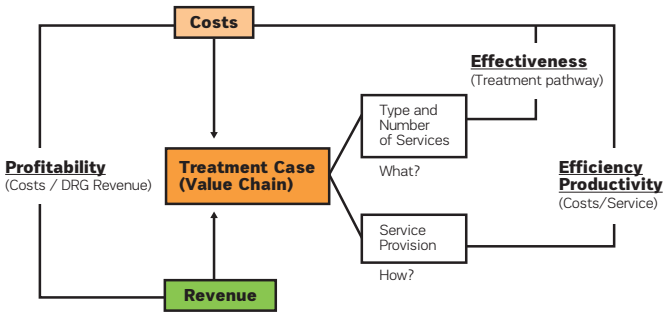


Figure 3.
Profitability (Effectiveness and Efficiency) of Treatment Pathways

exceptions. Patients and the hospital benefit from this.

As a healthcare system with flat fee compensation is already reality, there is no choice for this survival strategy. Structures and ways of thinking are marked by a series of optimised individual services. Management criterion is the service volume under the predetermined volume limit. Almost always services rendered were rewarded by additional revenue, personnel and equipment – not the avoided necessary services, i.e. the overall process quality. Even today, the internal bonus allocation (pool), which is mainly fed by the additional revenue, operates according to this principle.

This principle is no longer successful in case of flat-fee compensation. Let this be illustrated by an example:

> In order to optimise the requested examinations, the head radiologist attends clinical rounds as consultant. This is supposed to happen in the scope of the overall treatment process under medical aspects (Another MRI? Again?), service aspects (possible appointments – longer waiting periods for MRI examinations) and economic aspects (a cheaper ultrasound will provide the same medical results as a CT examination in this case). This consultation makes sense in the process optimisation of the necessary procedures. During this time, however, the head doctor is not able to contribute to the budget of the department through his/her own billable services. According to the target agreements (service volume per full-time doctor) or the next management consultancy with the criterion "examinations per doctor", however, this would lead to a staff reduction.

This example illustrates that the existing incentive and motivation system is not yet aligned with the new frame conditions. Personnel investments in higher process quality of the overall treatment do not pay off for individual departments; rather, they constitute a threat to the achievement of the department-specific targets.

How to reward the service rendered must evolve into the main idea:

> How to additionally reward the avoided unnecessary service or the choice of the medically equivalent, but cheaper examination.

In sum:

> How to reward the economic thinking in the diagnosis-based fixed compensation system of the hospital without decreasing the quality of the medical care.

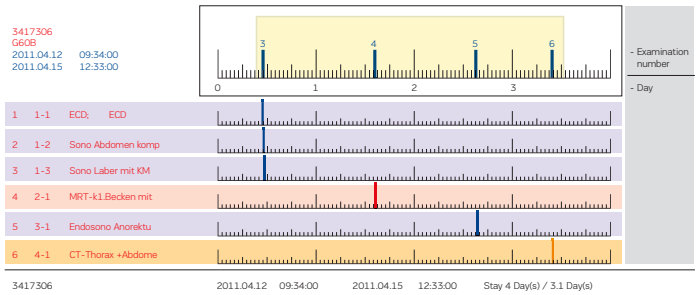
Therefore, a clinical department is not a "practice within the hospital". How should the "bonus system" for avoided services look in case of a practice within the hospital? When managing overall processes new ideas for the motivation and incentive system are required. The success of the overall treatment process must be the centrepiece, not just the individual partial service. Process quality is rewarded, not the amount of services!

Thinking and acting in overall processes requires appropriate structures, the establishment of centres and in central patient management.

The central interdisciplinary ultrasonography constitutes a new organisational form in Germany. In this section, ultrasonography specialists (internists, angiologists, surgeons, radiologists, nuclear medicine experts) work with top of the range equipment. The ultrasonography training for the entire hospital is done here. Ultrasound images and sequences (CE ultrasonography) are a fixed part of the PACS system and are demonstrated on par with radiological images of experts during clinical conferences. Ultrasonography is not merely an orientational initial diagnostic tool prior to a targeted use of more elaborate methods (e.g. CT, MRI, PET); ultrasonography diagnostics rank as a reference method which renders further imaging diagnostics superfluous in many cases.

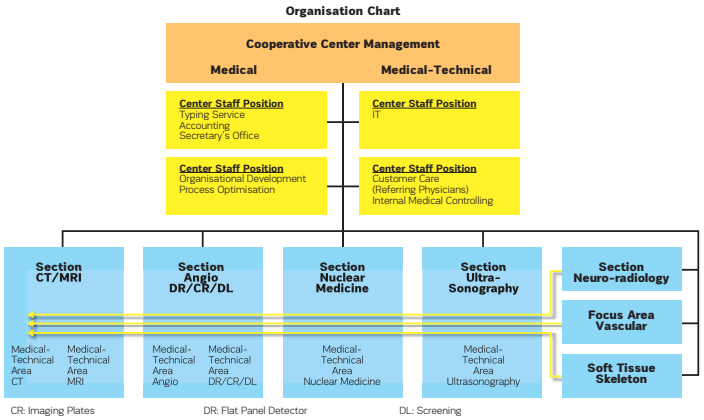
In the future process organisation must be more aligned with the treatment pathways. Apart from the execution of directly requested services, the interdisciplinary consultation prior to the diagnostics and the therapy of clinical pictures (e.g. vascular diseases) together with recommendations for medically and economically efficient diagnostic and treatment pathways must be the priority. A CT examination avoided due to set treatment

Figure 4.
Monitoring of the Imaging Pathway of DRG G60B (Rectal Carcinoma)



1	Day 1	After 0 d 1 h 7 m	12.04.2011 10:41	(SON1/41000) ECD; ECD
2	Day 1	After 0 d 1 h 38 m	12.04.2011 11:21	(SON1/43000) Ultrasound of entire abdomen; Ultrasound of entire abdomen
3	Day 1	After 0 d 2 h 4 m	12.04.2011 11:38	(SON1/43150) Contrast-enhanced ultrasound of liver (Sono Vue)
4	Day 2	After 1 d 4 h 49 m	13.04.2011 14:23	(MRT3/63402) MRI-pelvis minor with contrast agents; MRI-pelvis minor
5	Day 3	After 2 d 5 h 45 m	14.04.2011 15:19	(SONM/47000) Endosono anorectal; endosono rectum
6	Day 4	After 3 d 0 h 16 m	15.04.2011 09:50	(CT2/22005) CT-Thorax and abdomen (staging); + abdomen + rectum

Figure 5.
Organisational Chart of the Center for Radiology, Neuroradiology, Ultrasonography and Nuclear Medicine ("Imaging Center"), Hospital Krankenhaus der Barmherzigen Brüder.



pathways or interdisciplinary talks constitutes a benefit, both for the patient individually and for the value chain of the hospital. The disadvantage of the "island view" of radiology (fewer services = less staff = reduction of the department) should be a thing of the past. The Centre must continually offer new applications with additional revenue (e.g. virtual colonoscopy, cardio CT, full body MRI, spectroscopy), and invest any freed up personnel resources into an improvement of the process quality (e.g. shortening the waiting periods, period to the drawing up of the written result – increase of customer satisfaction). The target is the achievement of a continual improvement of the quality of processes, structures and results.

When selecting appropriate examination methods, the strategy ranges from "both ... and ..." to "either ... or ..." and "if required". The strategy should be encouraged to shift from an automatic parallelism to a well-organised and structured succession of necessary imaging procedures. The entire imaging process must be optimised (you have a diagnostic problem – we will solve this problem in an optimal medical and economic overall process). The target of the Imaging Centre is: one medical question – one appointment – and overall responsibility of the Centre for the imaging process. In this process, the radiologist must assume the role of the guide in the imaging process under medical, organisational and economic aspects in close coordination with the clinical practitioners.

Monitoring and optimisation of the imaging pathways place high demands on the quality of the processes in the Imaging Centre in this context.

In order to ensure a high processing speed, examinations must be booked. The examinations are selected and undertaken by the Imaging Centre in accordance with the agreed imaging pathway.

Example: Imaging Pathway Rectal Carcinoma
Booking (Prophylactically):

1. Endoscopy
2. MRI Pelvis (Day 1)
3. X-Ray Thorax (Day 1)
4. CT Pelvis+Thorax (Day 2)
5. Ultrasound Liver (Day 2)

The process organisation requires a same-day result and in some cases direct transfer of the patient to another examination in the Imaging Center.

For the Imaging Pathway Rectal Carcinoma this would mean:

Endoscopy: if possible, together with the rectoscopy

1. Day: MR Pelvis (same-day result)
Direct transfer to X-Ray Thorax (T< 3c)
2. Day: CT Abdomen (same-day result)
+ CT Thorax - T>=3c
- Suspicion of Lung Filiae
- Suspicion of Liver Metastases

In case of an unclear liver result, direct transfer to CE ultrasound (CEUS)

3. Day: **Overall Result Center TNM**

Conclusion

A trend-setting answer of modern hospitals to continually evolving frame conditions such as the introduction of the diagnosis-based group fixed compensation (DRG) lies in a process-oriented new alignment of structures, organisational forms and processes. Based on the previous improvement of individual treatment steps, the optimisation of the entire treatment and value chain along the DRG is required. The new alignment and restructuring according to the overall processes must be tackled in the short run as the frame conditions of the diagnosis-based fixed compensation of treatment processes will gain more momentum in the foreseeable future and good solutions require a longer implementation time. This is an exciting time for new ideas, visions and suggestions. ■

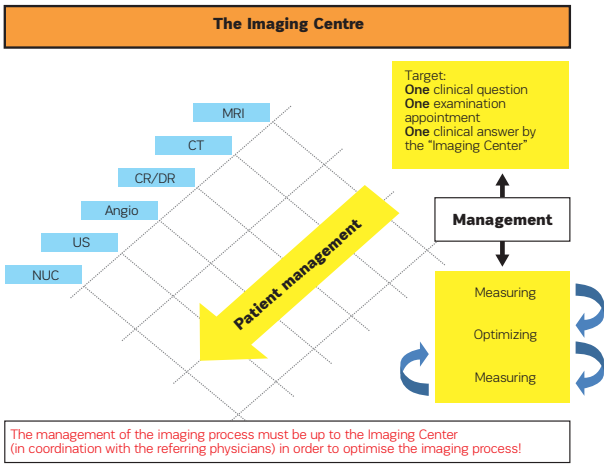


Figure 6.
Patient Management in the Imaging Centre. Thinking and Acting in Overall (Imaging) Processes

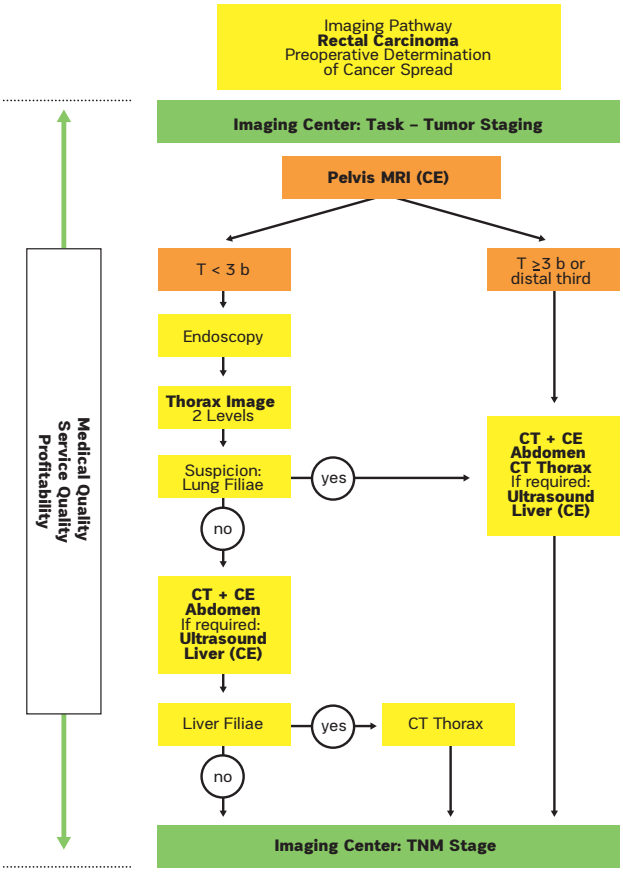


Figure 7.
Imaging Pathway: Staging Rectal Carcinoma

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PERSPECTIVES ON ERROR DISCLOSURE IN RADIOLOGY

Interviewees

Professor Stephen Brown (photo)

Assistant Professor of Radiology
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Harvard Medical School
Boston, US

Professor Thomas Gallagher

Department of Medicine
Department of Bioethics & Humanities
University of Washington
Seattle, US

Disclosure of errors in healthcare is not as straightforward as simply admitting that mistakes have occurred. The effect on patients, families and physicians, and the perceived risk of litigation, are just some of the barriers to disclosure. Radiologists have additional barriers to overcome, as they do not generally come into direct contact with patients.

To find out more about current research on error disclosure, HealthManagement editor, Claire Pillar, spoke to two experts.

Professor Stephen Brown practises paediatric and obstetrical imaging at Boston Children's Hospital. His research interests focus on the qualitative and quantitative assessment of professionalism in radiology and medicine.

Professor Thomas Gallagher is a general internist with research interests in the conflict of interest in the doctor-patient relationship. He practises as a physician in the General Medicine Clinic at the UW Medical Center-Roosevelt and as an inpatient attending physician.

Issues in Error Disclosure

What Motivated You to Research in the Area of Error Disclosure?

TG: *Recognising how stressful medical errors can be on the patient-provider relationship, and realising how difficult it was to know what to say to patients when something had gone wrong. This motivated me to learn more about the problem, and develop tools and strategies to help physicians and other clinicians respond to patients better in this difficult situation.*

Why Do You Think There Is Such a Gap Between Error Incidence and Disclosure, As Observed In Several Countries?

TG: *I think for a long time everyone thought that the gap was mostly due to healthcare providers' fear that disclosure would lead to litigation. It's not that doctors and others don't worry about being sued, but I think that other barriers like physicians' shame and embarrassment, their lack of comfort with the communication skills associated with disclosure, and the mixed messages they get from their institutions and malpractice insurers about disclosure are much more important barriers.*

What are Particular Issues for Radiologists in Error Disclosure?

SB: *Radiologists don't have primary relationships with patients, so they don't get to form any kind of bonds with patients that might help them in more difficult circumstances. They are strangers, essentially, to the patients. Without any face time in advance of any adverse event, it's an important obstacle.*

The nature of radiology itself is significant. Firstly, the abnormalities or potential errors are right there on a picture for everyone to see. There can be a lot of retrospective bias. There's a lot of overlap between what might reasonably be called normal, and what in retrospect might be discovered to be an error or an incorrect judgement. One might make a very reasonable judgement about a particular finding that turns out to be wrong, but only in retrospect. The great majority of breast and lung cancers, for example, are in retrospect present on earlier studies. It's a major challenge. Because we don't have frontline relationships with patients, we as radiologists are vulnerable to how the primary level physicians might characterise the misdiagnoses or misjudgements that we make to the patient. If it was a reasonable call, but it turned out to be wrong, it can be characterised in any number of different ways by the primary physician, without the radiologist having any input into having that patient understand the process of radiology and what actually happened.

Are There Notable Differences in Willingness to Disclose Errors Between Countries or Between Medical Specialities?

TG: *There doesn't appear to be a major difference between countries, interestingly, because the litigation environment between countries varies a lot. There are differences between specialities. When we looked at, for example, medicine versus surgery, surgeons are much more enthusiastic about disclosure. However, when you ask them what they would say, they would disclose less information about what happened than internists. Mammographers have very conservative attitudes on disclosing errors, and there are also special challenges for radiologists. We see much bigger differences across specialities than we do between countries.*

Prof. Gallagher – In Your Study of US And Canadian Physicians' Attitudes on Error Disclosure (Gallagher et al. 2006), 55% Reported Involvement In a Serious Error. Did That Seem High or is it Borne Out by Other Studies?

TG: *It's a little hard to know, because studies that have looked at this have either used different definitions of error or the disclosure was self-reported. However, I wasn't surprised by that number. If anything, it is probably a bit low. I think most physicians, at some point in their career, will have been involved in an error that causes serious harm to a patient. Healthcare is an inherently complex and dangerous activity.*

In the Same Survey only 23% Did Not Report that Any of the Barriers Mentioned Would Make Them Less Likely to Disclose a Serious Error to a Patient. 75% Reported Relief After Disclosure. Did These Findings Surprise You?

TG: *No, our experience has definitely been that physicians find disclosure very difficult. They frequently experience a variety of barriers, which is why support of physicians is so important, to help them overcome some of those concerns.* ■

The complete interview is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***
References are available on request from Claire Pillar, Managing Editor, HealthManagement, email: ***cp@healthmanagement.org***

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PROVISION OF A DEDICATED RADIOLOGY SERVICE FOR ACUTE HOSPITAL CARE

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Introduction

West Hertfordshire Hospitals NHS Trust (WHHT) provides predominantly secondary care acute hospital services to a population of about 500,000 people in Southern England. Emergency in-patient care is based around an (initially) 120 bedded, purpose built, Acute Admissions Unit (AAU), which opened in 2009. A new model of acute care was developed with intensive investigation and treatment of acute admissions and greatly increased consultant level input into management decisions. Ward rounds are performed on an extended hours 7-day model. To complement this, radiology is also provided in this manner with consultant radiologists being on-site 7 days per week and for extended working hours. This service is also based within the AAU in a dedicated radiology suite. Over the intervening years, with experience and changes (mainly increases) within the workload, the radiology model has developed in a dynamic manner, which will be discussed in this article.

Background

Following a strategic review of acute hospital care within West Hertfordshire, governmental approval was given to merge the acute hospitals services provided by two District General Hospitals on to one of the pre-existing sites. The major organisational drivers for this were to improve financial stability and allow for junior doctor rotas to comply with the European Working Times Directive. There would be a net significant reduction in the bed pool. To offset this, a 120 bed purpose-built freestanding acute admissions unit with integrated diagnostic suite was developed together with new, more efficient, ways of working. The aim was to reduce patient length of stay and improve the quality of care by increased consultant input, early use of high level imaging to improve diagnosis and extended hours working. The radiology department took this opportunity to substantially reorganise in-patient care, separating acute and elective work. This was facilitated by the coincidental development of radiology management software (Wizrad) and substantial modernisation of radiologists' working practices.

The Acute Admissions Unit

As originally constructed this was a free-standing modular built structure on three levels containing 120 beds. The ward accommodation comprises eight suites of 15 beds each, 12 in bays and three side rooms, on levels 1 and 3. Level 2 accommodates radiology, two cardiac catheter laboratories with 12 recovery beds and a robotic pharmacy. The radiology suite is furnished with a 64-slice CT scanner, ultrasound, three PACS workstations, offices and ancillary spaces. There is a plain film room on level 1. Most acute medical, surgical and orthopaedic patients are admitted to the AAU, either directly by family doctors, ambulance paramedics or via Accident and Emergency. Patients are seen by senior clinicians with multiple daily ward rounds. These are supported by a similar level of daily sub-speciality ward rounds (e.g. chest medicine, cardiology, and gastroenterology). Requesting of complex imaging is generally at this level or by speciality registrars. As the radiologists are based within the unit and dedicated to the in-patient service direct multidisciplinary discussion of cases is straightforward. We have recently moved to digital order communications. A side effect of this has been to reduce the clinic-radiological interactions. The radiologists see this as being detrimental to the service, but it has proven popular with the clinical staff, in particular the junior medical staff. The impact on workload has yet to be appreciated.

The original intention was that patients would spend a maximum of 48 hours within the AAU and either be discharged or transferred to speciality wards within the main hospital. Unfortunately this model has not been consistently sustainable due to bed blockages further down the line and delays organising discharge care packages and so on. Consequently some patients are spending longer within the AAU. Additionally there has been a dramatic increase in demand for acute care, particularly of the elderly frail. It has been necessary to increase the capacity of the AAU, which now has 156 beds, having been enlarged by additional linear positioned units. Some of these are dedicated to ambulatory care, and the AAU radiology department also provides imaging for these patients.

Radiology Staffing for the AAU

As well as fully funding the accommodation and equipment for the radiology suite the business case provided for two additional radiologists and two radiographers. It was agreed that a consultant-level radiologist (our department is staffed essentially entirely at this level) would be on-site 08:00-20:00 Monday-Friday and 09:00-13:00 on weekends and public holidays. Departmental analysis (a Wizrad function) suggested that a typical day's in-patient activity, excluding complex interventional procedures, equates to 20 hours of radiologist time. All in-patient CT and ultrasound scanning was to be performed in the AAU, MRI in the main department but reported via PACS by the AAU radiologist.

In order to staff this service a series of interlocking radiologist rotas was developed: AAU1 08:00-16:00, AAU2 10:00-18:00, evening 17:00-20:00, weekend and public holidays 09:00-13:00. The radiologists would do a week alternating as either AAU1 or 2 approximately once a month. Averaged over the year one evening and weekend session is performed per month. If a radiologist is not available to perform a session (typically half a day) because they are not contracted to be present or for other reasons (such as high priority clinical commitment, e.g. one stop clinics), another radiologist acts as a filler, compensated for by a reduction in their weekly workload. This is easily calculated because of the workload programming function within Wizrad used to allocate work in the weeks when not assigned to the AAU.

The disparity between providing 20 hours of radiology time during the week and four hours at weekends was originally due to a combination of funding and the radiologist's willingness to sacrifice the work/life balance. Currently we are trialling extension of the service until 18:00 on these days.

Outside of the extended hours scheme above a 'traditional' type on-call service is provided, largely via telemedicine. ■

Image 1.
Current expanded configuration of AAU

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The complete interview is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***

PEER REVIEW IN RADIOLOGY: THE CANADIAN APPROACH

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Incorrect interpretation of studies is the leading cause of malpractice lawsuits against radiologists. Regulators expect a definition of acceptable levels of performance amongst radiologists even if there is no enforceable consensus on any admissible error rate that could be used.

Over the past few years, Canada has been swept by a wave of highly publicised reviews of radiologists, from New Brunswick to British Columbia (BC), through Quebec and Saskatchewan. These affairs have made the front page of the national newspapers, and could be followed on all major audiovisual media. Triggered by hospital chiefs of staff or regional health authorities, to which erroneous radiology reports have been notified, extensive reviews have been undertaken, with tens of thousands of cases submitted to a second reading. In some cases, the reviews found high rates of misses, up to 30% of CTs for one radiologist on the West Coast, but in other cases, the rates of misses were very low.

This is of course a devastating experience for the radiologists incriminated, sometimes for very few misses, leading to shameful ends of careers or at best early retirements. But even if these reviews have been going on for several years, there has been very little action taken by the radiology community to remedy this situation. The need for peer review solutions became obvious in order to protect patients and radiologists alike.

The Cochrane Report

After an infamous review of thousands of CTs in British Columbia, which found an exceptionally high amount of errors, the BC Minister of Health Services requested in February 2011 an independent two-part investigation into the quality of diagnostic imaging, and asked Dr. Doug Cochrane, Provincial Patient Safety and Quality Officer, to lead this review. The first part of the report centred on the credentials and individual experience of the radiologists involved. The second part of the report provided a description of the events, a review of quality assurance and peer review of medical imaging, a review of physicians' licensing and credentialling, and issued 35 recommendations (Cochrane 2011). Among the recommendations pertaining to the provision of diagnostic imaging services, six were specific to Quality Assurance and Peer Review in diagnostic imaging (recommendations numbers 15 to 20) (Cochrane 2011).

The Canadian Association of Radiologists Guidelines

The recent cases have raised awareness among radiologists that they have to engage actively in quality control, in order to avoid situations where large-scale reviews are mandated by local or regional authorities.

The Canadian Association of Radiologists published a white paper in September 2011 to outline the requirements for peer review processes and suggest ways to integrate it into practice (Canadian Association of Radiologists 2011). This white paper came with a number of recommendations (see Table 1 on website).

Retrospective Peer Review. RADPEER™

Very few sites were using RADPEER™, the quality control solution developed by the American College of Radiology. One of our groups in Hamilton was among the first adopters in Canada.

The way RADPEER™ functions is to allow the capture of discrepancies in previous reports when available, while reporting the current case (American College of Radiology). Errors are rated on a scale from 1 to 4, where 1 is easily missed and 4 is obvious and should not have been missed; from 2 and above, there are 2 categories: (a) means no impact on patient management, (b) means that the miss may have created a risk to the patient.

But retrospective peer review solutions have limitations, the main one being its impact on patient care. With RADPEER™, the radiologist will randomly review the report of a previous exam when he/she reads a current exam. But this means that there must be a previous, and that this previous is usually old, more than six months, even up to two years, when it will be too late to take any corrective action. Then the radiology department will have to inform the referring physician and the patient that a mistake has been made, which of course is a disaster in case of malignancy, without taking into account all the legal implications which can arise.

Moreover, what happens if a case performed a few months ago had a wrong interpretation, but there has been no follow-up? Then this case will never be reviewed, with the potential consequences of a miss for the patient. Similarly, new patients, in particular emergency patients, will not see their images reviewed.

RADPEER™ was resented as punitive and not as the learning experience it should be, and radiologists had the feeling, sometimes justified, that the data could be used against them.

Prospective Peer Review

Many institutions across North America consider that the RADPEER™ model, which was a game changer when introduced 14 years ago, does not answer to their needs anymore, and that we should move away from retrospective peer review and rather adopt prospective peer review.

What is a prospective peer review? It is a review done by a peer before the report is finalised and sent to the referring physician, just in time for the radiologist to correct any misdiagnosis which could be relevant to patient care. The benefits of a prospective peer review solution are multiple. With a configurable rate of sampling, the review is fully integrated in the workflow. Exams will be reviewed anonymously before the report is distributed on the network, by a radiologist of the same specialty, but based at another hospital. If the reviewer disagrees with the original radiologist, he/she will communicate his/her impression to the first radiologist, asking that he/she amends the report. ■

The complete article is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***
References are available on request from Claire Pillar, Managing Editor, HealthManagement, email: ***cp@healthmanagement.org***

ELECTRONIC HEALTH RECORD USE IN HOSPITAL CARE IN SPAIN

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Investment in information technologies in healthcare is justified because they will help to achieve higher standards in terms of efficiency, quality, safety, and a closer engagement of patients and their families (Pagliari C et al. 2007), as well as the potential benefits of health information sharing (Jha et al. 2009).

However, the association between resource investment and performance improvement has not yet been demonstrated with sufficient evidence (De Lone & McLean 1992; Department of Health 2004; Restuccia 2012). It is said that the inclusion of key functions of electronic records such as computerised requests and electronic referrals between different healthcare service providers and healthcare levels, enables a more efficient and safer management of healthcare resources and it avoids duplications for patients due to a lack of integration (Poissant et al. 2005). In this sense, there is also a broad consensus about the potential benefits of the EHR and the incorporation of information coming from medical devices (Jha et al. 2006).

Electronic health records (EHRs) are being introduced variably in the different levels of the healthcare systems around the world (Institute of Medicine 2007). A recent study published in the United States concluded that only 10% of hospitals had a basic level of electronic medical records, at least in one clinical unit. This percentage rose to 59% if we look at one of the key functions of many that should have the EHR (Jha et al. 2009).

The Spanish Ministry of Health published recently that the Healthcare ICT expenditure and investment in the National Health System accounted for 0.9% (544 millions of Euros) of the Regional Health Services' overall healthcare budget in 2009. It also stated that 97% of hospitals had information systems to manage admissions, beds, outpatient appointments, while 85% had radiology management, pathology and Unidose pharmacy systems. In addition, storage systems in digital imaging were available in more than 60% of Spanish hospitals and more than 90% had an Information System Laboratory (Ministry of Health and Social Policy & Red.es 2010). Despite over 30% of Spanish healthcare professionals are working with EHRs systems (de la Torre-Díez et al. 2013), the computerization level of health records in Spanish hospitals is unknown and there is not any national scientific study that has investigated this issue in depth. The goals of this study were to describe the level of adoption of electronic health records in hospital care, to identify potential facilitators to its implementation and the following steps.

Methods

For the elaboration of the questionnaire we reviewed and synthesised previous studies based on hospitals that were focused in EHR systems or related functionalities (e.g., electronic order entry, laboratory and radiology results) in the previous four years (Jha et al. 2009; Robertson et al. 2010). We developed an initial draft of the questionnaire to be reviewed by a panel of professional experts in the electronic health record field from the Public Health School from the Region of Andalusia and a second group of hospital management experts were consulted, all of which are members of the Board of the Fundación Signo, which is a non-profit foundation whose goals are the promotion and financing of proposals based on management improvement and cost evaluations.

We administered the questionnaire to CEOs, managing directors and their assistants from acute care hospitals from the Fundación Signo members' database. The survey was sent for the first time in September 2011, followed by two reminders. The fieldwork was completed in November of the same year.

The respondents were asked about the presence or absence of 26 clinical features of an EHR system and the extension of its implementation and whether in the future they had planned to implement any of them or not. The dimension of these features consisted of: clinical documentation, radiology and laboratory results, electronic requests and a support and alerts system. Besides that, we asked about the potential difficulties in EHR adoption (16 issues) and the solutions to overcome them.

Given the potential heterogeneity in possible responses due to different combinations of features implemented, we considered the proposal made in a similar previous study (Jha et al. 2009) of two possible categories: Basic EHR and exhaustive EHR.

Results

There were a total of 64 responses from 214 hospitals contacted (30% response rate). 97% of the respondent hospitals were medium and large-sized hospitals that belong to the National Health Service (table 1).

The presence of certain electronic individual functionalities is considered to be necessary for defining basic or exhaustive levels of electronic-record systems (table 2). We identified 48 hospitals (75.0%) with an exhaustive or basic level of EHR and 16 hospitals (25.0%) with some electronic-record functions without being totally electronic-record systems. Medium-sized (56%), urban (40%) and university (43%) are the type of hospitals that have the highest percentage of exhaustive electronic-record systems.

In terms of the adoption of different types of key EHR functionalities, we found that most clinical documentation functionalities are implemented in all units in over 40% of the hospitals, except for physicians' notes, which are only electronic in all units in 34.3% of the cases (table 3). The high percentage of affirmative responses related to the laboratory and radiology digital reports (84.3%) is also remarkable. On the contrary, only 25% of the hospitals have the option to incorporate external digitalised documents in the EHR. The computerised provider-order entry section is the least computerized, with percentages ranging from 37.5% to 50.1% in all its functionalities. It is precisely in these functionalities where the respondents expected to initiate soon its computerisation, the same as with incorporating digital external information to the EHR (20.3%) and digital electrocardiogram (29.7%). Finally, the decision support and alert systems and computerisation level are the lowest compared to other functionalities. The drug alert functionality is most implemented in this section, 23% of the hospitals have it fully implemented in all units. Whenever there were more resources, more than 20% of respondents would decide to invest in this area.

Regarding the opinion of the respondents about their main perceived facilitators, hospitals with and without EHR identified technical support during implementation and

Table 1.
Hospital description.

	All Signo hospitals (n=214)	Respondents n(%)
Size		
Small (0-99 beds)	60(28%)	2 (3.1%)
Medium (100-399 beds)	98(45.8%)	16 (25%)
Big (> = 400 beds)	56(26.2%)	46 (71.9%)
University		
Yes	_	35 (54.7%)
No	_	29 (45.3%)
Location		
Rural	_	8 (12.5%)
Urban	_	25 (39.1%)
Urban - Regional capital	_	31 (48.4%)

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CIRSE

Requirements	Exhaustive EHR	Basic EHR
Clinical documentation		
Patient's demographic characteristics	x	x
Physicians' notes	x	
Nursing assessment	x	
Discharge report	x	x
Radiology and laboratory results		
Laboratory results	x	x
Radiology results	x	x
Additional test results	x	
Radiology images	x	
Laboratory results report	x	
Computerised provider-order entry		
Laboratory	x	
Radiology	x	x
Medications	x	x
Medical consultants	x	
Medical orders	x	
Support and alerts system		
Clinical practice guidelines		
Clinical order reminders		
Drug alerts		
Results		
Number of hospitals	25	23
Adoption percentage	39.1	35.9

Table 2. (above)
Electronic requirements for classification of hospitals according to a basic or exhaustive electronic-records system.

Requirements	Fully implemented in all units	To initiate soon	There are no resources but there is intention	Not planned
	Hospitals percentages (n=64)			
Clinical documentation				
Patient's demographic Characteristics	87.4	1.6	1.6	
Physicians' notes	34.3	6.3	12.5	3.1
Nursing assessment	43.6	7.8	14.1	1.6
Discharge report	75	1.6	1.6	
Surgical report	46.8	14.1	7.8	3.1
Radiology and laboratory results				
Laboratory results	84.4	3.1		
Radiology results	84.4	3.1		1.6
Additional tests results	42.2	10.9	6.3	3.1
Radiology images	76.6	4.7	1.6	
Laboratory results report	75	4.7	3.1	
Electrocardiographic tracing	4.7	29.7	20.3	18.8
Incorporation of external digital information	25	20.3	12.5	9.4
Computerised provider-order entry				
Laboratory	39.1	23.4	4.7	
Radiology	40.6	20.3	9.4	1.6
Medications	50	10.9	4.7	
Medical consultants	37.5	18.8	9.4	3.1
Medical orders	46.9	18.8	7.8	6.3
Supply chain	39.1	9.4	3.1	6.3
Support and alerts system				
Clinical practice guidelines	7.8	17.2	14.1	15.6
Clinical order reminders	12.5	6.3	6.3	17.2
Drug alerts	23.4	14.1	4.7	10.9

Table 3. (above)
Selected electronic functionalities and its implementation level in Spanish hospitals.

	Hospitals with EHR	Hospitals without EHR
Technical support for the implementation and maintenance	87.5	62.5
Security certification and warranty	81.3	62.5
Objective third-party evaluations of EHR products	77.1	56.3
Incentives for implementation	62.5	50
Exempt physicians from all responsibility in confidentiality	39.6	25

Table 4. (above)
Perceived facilitators to adopt Electronic Health Records (EHRs) among hospitals with and without electronic-record systems.

maintenance, security certification warranty and objective third-party evaluations of EHR products as the most important for EHR adoption (table 4). Incentives for implementation or to exempt doctors from confidentiality responsibility were less likely cited as facilitators.

The following improvements for the electronic-record system (table 5) for those hospitals with basic EHR are focused on adding new data sources (48%) and digitalization of paper files (30%). For hospitals with an exhaustive EHR, the following steps are focused on adding new data sources (24%), digitalisation of paper files (28%), incorporate data analysis and performance indicators (24%) and to reduce the paper files delivery (20%). In addition, we asked their opinion about the impact of the economic crisis. The responses were different among hospitals with an exhaustive EHR from others with a basic EHR. In the former case, the economic crisis affected less as most decisions had been taken and most of the investment was already made (44%). On the other hand, in the latter, 56.5% of the respondents mentioned that the economic crisis reduced the investment in the EHR projects drastically or even paralysed them.

Discussion

According to our results, 39.1% of the surveyed hospitals had an exhaustive electronic-record system and in 32.8% of the cases it was basic. In addition, we found that 28.1% of the hospitals did not have an electronic-record system according to our parameters, but almost all of these hospitals had some electronic functionalities, especially for clinical documents, including hospital discharge reports, and electronic order entries.

If we analyse the prevalence of the different types of clinical documentation functionalities, it is significant that 34% of respondents have physicians' notes in all the clinical units. In terms of nursing assessments, the total percentage is slightly higher (43.6%), and an additional 7.8% of the hospitals have the intention to initiate this functionality soon. Jha et al. (2009) stated that nursing assessments and physicians' notes are the fundamental functionalities that determine an electronic-record system. In 2009, this author found that U.S. hospitals had 27% of electronic physicians' notes in at least one or all units and 57% had nursing assessments. Despite it being only three years of difference between the two studies, the change in the implementation level for U.S. hospitals could be significant, according to the amount of investment in this country. On the contrary, given the low investment in Information Technologies by the Spanish Government, only 1% of the healthcare budget (Ministry of Health and Social Policy & Red.es 2010), the numbers found in this study are surprisingly high. Other clinical documentation functionalities, usually easier to implement and previous to an EHR, such as electronic discharge reports and surgical reports are high, with rates of 75.4% and 46.9%, respectively.

In the group of radiology and laboratory results, it is significant that most of these electronic functionalities are highly implemented in all clinical units of the hospitals, similar to what Jha et al. found in USA hospitals in 2008 (Jha et al. 2009). He also found that diagnostic test images such as electrocardiographic tracing had a low implementation. Similarly, only 4.7% of the Spanish centres confirmed the availability of this tool in all units. The hospitals that cited having a digital radiology storage system had increased by 16% compared to the results published by the Spanish Ministry of Health in the year 2009 (Soria 2009).

In electronic order entry, functionalities such as medical orders and medications are the most prevalent, in 46.9% and 50% of cases, respectively, in all units of hospitalisation. In contrast, there are few centres that have digitalised the orders of the supply chain and few have the intention to invest in this functionality. It is a focus of concern for some managers to be too focused on the health field, leaving apart optimisation opportunities from logistic processes and their costs, supporting the health services. The improvement potential in the supply chain management can be an important point of cost savings without consequences in the health services field (McKone-Sweet et al. 2005). This saving capability is hampered if the demand order entry is not computerised, because it makes planning more difficult, which is a basic step in the supply chain management.

Conclusions

In conclusion, this is the first scientific study in Spain that analyses the level of EHR digitalisation in hospitals, and the main facilitators to its implementation. The number of hospitals that have EHR is high but a third of the hospitals still did not have EHR in 2011, although they had launched some EHR functionalities, particularly those related to clinical documentation. The three most cited facilitators were the possibility to hire technical support during the implementation and afterwards, security certification warranty and objective third-party evaluations of EHR products. Support tools in clinical decision-making and alerts are less prevalent; with the related drug alerts being the most implemented. ■

References available upon request, *lee@healthmanagement.org*

THE WHO SURGICAL SAFETY CHECKLIST

A MULTIFUNCTIONAL HOSPITAL RISK MANAGEMENT TOOL

Hospital risk management includes human factors and technical hazards as well as leadership, procedural, educational, financial and organisational issues. The World Health Organisation's Surgical Safety Checklist is a multifunctional risk management tool related to all these fields. The checklist reduces perioperative morbidity and mortality. However, its effectiveness depends on correct implementation and performance. Not only checking of important items, but also communication, teambuilding, leadership, education and organisation are important.

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The Surgical Safety Checklist

The WHO Surgical Safety Checklist is a checklist designed to reduce perioperative mortality and morbidity by avoiding errors and complications of surgery and anaesthesia. It consists of three parts, each containing roughly ten items concerning identity of patient and team members, anaesthetic and surgical procedures, pre-existing diseases, equipment and postoperative recommendations. These items have to be checked and communicated orally to all participating team members at three points in time during the procedure.

The first point is immediately before induction of anaesthesia (Sign In), the second immediately before incision (Time Out) and the third (Sign Out) immediately after suture. At these points in time the activity of all team members has to be interrupted to ensure that everybody is participating in communication.

The WHO checklist can be downloaded from the WHO website together with a guideline for implementation. Both correct and incorrect practical application of the WHO checklist are demonstrated on videos accessible via YouTube.

The effectiveness of the WHO checklist on morbidity and mortality was first shown by Haynes et al. in 2008. These results led to a worldwide recommendation to use the checklist during all surgical procedures issued by the WHO and a number of studies confirming its effect on outcome and safety culture. These studies have been reviewed recently. This article focuses on the general principles of risk management involved in correct application of the WHO checklist and their impact on implementation.

A Multifunctional Risk Management Tool

Human Factors

Risk management must take into account human factors, communication, equipment and processes as well as leadership, procedural, organisational, financial, and educational issues. Implementation and use of the WHO checklist is related to all these fields (Figure 1). Human factors have been recognised as primary sources of complications and critical incidences in medicine as well as in other critical environments in industry and transportation. Lack of knowledge and skills, errors, mistakes and mishaps are causes of false actions and thoughts resulting in adverse events. These individual errors can be reduced by checking important issues using the WHO checklist.

Communication

In addition to individual human errors, communication problems have been identified as a major cause of complications in medicine. Bad communication habits increase the risk of complications due to loss of important information. Hence, understanding and using the WHO checklist as a communication tool is essential for its effectiveness. This aspect is not always easy to realise in practice. Speaking up and repeating all important aspects loud and clearly to all team members is unfamiliar to many operating room staff members and sometimes regarded as redundant and too time- consuming. Using the checklist is often reduced to ticking all the boxes by one team member without communicating with others. Therefore training and supervising the application of the checklist in clinical practice are important parts of implementation. This is achieved, if one team member with sufficient authority supervises and corrects errors during the use of the checklist.

Equipment

Equipment problems and technical hazards are rare in comparison to human failure. However, they are regarded as more avoidable as the latter by defined interventions. Confirming functioning of technical devices and completeness of instruments are parts of the three points in time of the WHO checklist. Procedural standardisation is another important issue. Local written and standardised procedures referring to national or international guidelines are recommended to reduce perioperative risk. The WHO checklist is a standardised protocol and operating theatre workflow is facilitated by the clear communication structure provided.

Leadership

Leadership style also has a substantial impact on team performance, error rates and patient outcomes. Top-down attitudes combined with misconduct, intimidating or disruptive behaviour negatively affects the mood and wellbeing of co-workers. Moreover, it increases error rates and impairs patient outcomes in the operating room. Leadership in medicine is widely regarded as a soft skill that cannot be taught or influenced by systematic approaches. However, there is a lot of available literature on leadership and some basic principles can be learned quickly.

Good leaders have an equally high goal and people orientation, thus keeping a balance between the requirement of achieving a task and good interpersonal relationships. They prefer a flat hierarchy with short lines of communication. Performing the WHO checklist systematically enforces good leadership habits like contacting and informing all team members about what is planned and what background information is needed as well as providing time for remarks and questions without disturbing the procedure. ■

Useful Links

- WHO surgical safety checklist and implementation manual http://www.who.int/patientsafety/safesurgery/ss_checklist/en/index.html
- How to do the WHO safe surgery checklist [video]. www.youtube.com/watch?v=CsNpfMldtyk
- How not to do the WHO safe surgery checklist [video] www.youtube.com/watch?v=REyers2AAeI&feature=related
- WHO surgical safety checklist and implementation manual http://www.who.int/patientsafety/safesurgery/ss_checklist/en/index.html
- How to do the WHO safe surgery checklist [video]. www.youtube.com/watch?v=CsNpfMldtyk
- How not to do the WHO safe surgery checklist [video] www.youtube.com/watch?v=REyers2AAeI&feature=related

The complete article is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***
References are available on request from Lee Campbell, Managing Editor, HealthManagement, email: ***lee@healthmanagement.org***

THE RADIOLOGY DEPARTMENT AS PARTNER IN BRIDGING THE KNOWING-DOING GAP

HOW CAN LEADERSHIP ENCOURAGE RADIOLOGISTS, SECRETARIES, RADIOGRAPHERS, CLINICIANS, AND NURSES TO DEVELOP INNOVATIVE PATIENT PATHWAYS?

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In our institution the radiology department was thought to be very conservative, and an obstruction when implementing new research results and optimising patient pathways. Earlier approaches to solve the problem, relying on established hierarchical work methods, had not proved successful. Out of necessity and to solve the knowing-doing gap, leadership had to be redesigned and an innovative work approach had to be embedded in daily clinical work. In order to establish partnership between professions and departments, management and leadership had to be enacted in an 'unbossed' way creating an urge among staff to become involved in development processes. Based on this, and to reduce the knowing-doing gap, we developed a work method, called 'plastic organic group' (PO-group). The groups were named plastic organic groups to envision that the shape of the groups, ie the participants and the topic, can change over time. The only thing that cannot change is the focus on the general optimisation of the specific patient pathway. The work method includes elements from e.g. Clinical microsystems, Lean, and Breakthrough improvement.

The PO-group method was first applied when acknowledging a quality defect in the treatment of Transient Cerebral Ischaemic attack (TCI). Before the first meeting the quality measurements were only met in 70% of patients. In a few weeks they had changed and were met in 100%, and over one year the whole concept of treating and evaluating these patients had changed. This led to a remarkable reduction in length of stay, including reduced time used for diagnosis and for initiating treatment. Altogether this had a great impact on not only the department's but the hospital's economy.

Plastic Organic Groups as an Innovative Work Method

A PO-group is focused on redesigning a patient pathway. The staff members across hospital departments involved in the pathway in question are invited to participate, but are not appointed by management. Hence, participation does not require approval by a manager. The work method schedules short (15 minutes) weekly meetings with minutes but no agenda. It is an iterative method, focused on fast stepwise changes with a long-range goal with potentially changing endpoints. A meeting in a plastic organic group always takes place at the same time and in the same room to ease participation. The work method challenges the intuitive or preconscious reluctance to challenge routines, and over time minimises the opposition to changes in daily practice, which is a known barrier for implementing new knowledge. Implementing new ideas this way as trial actions is more acceptable, as they can be tried in practice, and, if not working, rolled back within a week, i.e. at the next meeting.

Another common obstacle to engaging staff in innovation and in developing new ideas is said to be the time taken from patient care. Rather than turning to the common solution of this problem; that the manager who is not involved in direct patient care redesigns the new patient pathways, a PO-group makes it possible for clinical staff to be engaged and involved directly in the change process. By reducing the meeting time, making minutes available for all involved and making the meeting point and hour known to everybody, it becomes possible for staff members to participate. It is important that everybody knows that although you are part of redesigning the pathway as such you may, if wished, only participate when your expertise is necessary for the next step. In this way, redesigning and rethinking pathways can be part of daily clinical practice integrated on equal terms with other duties such as X-ray examinations.

Leadership in Plastic Organic Groups

Working with PO-groups challenges the archetypal hierarchical management often seen in hospitals, and the negative impact of hierarchies and department boundaries is reduced. Leadership is of utmost importance to do this. On an overall level, leadership is required to create and enact a culture where focus is removed from today's survival to fundamental improvements, and where staff members have freedom to act. Furthermore, short decision-making processes are needed as well as a willingness to add a focus on quality to the common managerial focus on economy. Finally, a leadership signalling change and a strong belief in staff members' competences is mandatory.

PO-groups emphasise partnership, and hence leadership is also needed to establish a room for discussion where all staff members, though having different education, participate on the same ground with their specific professional insight. It requires that leadership both emphasises and acknowledges the value of each contributor.

In regard to the specific PO-groups leadership is needed to justify the group, to remove obstacles, to focus on progress and 'cut through' if necessary. At the same time, leadership is needed to ensure that the long-range goal is known, and that the quality of the redesigned patient pathway is high. It is also the managers' role to allocate resources, but in general it is essential for the manager to step back and not control the development process in the PO-groups.

Conclusion

Leadership is necessary to enable a culture where PO-groups as an approach can be nurtured, but also in regard to the working of the PO-groups. The work method is a way to integrate development

in daily clinical practice, thereby reducing some of the common obstacles to the implementation of new research. The method is robust and has been applied to several patient pathways (Cancer Occulta, Fast-track MRI heart, Deep-vein thrombosis, Open access to rheumatology, CT colonography, Electronic requests, Working climate), succeeding in reducing the knowing-doing gap. At the same time the work method has had the spillover of establishing the radiology department as a key player when optimising patient treatment. By becoming an initiator and a vehicle for change, the radiology department has obtained a unique opportunity to influence clinical handling of patients. ■

Key Points

- *Leadership has to be redesigned to overcome the knowing-doing gap and make changes happen fast and viably.*
- *Development of new patient pathways should be carried out by staff members taking part in the patient pathway.*
- *'Plastic organic groups' is a cross-disciplinary work method to integrate development in daily clinical practice and overcome common barriers.*

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INTERVENTIONAL RADIOLOGY AND RENAL DENERVATION

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Background

Hypertension is said to be the single largest contributor to death on the global platform. Estimates are around 1 billion for the world population (World Health Organization 2011). Approximately one third are treated and controlled, another third treated but uncontrolled and the final third remain untreated (see Figure 1). As a largely asymptomatic disease the 'sting in the tail' is the long-term damaging effect it has on many of the body systems, particularly the heart (heart attacks), the brain (strokes) and the kidneys (kidney failure). Two thirds of strokes and half of all heart attacks are caused by hypertension. There is a linear relationship between blood pressure and cardiovascular death so that with every 20mm increase in systolic pressure the 10-year risks double.

Although there have been huge steps forward in the pharmacological control of hypertension over the last 50 years, there are many obstacles not least patient compliance. We should not underestimate the challenges in persuading a patient with no symptoms to take lifelong medication (sometimes suffering side effects) with little if any short-term gain.

Resistant hypertension is a defined sub-group:

- BP consistently >160mm (>150 mm if diabetic);
- On at least 3 different medications;
- Treatable secondary causes (e.g. adrenal disease) excluded;
- Poor compliance addressed.

The prevalence of this subgroup in the hypertensive population is difficult to accurately quantify (a figure as high as 30% has been quoted) and a more reasonable estimate after specialist work up and investigation is more likely to be 5-10%. However, with as many as one third of the population suffering from hypertension this adds up to a substantial global healthcare problem.

Sympathetic Nervous System

The cause of hypertension remains largely elusive but for several decades we have known that the sympathetic nervous system appears to be in overdrive, coined by some a 'sympathetic storm'. This complex system of nerves provides a communication pathway between many parts of the body, including the brain, heart, kidney, blood vessels, skin and muscle, to name but a few. Nerves linking the brain and the kidney are of particular interest and over activity in these pathways leads to the retention of sodium and water, vasoconstriction and activation of several neuroendocrine systems. These all summate and have a potent adverse effect on blood pressure. Early work in the 1930s involved surgeons dividing these nerve pathways and this often resulted in a potent lowering of blood pressure. The price, however, was significant post-operative morbidity and mortality, and with the advent of ever increasingly potent medications the operation fell into disuse.

Catheter-Based Renal Denervation

With the development of radiofrequency (RF) energy probes for interrupting abnormal nerve pathways in the heart and treating malignant tumours an opportunity was grasped using the same technology to destroy the sympathetic nerves running to and from the kidneys. This entails a minimally invasive 'endovascular approach' far safer than the surgical attempts of the 1930s.

"a multidisciplinary approach to renal denervation is essential"

The procedure involves applying some form of energy (e.g. RF) to the inside wall of the renal artery thereby destroying the sympathetic

The Cardiovascular and Interventional Society of Europe (CIRSE) has recognised the importance of RDN to interventional radiology and set up a Task Force in 2013.

The Task Force is chaired by Prof. Jon Moss (Glasgow/UK), who was later joined by Jim Reekers (Amsterdam, NL), Dierk Vorwerk (Ingolstadt, DE), Anna Belli (St. Georges Hospital, UK), Mick Lee (Beaumont Hospital, IE) and Jan Peregrin (Charles University Clinic, CZ).

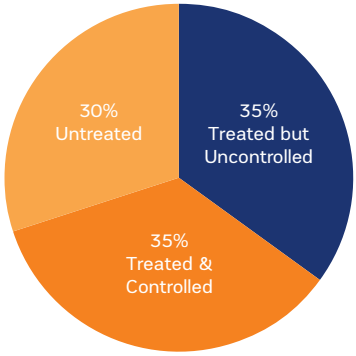

Figure 1.
The epidemiology of hypertension (Chobanian et al. 2003)

Reference: Chobanian et al. (2003) Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension, 42(6): 1206–52.

nerves that run on the outside of the vessel (see Figure 2). Both the afferent (running from the kidney) and the efferent (running to the kidney) nerves are targeted in a non-selective manner. The renal artery is accessed using standard endovascular catheters from the femoral artery. Both kidneys are treated and the procedure takes around 30-45 minutes. The procedure is carried out under local anaesthesia and conscious sedation, and many patients can be treated on a day case basis.

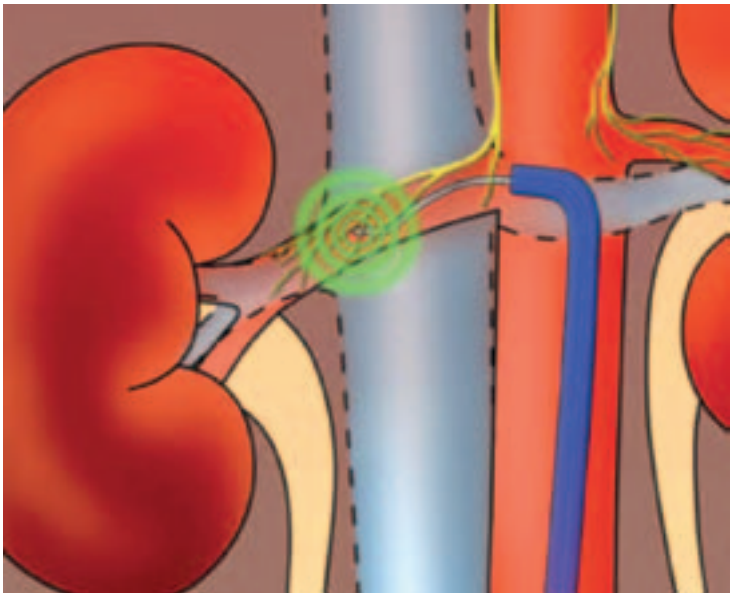

Figure 2.
Diagrammatic representation of renal denervation.
Image credit: Medtronic Inc. USA

The Renal Denervation Team

A multidisciplinary approach to renal denervation (RDN) is essential, and this reflects good practice and governance, to maximise patient safety and outcomes. The team should include, as an absolute minimum, a hypertension specialist and a vascular interventionalist. Careful patient selection is critical and other causes such as white coat hypertension, poor compliance and treatable secondary causes of hypertension should be excluded.

The interventionalist must be familiar with renal artery catheterisation and rescue procedures should complications arise, e.g. arterial dissection, occlusion and embolisation. Interventional radiologists are in a strong position to fulfil this role, and already undertake other renal artery interventions such as stenting and embolisation.

The Technology

A U.S. company (Ardian) launched the first commercial product (see Figure 2), and this device remains the global leader. With so much commercial interest at stake there has been an almost unprecedented explosion in activity from the device industry. To date there are six CE marked devices with about another 50 in various stage of development. Other forms of therapy such as high intensity focused ultrasound, drug-laden nanoparticles and local drug delivery are being researched. Much of this technology is running ahead of itself, and there is very little good evidence to support the newer devices at present, although that is rapidly changing.

Most of the CE marked devices need a suitable 'landing zone' of about 2cm within the renal artery with a minimum diameter of 4mm. This remains a significant issue for some patients with early arterial branching and multiple renal arteries which are often under 4mm diameter.

Evidence Base for RDN

Pioneering work led by Esler in Australia led to a trail blazing 'proof of principle' publication (Symplicity HTN-1) in the Lancet (Krum et al. 2009). This was followed by another landmark study from the same group, this time a randomised controlled trial (Symplicity HTN-2) (Symplicity HTN-2 Investigators et al. 2010). Both studies showed a convincing drop in office blood pressure in the region of 33mm Hg systolic and 11mm Hg diastolic at 6 months. In the randomised study there was no drop in BP in the control arm and the group difference was highly significant. These were small studies including fewer than 200 subjects and a third and larger trial Symplicity HTN-3 (600) is underway in the U.S.A, which includes a 'sham arm'. The evidence base for the other CE devices is less mature and with small numbers, but larger trials are in progress.

There is little long-term data with such a new technology, but 36 month results seem to demonstrate durability.

From a safety perspective there have been surprisingly few concerns. Anecdotal reports of arterial dissection and other vessel damage seem few and far between. Perhaps this is because the devices are only used when there is a normal renal artery free from atheromatous disease. Further confirmation of safety will require larger numbers followed longer term and the on-going national registries should address that concern.

Other Indications

Although the evidence base and national and international consensus statements only support the use of RDN for resistant hypertension there may be other indications. The involvement of the sympathetic nervous system in so many of the body's systems has encouraged physicians to explore new indications. Cardiac failure, diabetes mellitus, sleep apnoea, chronic kidney diseases, intractable ascites and polycystic ovarian syndrome are all currently being investigated.

The Future

RDN appears to have a solid and exciting future and we may only be on the first few pages of a very thick book. Some have likened it to angioplasty in importance to the interventional radiology community.

The ever hungry thirst for high quality evidence and cost-effectiveness at national and international level should keep RDN firmly on the rails. At a time of global financial uncertainty the pressure is on in many countries to offer clinically effective and cost effective medicine. RDN deserves to be on the medal podium. ■

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INTERVENTIONAL RADIOLOGY AND STROKE THERAPY

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Introduction

Until recently, the management of ischaemic stroke has largely been a passive process, centred on control of patient complications and rehabilitation of acquired deficits. However, recently there has been a refocusing of attention on more proactive stroke management, with interventional radiologists now often playing a central role within the stroke management pathway. Multiple therapeutic options are now available for managing acute ischaemic stroke. All of these therapies aim to achieve early recanalisation of occluded arteries leading to early vascular reperfusion of the ischaemic penumbra, the area of potentially salvageable brain tissue surrounding the permanently infarcted core. The currently available acute stroke therapies can be categorised according to the technique used to achieve reperfusion:

1. Intravenous thrombolysis (IVT)
2. Direct intra-arterial thrombolysis (IAT)
3. Intra-arterial mechanical thrombectomy

Due to their heavy reliance on image guidance, the latter two therapies are generally performed by interventional radiologists, and form the main focus of this paper. However, the role of the interventional radiologist cannot be taken in isolation from the stroke care pathway, which is of the utmost importance.

Pre-Intervention Stroke Care

The stroke care pathway begins at the moment of the first clinical signs of stroke. It is often quoted that in the setting of stroke that 'time is brain'; certainly if outcome is to be optimised a rapid recognition of symptoms and expedient transfer to an adequately equipped medical centre is essential. This allows not only emergency care to be administered, but also maximises the chance of successful interventional therapy. We need the right patient, in the right place, at the right time.

The key stages in acute emergency stroke care are:

- Early recognition of stroke symptoms by patients, members of the general public or their physician in the community. Health information strategies have been key in this area with the 'FAST' public education campaign leading to a 55% increase in stroke-related emergency calls in the UK, for example.
- Rapid transfer to a hospital with the necessary expertise for multidisciplinary stroke care.
- Timely non-invasive imaging of the brain. This may include:
  - Non-contrast brain imaging using CT or MRI;
  - CT or catheter-directed angiography;
  - CT/MRI perfusion/diffusion imaging;
  - Carotid Doppler.
- Multidisciplinary triage to improve selection of patients suitable for more aggressive interventional therapy. In the acute setting, deciding which patients should not proceed to interventional therapy is as important as deciding which patients should proceed, in order to minimise complications and optimise outcomes.
- Initiation of appropriate intervention, be it thrombolysis or thrombectomy, without delay in those patients suitable for this therapy.

Imaging in Acute Ischaemic Stroke

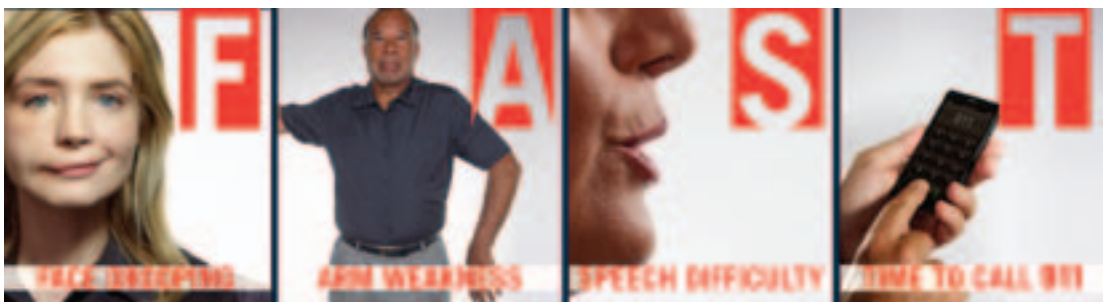
Imaging plays a central and active role in the management of ischaemic stroke. Non-contrast CT and MRI are still the mainstays of acute stroke imaging. Other modalities include non-invasive CT/MR angiography, CT/MR perfusion and MR diffusion, which can give an imaging phenotype to the presentation. Invasive digital subtraction angiography may be used both in a diagnostic or therapeutic fashion. There is no universal agreement on one imaging algorithm and most imaging triage and protocols are dependent on local resources of people and hardware. The goals of imaging are to:

1. Confirm the diagnostic suspicion of stroke;
2. Characterise the stroke event and its distribution;
3. Guide candidature for various therapeutic interventions.

Presence of haemorrhage, intravascular thrombus and the relative size of core and penumbra are key features. Some also comment on collateral circulation and arterial and venous dynamic flow patterns. Most groups agree on the role of angiography - computed tomography angiography (CTA), magnetic resonance angiography (MRA) or digital subtraction angiography (DSA), but the role of perfusion imaging has waxed and waned as groups explore its predictive value. Although the ischaemic penumbra can be defined objectively using CT or MRI perfusion studies, its biologic correlate and link to therapy and outcome remains elusive. Some interventionalists prefer to transfer the patient to the angiography suite immediately, performing cone-beam angiography and bypassing traditional non-invasive imaging. At our institution patients undergo non-contrast CT brain followed by dual-phase CTA.

Intra-arterial Thrombolysis (IAT)

Catheter-directed delivery of fibrinolytic drugs directly to the site of thrombus in the cerebral circulation intuitively seems like a good idea. Early studies focused on delivery of IAT agents into the larger proximal vessels, the carotids and vertebrals. These studies demonstrated



Further information

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high rates of recanalisation (75-80%) (Casto et al. 1992; del Zoppo et al. 1988), but with significant levels of haemorrhagic transformation (between 20-30%) (Fitt et al. 1993).

Microcatheter design allowed more distal access into the thrombus and beyond, with the randomised PROACT I and PROACT II trials demonstrating high recanalisation rates of 66% (compared to 18% in the control group) (del Zoppo et al. 1998; Furlan et al. 1999). In spite of a higher rate of early intracranial haemorrhage in the IAT group (10% vs. 2% in the control), outcomes were significantly improved at 90 days with a 15% benefit in functional independence. A trial of IA thrombolysis in thrombotic middle cerebral artery (MCA) strokes reported higher rates of favourable outcomes in the IAT group compared to the IVT group with better recanalisation of arteries occluded by large thrombi (Mattle et al. 2008). A recent meta-analysis comparing IAT to 'standard treatment' or IVT published earlier this year suggested only a modest benefit for IAT over standard treatment, but no clear benefit of IAT over IVT (Nam et al. 2013). Small case series still suggest that IAT is a reasonably safe treatment option in certain patients in whom IVT is contraindicated.

Many early studies were undertaken using urokinase via the IV route, and there has been some extrapolation of this data to newer thrombolytic agents and to delivery of these agents via the IA route. Currently the most commonly used thrombolytic agent is acteplase, tissue plasminogen activator (tPA) produced using recombinant DNA technology.

Although thrombolytic treatment with tPA is of proven benefit, this agent is far from ideal, with other thrombotic agents, such as Tenecteplase, demonstrating superiority in some studies. Many other novel agents are also under investigation. Desmoteplase is a plasminogen activator, derived from the saliva of vampire bats, which has shown high rates of reperfusion when given in IV form (70% compared to 19% placebo) and low rates of intracerebral haemorrhage. Further trials (DIAS-3 and DIAS-4) are ongoing, and desmoteplase may well be suitable for targeted IAT therapy.

Other newer agents include fibrinogen-depleting substances derived from snake venom (alfimeprase, ancrod), which have demonstrated mixed results when used IV, and may be more effective via IA delivery. Active plasmin delivered directly to the site of thrombus via catheter and microplasmin are also under investigation. Lysis may be administered in association with instrumentation, but there are no set protocols in this regard.

Current recommendations from the American heart and stroke associations (Jauch et al. 2013) state that:

- IAT is a valid treatment option in patients with major ischaemic MCA strokes of < 6 hours' duration who are not candidates for IVT or in large artery occlusion refractory to IVT;
- IAT should only be performed at an experienced stroke centre with access to suitable expertise.

It is noteworthy that fewer centres practise IAT with tPA and few perform IAT without thrombectomy, except perhaps in the posterior circulation where there are limited other options.

Mechanical Thrombectomy

The effectiveness of IAT for large clot burdens is questionable, and traditionally there was little beyond suction thrombectomy available to the interventionalist for clot retrieval. The last decade has seen the emergence of a series of devices designed specifically for intra-cranial clot retrieval.

The Merci clot retrieval system was the first system to obtain FDA approval in 2004, and helped generate interest in the area of clot retrieval. Memory-coiled nitonol loops delivered by microcatheter with balloon occlusion of the artery sought to remove the clot. The MERCI 1 trial showed recanalisation was achieved in 43% using the device alone and 64% using the Merci device with additional IAT (Gobin et al. 2004). The Multi Merci trial for a newer generation of Merci devices demonstrated a higher rate of recanalisation with newer devices, 57% with the device alone and 69% when used in conjunction with IAT (Smith et al. 2008). A recent review including over 1,200 patients treated with the Merci device concluded that it was a safe treatment modality for patients presenting with intracerebral large vessel occlusion within 8 hours of onset, though there is a lack of randomised clinical trials comparing the Merci system to IVT (Alshekhlee et al. 2012).

The Phenox clot retrieval system uses microfilaments to retrieve the clot. The most recent study assessed the device in a case series of 54 patients, and concluded that it was a safe and effective treatment option, with 54% recanalisation achieved with the Phenox alone and 72% recanalisation achieved when using the Phenox as part of a multimodal approach (Prothmann et al. 2012).

The Penumbra system adds vacuum to the process, and studies have shown that 81% arterial recanalisation was achieved with minimal adverse effects reported, with a good neurological outcome achieved in 57% (Clark et al. 2009). A recent meta-analysis of observational studies using the Penumbra system included over 400 patients, and demonstrated recanalisation rates of 86%,with average puncture to recanalisation time of 64 minutes (Almekhlafi et al. 2013).

Open stent design has been explored as a means to withdraw clot. Two examples include the Trevo and Solitaire. The TREVO 2 study demonstrated revascularisation rates of 86% and good clinical outcomes of 40% (Walcott et al. 2013). A recent review, published in 2013, analysed the cumulative human experience of the Trevo system, included 221 patients, and reported a revascularisation rate of 83% and a good outcome rate of 51% (Walcott et al. 2013). The SWIFT trial, a prospective, randomised, multicentre trial comparing the Solitaire device to the Merci clot retrieval system showed that significantly better revascularisation rates were achieved with the Solitaire device (61%) than the Merci device (24%), with corresponding 90-day good neurological outcome rates of 58% and 33% respectively (Saver et al. 2012). A recent publication of the North American Solitaire registry clinical outcome results included 354 patients compared favourably to the SWIFT trial with similar rates of recanalisation (83-87%) and a high 90-day good neurological outcome (Zaidat et al. 2013).

The experience in our jurisdiction would reflect AHA guidelines that favour stent-retrieval platforms over wire-loop systems. Though newer devices have improved the safety profile of thrombectomy, trial evidence has been challenged on methodological grounds. The ESCAPE trial seeks to directly measure the benefit of stent-retrieval versus best medical therapy (University of Calgary).

Many other experimental techniques are currently under investigation, all of which aim to achieve rapid recanalisation and reperfusion of the ischaemic penumbra in acute stroke. These include intracranial stenting, balloon pump technology, flow reversal strategies and ultrasound-accelerated thrombolysis.

Conclusion

The era of the pro-active management of stroke patients has arrived and is here to stay. As we progress, we learn how much we still do not know. There is currently no accurate imaging biomarker to determine which patients will benefit most from which intervention. Existing limits in thrombolytics and devices are being addressed with rapidly evolving translational and clinical research. These efforts are reflected in the rapidly changing patient algorithms. Imaging developments will help refine pathways for individualised care and help marry specific pharmacological-thrombectomy combinations to those who will benefit most with the least risk of adverse effects. Much done, much more to do and continued critical reflection on our processes will be key. ■

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FOCUS ON NUCLEAR MEDICINE

The European Association of Nuclear Medicine (EANM) recently held its annual congress in Lyon, France. HealthManagement caught up with EANM President, Professor Fred Verzijlbergen (FV), and Congress President 2013, Professor Dominique Le Guludec (DLG), to learn their thoughts on the congress, the role of the EANM and the direction of nuclear medicine.

What does the annual congress have to offer?

DLG: *The annual congress is the most important event each year for our community, because it's the only place where everybody meets. Everyone involved in the field of nuclear medicine – doctors, technologists, physicists, radiopharmacists, industry – all partners are there. There are plenty of sessions – scientific sessions, CME sessions, sessions for technologists, symposia and plenaries with very famous lecturers. There is also a big industry exhibition, and an opportunity to have fun. All CME sessions are online after the meeting, at http://eLearning.eanm.org/, so people who couldn't come can also enjoy them. That's important for our community.*

FV: *People come for the science. They want to learn about the newest ideas and innovations, but they also want to meet colleagues and to hear about their ideas on how to treat patients and how to perform diagnostic procedures. The focus is on education and innovation but also to an extent on meeting friends and having an enjoyable time together.*

What were the highlights of EANM 2013 for you?

DLG: *The increased number of abstracts submitted on PET. New tracers and radiopharmaceuticals are of huge importance, as is the use of bioimaging in the management of therapy in all fields, including oncology, cardiology and neurology.*

FV: *As President I don't get much time to hear the presentations, so my highlights were meeting colleagues and friends, not only from EANM but also from other countries – the U.S., India, Japan – and planning for the future in relation to education, training and research.*

More highlights of EANM 2013 in Lyon at http://www.flickr.com/photos/officialeanm/

This is the second time the congress has been in France, and the first time in Lyon. Please tell us about the state of nuclear medicine in France.

DLG: *Nuclear medicine in France is quite a big specialty. We have 217 nuclear medicine departments, 468 gamma cameras, one-third of them equipped with CT, over 115 PET-CT machines and 31 cyclotrons, including four cyclotrons only for research. There is extensive research on bioimaging in France, with more than 80 groups and over 1000 people involved. During the past 12 years more than 15,000 papers have been published in imaging journals, with a quarter on nuclear medicine. Progress in the field is being fostered by France Life Imaging (FLI), a project to establish a coordinated network of in vivo biomedical imaging research throughout France (see http://its.aviesan.fr).*

Why did EANM change its logo and add the slogan "biomedical imaging and therapy for personalized healthcare"?

FV: *It emphasises better what nuclear medicine is doing. Many people are unclear about the nature of nuclear medicine – they have fantasies about it and think terrible things – but the term "biomedical imaging" emphasises that we are imaging a biological process. We are able to visualise what is happening in the body in healthy people, but also in people who are ill. If we can image that, we can also follow the process and visualise what's happening during treatment. It gives us a lot of opportunities to really attract attention to the biological process in the body. This is very interesting because nowadays we are all focussing on personalised medicine in many ways, which means that we are trying to find medications and treatments which are dedicated to a specific situation for a person or a small number of patients with a particular disease. If you are able to focus on that, have the means to visualise that, then it makes you very strong.*

Please tell us more about the EANM.

FV: *The heart of the EANM is within training and education. We have a European School of Nuclear Medicine (ESNM) and organise training in Vienna, which includes all kinds of courses for physicians who want to be educated in nuclear medicine, together with radiation oncologists. In addition, we organise courses in Central and Eastern Europe. That is the main task of the EANM: to educate and train our young residents, as well as older medical specialists who want to improve in their work. We also have the scientific side of the EANM, with a lot of scientific committees working on different issues. Then there are organisational matters, including making ourselves visible to other organisations – that is more about the future.*

What barriers have you encountered inside and outside the EANM?

FV: *There are not so many barriers. There were issues in the last few years about collaboration with radiologists, and some authorities in Europe are not sufficiently aware of what nuclear medicine is doing, but beyond that there are no major obstacles. There are, however, some minor issues like radiation protection. We have to be very aware that we use a small amount of radiation and have to defend that. We have the knowledge and are able to demonstrate and defend what we are doing.*

What are the recent developments in the relationship between nuclear medicine and radiology?

FV: *We can collaborate with radiology. A younger generation is coming through which is more interested in education and cooperation, including finding the best ways of studying and imaging particular diseases. Things are definitely improving, and in the next few years there will be more collaboration.*

What will be the next task you have to cope with after the congress?

FV: *We need funding. The EU has granted more than €63 billion for research, and nuclear medicine needs a lot of money for research. We want to find partners for the research we want to perform – to find better radiopharmaceuticals and improve in the area of personalised medicine (see resEARch 4 Life http://earl.eanm.org). These partners could be from other clinical fields, for instance cardiology and oncology, but also from areas like radiation oncology and radiology. The choice of partner will vary depending on the issue we want to study.*

What are the challenges for nuclear medicine in Europe outside the EANM?

FV: *The most important one for me is making ourselves visible. The EU should know that if they discuss personalised medicine and biomedical imaging, they have to go to the EANM. It is not easy to ensure such visibility because most authorities are not aware of nuclear medicine, and we therefore have to go to the European committee, the Parliament, and find those bodies that are interested in this. This is a very important issue for next year.*

Interviewees

Prof. Dominique Le Guludec

EANM Congress President 2013

Prof. Dr. Fred Verzijlbergen

EANM President 2013-2014

What attracted you to nuclear medicine as a specialty?

DLG: *I used to be a cardiologist. I moved to nuclear medicine because I thought it was really innovative and had a lot of new ideas and tools for healthcare. Nuclear medicine represents biology in vivo. That's a tremendous field of improvement of healthcare. It has fulfilled all my expectations.*

FV: *I trained as a clinical doctor, in internal medicine. At the end of my training I started working in a department of nuclear medicine, for research. I added nuclear medicine training to my internal medicine training, and was able to work in a hospital where I could spend time as a specialist in internal medicine for one day a week and the rest of the time in nuclear medicine, as well as doing some scientific work. For me that was the ideal combination – see patients, do research and work in a laboratory facility. It's an absolutely fascinating and always thrilling combination. It's lived up to my expectations.*

How important is it for healthcare management to be more efficient in regards to nuclear medicine?

DLG: *Management is important in all fields of medicine. I am chief of a department and chief of a research group, so there's a lot of management of human and financial resources and management to ensure compliance with laws. We have a lot of rules in nuclear medicine in relation to radiation protection, the use of radiation, the role of radiopharmacy and so on. A large part of our work is management, so it's important to be efficient in the use of public resources.*

FV: *Nowadays, because of economic problems, resources for hospitals are decreasing everywhere in Europe. What you see is that doctors are performing diagnostic procedures in a more stringent way. They think twice before they ask the nuclear physician to perform the procedure. The result is that we perform fewer studies. In many situations that is good because we save money and limit radiation to the patient, but handling this situation is also a challenge for the hospital and the department of nuclear medicine. I think we are approaching a point where we are able to work very efficiently and save as much money as we can, while also improving the quality of procedures. That involves management at the hospital and the nuclear medicine department level. We have to spend a lot of time on that.* ■

For more information on the EANM and EANM 2014 in Gothenburg, Sweden, please visit http://www.eanm.org and https://www.facebook.com/officialEANM.

Watch the full interview at http://www.youtube.com/user/officialEANM.

For any questions, please contact: Agnes Falkner | EANM Project & Communications Manager | a.falkner@eanm.org

Interview

Prof. Dr. Udo Sechtem

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HealthManagement Editorial Board member

NEW EUROPEAN SOCIETY OF CARDIOLOGY (ESC) GUIDELINES ON THE MANAGEMENT OF STABLE CORONARY ARTERY DISEASE

As Director of Department of Cardiology and Pulmonology at Stuttgart's Robert-Bosch-Krankenhaus in Germany, Prof. Dr. Udo Sechtem is one of the Chairpersons of the Task Force that developed the 2013 ESC Guidelines. HealthManagement spoke to him about the role of medical imaging in the diagnosis of stable coronary artery disease (CAD).

Professor Sechtem, what motivated the ESC to revise the guidelines previously in effect?

The ESC has the policy to revise guidelines every 4-6 years. Hence, the 2006 guidelines were up for revision. Of course, the field has moved forward considerably in the meantime and a lot of new publications needed incorporating.

It appears that ECG should no longer be the initial test of choice in the diagnosis of CAD. How important are the advancements made in medical imaging technology for these recommendations?

It is in fact the ECG itself with its suboptimal test properties which induced us to limit the role of the ECG in the current guidelines. Nevertheless, the ECG is still a good technique as long as the pretest probability of patients with suspected stable CAD is below 65%. The low sensitivity of about 50% of the exercise stress ECG makes testing at higher pretest probabilities, however, not useful. This is because at such high pretest probabilities the number of false negative tests will become unacceptably high. In contrast, all imaging techniques have a better sensitivity and are hence better especially for patients at pretest probabilities between 65 and 85%. Above a pretest probability of 85% all testing will result in increasing numbers of false negatives which led us to recommending no additional testing in those patients (elderly males with typical angina) for the purpose of making the diagnosis of stable CAD.

The new guidelines place an unprecedented emphasis on local expertise available in each health centre. Will this not be of disadvantage to those not equipped with the latest imaging systems?

It is not necessary to have the "latest imaging systems". More important than the latest equipment is the local expertise which refers mainly to the interpretation skills of those performing the test. However, for coronary CTA a 64-line state-of-the-art CT is required.

The recommended revised diagnostic algorithm for diagnosing CAD is now relying on pretest probability. Why is this so significant?

Pretest probability has always had a role in choosing the right diagnostic tool. However, in the previous guideline of the ESC this role was not as explicitly defined as it is now. Pretest probability as outlined already above when discussing the exercise stress ECG is important for optimal use of health

resources. For instance, a young lady with atypical chest pain has such a low probability of stenosing CAD that performing any test will more likely result in a false (false positive) test result than when assuming that she has nostenosing CAD on the basis of a pretest probability being smaller than 15%.

How have these new guidelines been received in practice? Has the ESC collected any feedback from cardiologists who have already adopted them?

The process of adopting guidelines is a long one and a lot of educational effort is needed to popularise the guidelines. Until now we have had some educational sessions at the ESC Congress in Amsterdam and a Webinar has been broadcast and is now available online (http://www.escardio.org/education/eLearning/webinars/general- cardiology/recordings/Pages/patient-with-stable-angina.aspx).

Another Webinar will be broadcasted in December 2013 led by Professor Gilles Montalescot and it will focus on the therapeutic aspects of this guideline.

What are your predictions for the future with regards to medical imaging and disease diagnosis?

I am afraid that we physicians will lose our free choice of test frequencies and test modalities in the future. The expenses for medical imaging have risen so dramatically that some restrictions by authorities will likely apply to our future choices. ■

RADIOLOGY IN RUSSIA

What are the main professional challenges for a radiologist working in Russia today?

One of our major problems is infrastructure. While our government has bought a lot of equipment, we still need more. Very few hospitals are equipped with PACS and RIS, and these systems are from different vendors and usually they are isolated from each other. Very few people understand how to proceed further with them.

The number of radiologists is Russia is quite high, above 14,000 (just in public healthcare, not counting the ones in the private sector), and including nuclear medicine and ultrasound specialists it is about 27-29,000. However, even in big cities like Moscow there is a shortage of radiologists educated in high tech medical systems who can work effectively with MRI, PET-CT and so on. In part this is because of low salaries. I know it is a problem for many European countries, but it is acute for Russia too. Secondly, we have the old system of education for radiologists, from Soviet times, which was mostly working with classical x-ray. Now we have CT, MRI etc. in the curriculum, but the duration of training is not enough. Many teachers of radiology must be upgraded and motivated to do so, which again can be hard because of low salaries. I teach a lot, but most of us do it pro bono to improve things. This cannot work on a big scale and last forever. We need a programme to 'teach the teachers.'

Is demand for medical imaging increasing?

It is, because our surgical interventions are developing. In Russia surgeons do all kinds of oncological, cardiovascular procedures etc., so demand for imaging is going up and up. Also our healthcare administration recently announced (from my point of view a very good decision) they think we have too many hospital beds with comparatively underdeveloped outpatient centres. They want to improve outpatient services and do as many examinations and medical procedures in outpatients. We need more equipment and qualified radiologists for this.

Are waiting lists for imaging exams a challenge in Russia?

It is difficult to know the whole picture, but in Russia I never heard complaints about long waiting lists. In my department, which is quite large, the longest wait is 2-3 days. If there is a need for urgent exam we do it on the same day.

Are departments of radiology in Russia commonly audited and accredited for quality levels?

No they are not. However, we have state control on radiation exposure. We have special bodies, which control the work of radiological equipment, radiation exposure to patients and staff and carry out regular checkups about radiation exposure. We have a national law on radiation safety. Quality of medical care is a very poorly shaped field. In general the ministry of health does formally care about quality, but practically there are no measures for it. We provide annual reports to the ministry, but it's in numbers, how many procedures, of what kind. Sometimes we are asked about the number of our mistakes. Usually I believe they are a little bit diminished, so these are the tip of the iceberg.

Does the size of the country affect access to imaging services?

Yes, due to the difference in population density across the country. Russia has 89 regions, some of which are bigger than many European countries. There are very big discrepancies in quality of radiology services across Russia. In big cities you can find hi-tech equipment, including PACS, PET/CT etc., and in small cities still there is not enough hi-tech equipment and there are problems with staffing.

To what extent is teleradiology used in Russia? Is teleradiology regulated by specific national laws?

Due to the differing access to services, there is big demand for teleradiology. We are at the beginning of teleradiology. Just this year my hospital started a pilot project to provide a teleradiological service for the Russian Far East, for Vladivostock and cities and towns in the area. It does not mean we are taking jobs from them. We are helping them, showing them how it could be done, as a kind of outsourcing. The final part of the project is that each region should establish centres for teleradiological services in their own territories. In no way are we suggesting that Moscow will provide a service for the whole territory.

There are no official regulations on teleradiology, how it should be done. The Ministry of Health has plans to develop regulations.

Is outsourcing an issue in Russia?

Outsourcing is not a problem for public healthcare, as few people abroad can speak Russian. Patients can of course apply to a hospital or teleradiology company abroad for a private consultation. The only way for outsourcing, given the shortage of radiologists, is for top radiological centres to assist with clinical consultations in cases of difficult patients, provide training for future consultants in the field, and help regions to create their own teleradiological centres.

Are radiologists under threat from competitors?

So far it's not a big problem for my country. From time to time we face cardiologists, for example, saying that they want to do a cardiac MRI or CT, but according to our regulations, only radiologists can do these. For ultrasound every medical doctor can perform it, after proper training. For CT and MRI we are not facing competition, and I hope this stays for the coming years.

Interviewee

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What is the Russian approach to dose management and radiation exposure?

We have a national system of control of radiation exposure and we have a law that every medical record includes a table of the radiation dose the patient received. Our government has guidelines on how dose should be done, comparable with international guidelines. However, the major issue in Russia is knowledge of radiation exposure. Russian doctors are quite sensitive to their own exposure, but probably they should be more concerned about the patient's exposure. Still a lot should be done to promote dose according to ALARA (As Low as Reasonably Achievable) principles, in children and young adults, in particular. In our department, we were the first (in Russia) to perform low dose cardiac CTA. You can cut down exposure 4-5 times less and provide the same diagnostic information. It is a great step forward. This is a big issue for education, and with the involvement of industry, and our radiological community, we need to think not only about the right exam, but also about radiation exposure to patients. We can do more to decrease exposure even further.

Radiology Equipment	
X-ray units	36700
CT	1300
MRI	600
Angio units	410
SPECT	380
PET and PET/CT	21

Valid for system of medical centres in the frame of the Ministry of Health, as at April 2013

Please tell us about the Russian Association of Radiologists: what are its most important activities today?

The Russian Association of Radiologists (RAR) is our major national radiological society. We have also several subsocieties – on interventional radiology, cardiac radiology and so on. I feel our national society needs to be more active in education, professional CME and dealing with our Ministry of Health. All regulations and standards etc., which the ministry develops should be done with the involvement of professional organisations. Outside of Russia the European Society of Radiology (ESR) has nearly 1000 Russian members, which is a tremendous growth over the last few years. We cannot get all knowledge in our own country. Today radiology is international. I teach a lot of medical students, residents, fellows and I tell them to please learn English. You don't need to be perfect, but you should be good enough to understand scientific literature.

You are Chief of the Radiology Department at the Federal Centre of Medicine and Rehabilitation in Moscow. What are its activities today?

I came five years ago. It was a challenge, and I have reshaped it completely. Now I have a new team of mostly young motivated doctors who want to work better and be part of the international community. We are a teaching base for Moscow State University, the top educational institution in our country. We provide radiology electives, and medical students come to our department, I encourage them to attend international congresses, e.g. ECR provides free places to medical students.

We do approximately 5-7,000 radiological examinations per month (70,000 -80,000 a year). We do practically everything – breast, brain, spine, abdominal, cardiac, emergency, nuclear medicine, interventional procedures, you name it, we do it. Our young doctors should be more or less well trained in all these fields. Later on they can sub-specialise. When necessary we send doctors overseas for further training One has to be part of the international radiological community, to follow the best examples of our profession.

Your current roles include: President of the European Congress of Radiology 2014, President of the European Society of Cardiac Radiology and Board member of the Russian Association of Radiology. How do you balance these activities with your clinical/medical work?

It takes a lot of my time, but I like it. Each term of duty is good for one thing, and I approve that there is room for everybody, and you cannot hold the same position twice. I get the opportunity to use my invaluable experience from working in the framework of ESR and the European Society of Cardiac Radiology for the benefit of my department, my colleagues, students and residents and for Russian radiology. I spend as much time as I can in my department. I still do clinical work, write reports, consult on difficult clinical cases and I am involved in educational activities. We run a course in English for Russian-speaking radiologists (ESOR - European School of Radiology - from ESR) , which has faculty from Russia and overseas. This year we ran it for the 5th time, and we will continue this.

As I am President of ECR 2014, the congress will include the session "ECR meets Russia". More and more Russian radiologists are involved in the activities of ESR and its sub-societies. I hope it will be a lot of help to the further development of Russian radiology, and bring us closer to the best U.S. and international standards.

You are active in social media, running a blog and tweeting. Why do you think radiologists should get involved in social media?

Radiologists who are going to be part of international radiology should be involved. It's the best way to get up-to-date. All the top information can be obtained only from the internet - from blogs, Facebook, Twitter, including the ones run by the European Society of Radiology. These are all excellent tools to communicate with our friends in the front-line of radiology, and be the first to get news from publications, journals and congresses. I cannot be at all of the international congresses, and social media gives me the opportunity to get highlights. I am very happy that all top journals, including your journal, use social media, send out highlights, tables of contents, and provide e-learning, internet editions and special portals. ■

Statistics

Total population	143,000,000
As percentage of total population:*	
Urban	74
Rural	26
Gross national income per capita (PPP international $)	20,560
Life expectancy at birth m/f (years)	63/75
Probability of dying under five (per 1 000 live births)	10
Probability of dying between 15 and 60 years m/f (per 1 000 population)	351/131
Population decrease % (2011)*	-0.9
Total expenditure on health per capita (Intl $, 2011)	1,316
Total expenditure on health as % of GDP (2011)	6.2
No. of physicians per 10 000 population (2010)*	50.1
No. of hospitals (000s) (2010)*	6.3
No. of hospital beds per 10 0000 population (2010)*	94
Number of medical institutions rendering out-patient services (000s) (2010)*	15.7

Figures are for 2009 unless indicated. Sources: World Health Organization Global Health Observatory, *Russian Federation Federal State Statistics Service

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RADIOLOGY IN SOUTH KOREA

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Healthcare in South Korea

The Ministry for Health, Welfare and Family Affairs (MIHWFA) is responsible for the health of the population, and has a supervisory role in health insurance policy. Universal medical coverage is achieved through a mandated National Health Insurance programme introduced in 1977 and extended to the entire population by 1989. The National Health Insurance Corporation (NHIC), a public non-profit organization, is the single insurer. The NHIC is responsible for providing healthcare benefits to the population, collecting contributions and reimbursing providers on a fee-for-service basis.

The Health Insurance Review and Assessment Service (HIRA) reviews the cost of healthcare benefits and evaluates the reasonableness of healthcare services provided by medical institutions.

Only authorised healthcare professionals can provide health services. The majority of the financing is covered by the social insurance payments, government sources. About 21% are non-covered services, for which patients pay in full, mostly medical imaging fees, including ultrasound and partially for MRI. Most medical examinations and diagnostic procedures have predetermined fees, which consist of the patient share and the national share, with the patient share usually less ıan the national share. Most medical fees ıd surgical costs are affordable and, in some rcumstances, the fees are limited according ı the disease category. Most radiology exam-ations and procedures are covered by the ational Health Insurance Program.

South Korea relies heavily on private ector providers, with approximately 90% hospital beds being private. Most private ıedical facilities are located in urban areas, here 90% of physicians are and 80% of the ɔpulation lives. Severe regional disparities ..ist in medical services.

Primary care services are provided through clinics, hospitals and general hospitals. Patients can choose their medical provider and visit primary and secondary hospitals without a referral. Patients must have referrals from primary and secondary hospitals or a primary care physician to be treated at tertiary hospitals. When patients are referred to tertiary medical institutions, hospital selection is unlimited, and there is practically no delay in scheduling a medical examination when a patient transfers from the primary or secondary healthcare institution to the tertiary healthcare institution.

Oriental medicine is another main component of healthcare in Korea. Some oriental medicine doctors use imaging tools including US, CT and MRI, which is becoming a problem for radiologists in Korea.

Medical Imaging

When patients visit the doctor, the orders for imaging examination are given out by the physicians. The performance of and billing for the imaging examination is traditionally carried out within the radiology department. Although performance and interpretation of imaging can be done by any registered physician, if the formal report is signed by a radiologist, an extra 10% fee is reimbursed. Therefore most of the CT and MRI interpretations are done by radiologists. However, for plain radiographs and ultrasound, non-radiologists are involved to a large extent. The fee for ultrasound is not covered by the mandatory National Health Insurance system, therefore the fee is not regulated by the government, and the fee is relatively expensive compared with other imaging modalities. A very competitive turf battle is going on for ultrasound in Korea between radiologists and non-radiologists, and even with technologists.

Approximately 70% of radiologists work at training hospitals such as university or general hospitals, and the proportion of private radiology practitioners is low, approximately 13% in 2007.

There are several public hospitals, consisting of less than 10% of all hospitals in Korea, governed by different ministries including the Ministry of Health & Welfare, Ministry of Education and Human Resources, Ministry of Government Administration and Home Affairs and local governments with attending radiologists.

Due to the shortage of radiologists in Korea, teleradiology has become widespread and commercially available since 2008. Unlike other countries where teleradiology mainly covers after-hours work, teleradiology in Korea is mainly used in general hospitals with a small number of radiologists in order to get reimbursement for the imaging studies already done. It is also used in instances when special studies are performed but subspecialty radiologists are not available in certain university hospitals. It is not widely used in the emergency radiology setting yet. Some teleradiology services also provide radiologists to do ultrasound. There is growing concern over the spread of teleradiologists within the radiology profession in Korea, because some of the hospitals prefer to save money by outsourcing radiology departments and not hiring radiologists.

The Korean Society of Radiology

The Korean Society of Radiology (KSR) was founded in 1945, and the first meeting was held in Seoul in the same year. The KSR has been awarded as the 'best medical society in Korea' for three years in a row by the Korean Academy of Medical Sciences. Approximately 3700 members are registered, including over 3000 specialists and around 600 residents.

The KSR is headed by a President (Tae-Hwan Lim), Board of Councillors and Board of Directors. The KSR committees are for planning, scientific, Board examination, training, information & communication, international liaison, clinical practice guidelines, ethics, health policy and practice, health insurance, medicolegal affairs, public communication, accreditation, radiation safety and editor-in-chief.

Subspecialty groups in the KSR started as small group meetings during the 1980s, and expanded to include 10 subspecialty societies:

- Korean Society of Neuro radiology and Head and Neck Radiology (www.ksnhnr.org),
- Korean Society of Thoracic Radiology

Source: World Health Organization Global Health Observatory http://apps.who.int/gho/data/view.main

Statistics

Total population	49,003,000
Gross national income per capita (PPP international $)	30,370
Life expectancy at birth m/f (years)	77/84
Total expenditure on health per capita (Intl $, 2011)	2,181
Total expenditure on health as % of GDP (2011)	7.2

MRI units per million population	23.5
CT scanners per million population	37.1
MRI exams per thousand population	19.6
CT exams per thousand population	129.3

Source: OECD Health Data 2013 http://stats.oecd.org/Index.aspx?DataSetCode=HEALTH_REAC

(kstr.radiology.or.kr)
- Korean Society of Abdominal Radiology (ksar.radiology.or.kr)
- Korean Society of Pediatric Radiology (kspr.radiology.or.kr)
- Korean Society of Urogenital Radiology (ksur.radiology.or.kr)
- Korean Society of Interventional Radiology (intervention.or.kr)
- Korean Society of Breast Imaging (ksbi.radiology.or.kr)
- Korean Society of Cardiovascular Imaging (kosci.co.kr)
- Korean Society of Musculoskeletal Radiology (ksms.co.kr)
- Korean Society of Interventional Neuroradiology (www.ksin.or.kr).

Each society holds monthly meetings to discuss interesting cases, twice-yearly imaging conferences for residents, and an annual academic convention and symposium. The Korean Society of Thoracic Radiology operates a weekly quiz site (kstr.radiology.or.kr/weekly/index2.php) open to radiologists and other physicians in Korea and internationally. There are currently approximately 30 participating countries, making this one of the world's more frequently accessed thoracic radiology sites.

The KSR holds an annual Congress of Radiology (KCR) in Seoul each October (www.kcr4u.org). KCR is the one of the biggest congresses in Asia, with more than 3,500 participants from around the world, invited guests of world renown and a large technical exhibition.

The Korean Spring Symposium of Radiology is held annually, and focuses on more practical matters concerning quality and safety in radiology, including guidelines, radiologic safety, legal aspects, clinical research methodology course, hybrid imaging, and policy making.

The KSR publishes two official journals. The Journal of the Korean Society of Radiology is a peer-reviewed monthly journal in Korean, with English abstracts (1964- http://koreamed.org/JournalVolume.php?id=16). The Korean Journal of Radiology (KJR) (2000-, http://www.kjronline.org) is a peer-reviewed bimonthly journal in English, which aims to produce and provide knowledge on radiologic imaging and related sciences. Both journals are equipped with online submission and peer review systems. A unique feature of the articles in the journal is their reflection of global trends in radiology combined with an East-Asian perspective. World-outstanding radiologists from many countries serve on the editorial board. The KJR is indexed/tracked/covered by MEDLINE, PubMed, PubMed Central, Science Citation Index Expanded (Impact Factor in 2012: 1.555), KoreaMed, Synapse, KoMCI, SCOPUS, Embase and Google Scholar.

Online learning materials for continuing education are available on the KSR website, including 1000 online lectures, 303 educative cases and self-assessment modules.

International Outreach

KSR has a Speakers Exchange programme for KCR to fortify its status as an international congress. Awarded posters selected during the KCR are exchanged with other society's awarded posters at the annual congress.

Recently the KSR has devoted time and efforts to increase communication with other Asian Radiological Societies. With help from subspecialty and hosting societies, KSR has held Friendship symposia with many Asian radiologic societies with speakers from both societies, including Indonesia in 2012 and Thailand, India and Taiwan in 2013.

KSR actively collaborates with other societies to synergistically enhance the journals of the two societies. Activities range from advertising journals to counterpart society members, mutual exchange of advertisements about counterpart scientific programmes, exchange of reviewers and introducing excellent papers from the counterpart.

KSR provides an international membership programme with free membership dues. International members have free access to the Korean Journal of Radiology (KJR) KSR website and the KSR E-learning system. International members get a discount on the KCR registration fee and prior consideration in KSR fellowship.

The Society officially invites candidates from Asian countries to apply for the KSR Fellowship programme to promote research by specialists in radiology, to train them in Korean academic institutions and to contribute to the distribution and improvement of radiology, encouraging mutual understanding as well as scientific cooperation.

Presentations given internationally by members of the KRS have increased (192 scientific presentations at the 2007 annual meeting of the Radiological Society of North America (RSNA), the fourth largest number among all presenting countries), and Korean publications in the major international academic journals also continue to grow. For example, in the AJR, Korea is ranked as the third country in the number of articles submitted. In addition, there are increased efforts by Korea to host international academic meetings. Through these activities, efforts to improve the international awareness of KRS members and to promote international collaboration are continually being made

Quality Management

Image quality control has become an important issue, due to the increase in the various types of imaging instruments during the past several years. For that reason the Korean Institute for Accreditation of Medical Imaging (KIAMI) was established in 2004 under the Ministry of Health and Welfare to assure image quality management for mammography, CT, and MRI. In addition, practice guidelines and technical standards have been announced by each subspecialty to acquire images that meet established levels of quality. The image quality management has expanded to other modalities including ultrasound, PET CT, fluoroscopy, C-arm etc. this year.

Women Radiologists

The increase in the number of women radiologists corresponds to the continuing social changes in Korean society and to the overall changes in the medical community. Although women physicians formerly composed 20% of the general medical population, the current proportion of women undergraduate students in Korean medical colleges is as high as one third. In the case of radiologists, the proportion of women doctors is higher compared with other subspecialties, and since 2005 newly certified women radiologists in Korea outnumbered newly certified male radiologists. Therefore, the future role of women physicians is expected to increase in importance. ■

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The complete article is on our website at: ***http://healthmanagement.org/c/imaging/issue/volume-13-issue-3-2013***

CIRSE 2013

ANOTHER TRIUMPH FOR THE WORLD'S LARGEST CONGRESS ON INTERVENTIONAL RADIOLOGY!

Attracting a record-breaking 6,594 delegates from 94 countries, CIRSE 2013, held in Barcelona, Spain from September 14-18, upheld the congress' reputation for being the world's most comprehensive interventional radiology (IR) event.

To ensure coverage of all aspects of this diverse specialty, the scientific programme was organised around six key themes – Vascular Interventions, Non-Vascular Interventions, Interventional Oncology, Neurointerventions, Transcatheter Embolization and IR Management. Two of the many congress highlights were the Hot Topic Symposia, in which experts joined together to debate Intra-arterial stroke management – should this be an IR procedure? and Treatment of lung cancer – the choices, and how to make them. CIRSE 2013 also premiered two new session formats – the Evidence Forums, focusing on topics such as below-the-knee (BTK) and superficial femoral artery (SFA) interventions, and the popular new Amazing Interventions session.

This year's prestigious Andreas Gruentzig Lecture was delivered by Andrew Holden on the exciting topic of EVAR for AAA – evolution or revolution? while Mario Bezzi was this year's Josef Roesch Lecturer, addressing the important topic of High-intensity focused ultrasound: an IR tool for the future?

Statistics from the Congress

- 6,594 participants from 94 countries
- 8,500m² of technical exhibition, learning centre and meeting space
- over 100 exhibitors
- 250 hours of sessions and workshops
- 1,368 submitted abstracts
- 35 industry symposia
- 11 learning centres
- 39 hands-on workshops
- over 500 live stream viewers

Leaders in Endovascular Interventions

Through its dedicated vascular track, with sessions ranging from the Andreas Gruentzig Honorary Lecture to Evidence Forums and Hands-on Workshops, CIRSE 2013 reinforced the Annual Meeting's reputation as Europe's premier endovascular congress. One of the key topics in the vascular track was renal denervation, which was examined in dedicated Special Sessions, Hands-on Workshops and 'Principles to practice' simulator sessions, as well as a collaborative session with the European Society of Hypertension (ESH) in CIRSE meets ESH: An introduction to hypertension for interventional radiologists.

Leading companies in image-guided minimally invasive medicine showcased their latest products and devices in the technical exhibition.

A record-breaking 6,594 delegates from 94 countries gathered at CIRSE 2013 to learn about the advances in the discipline. (left)

Amazing Interventions featured presentations on some of interventional radiology's most unusual cases. (right)

Streaming to the Masses

Last year, a Live Stream of some of the congress' top sessions was introduced on ESIRonline (www.esir.org), and CIRSE 2013 built on this success by expanding the Live Stream to encompass sessions from four lecture rooms. This further branching out into a virtual format was much appreciated, with over 500 users logging in to watch sessions. ESIRonline users will soon be able to revisit top sessions from the Congress by logging in online.

A Hub for Industry

As the leading IR congress, the CIRSE Annual Meeting continues to attract a large industry presence. At CIRSE 2013, medical researchers and representatives from more than 100 companies gathered to demonstrate medical breakthroughs and showcase cutting-edge technology within an impressive 8,500m² of exhibition, learning centre and meeting space.

InspIRing the Future

Students are the interventional radiologists of the future and a dedicated Student Programme was a key feature at CIRSE 2013. Over 300 students were provided with complimentary registration and lunch for each day of the congress, as well as a travel and accommodation grant to the first 200 registrants from outside Barcelona. A number of sessions were particularly recommended to students and several dedicated Student Sessions took place, which introduced them to core concepts and techniques in IR. Each session had an interactive element, with question-and-answer sessions and Hands-on Experiences, in which students could use simulators and even treat a virtual patient.

Smaller discussions and hands-on workshops are a vital part of the educational programme at CIRSE meetings. (above)

Over 300 medical students were introduced to the fascinating specialty.

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Including:
- How to lead
- Building a culture of excellence

IN FOCUS

- Medical Device Approval

COMPASS

- Cyprus

CONGRESS LIST

December 2013

December 1-3
ICI Innovation Awards,
Tel-Aviv, Israel
www.icimeeting.com

December 1-6
RSNA, Chicago, U.S
www.rsna.org

December 11-14
EuroEcho-Imaging
Istanbul, Turkey
www.escardio.org

January 2014

January 9-13
SCCM,
San Francisco, U.S
www.sccm.org

January 27-30
Arab Health,
Dubai, UAE
www.arabhealthonline.com

February

February 23-27
HIMSS, Orlando,
Florida, U.S
www.himssconference.org

March

March 6-10
ECR, Vienna, Austria
www.myesr.org

March 8-10
EuroPRevent
Amsterdam, the Netherlands
www.escardio.org

March 10-13
ECCMID, Barcelona, Spain
www.eccmid.org

March 18-21
ISICEM , Brussels, Belgium
www.intensive.org

March 26-28
EAHP, Barcelona, Spain
www.eahp.eu

April

April 2-4
WoHIT/E-Health Week,
Nice, France
www.worldofhealthit.org

April 10-12
II International Congress on Health and Tourism,
Albufeira, Portugal
www.aptsbe.com

April 23-26
ECIO, Berlin, Germany
www.ecio.org

May

May 6-8
CONHIT, Berlin, Germany
www.conhit.de

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