

I M A G I N G

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Application of the Balanced Scorecard in Radiology

Cost Optimisation in PET/CT Scanning

Recommendations on Contrast Enhanced Ultrasound (CEUS)
in Non-Hepatic Applications

Managing Risk in Complex Healthcare Organisations



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Designing the Imaging Service

Dear readers,

Our cover story this issue is on building the imaging service. Prof. Alan Dilani sets the scene by looking at the influence of design and architecture on health. He sheds light on research into the factors in the physical environment that can promote health, well-being and increase productivity and profitability. Anil Shastri then considers the factors involved in designing an imaging department. After this look at the big picture, Alexander Gutu writes about setting up a private imaging centre in Moldova, which involved many challenges in the task of providing up-to-date diagnostic methods in this small agricultural country.

In some countries, the challenge is to fight for resources to update existing equipment. Ashley Shaw and Glenn Pascoe demonstrate that a risk register can be used to show that purchasing up-to-date radiology equipment can alleviate risk, if the risk is graded high.

Contrast-enhanced ultrasound (CEUS) is the topic of a comprehensive overview of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB)'s recommendations on CEUS in non hepatic applications by Drs. Gallotti, Calliada, Terzi and Prof. Piscaglia.

The recent Management in Radiology Annual Scientific Meeting, which took place in Milan, Italy, addressed the challenges of integrating management techniques into a busy working life. The future of radiology and radiologists was also a hot topic. This edition includes a review of this meeting, which goes from strength to strength.

In our regular Technology Horizons feature, Kaavya Karunanithi looks at the dynamic CT market, which is the second largest diagnostic medical imaging market and highly price sensitive.

There are a wealth of techniques used in industry which can be applied in a medical environment. For example, the cost-effectiveness of a radiology department can be analysed by using the Balanced Scorecard to optimise workflow. Dr. Martin Maurer explains how this method can be used to improve a radiology department.


PET/CT scanning offers higher quality examinations compared to traditional methods. However, it is rather cost-intensive. Dr. Giesel looks at one way of improving the cost-effectiveness of this modality by focusing on the marginal costs of FDG (fluorodeoxyglucose).

We continue our focus on different countries by looking at radiology in Japan.

The future of radiology and radiologists is a perennial topic of discussion. It was therefore fitting that 2012 saw the first International Day of Radiology. Events took place around the world to demonstrate the value and progress in radiology.

I welcome your comments and submissions. You can contact me via email at im-ed@healthmanagement.org

Sincerely,




Prof. Lluís Donoso Bach

Editor-in-Chief
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Designing the Imaging Service

This issue, we look at design of the imaging service, including a comprehensive summary of research into the influence of design and architecture on health, consideration of safety factors and specific case studies. The recently updated European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) recommendations on contrast enhanced ultrasound (CEUS) in non-hepatic applications are the subject of a comprehensive overview. The cost-effectiveness of PET/CT scanning is addressed by focusing on the marginal costs of FDG. Other papers consider the use of the Balanced Scorecard in radiology and using a risk register to manage risk.



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ASSOCIATION NEWS

MIR Winter Course



Seefeld in Austria is the venue for the MIR Winter Course, 10-12 January 2013. The course is an interactive and informative programme which aims to build a practical skill set. The course will be led by professional healthcare trainers from "Inspire Change". Each delegate will leave with new insights and practical solutions they can implement immediately.

Course Programme**Advanced Influencing Skills**

This workshop explores how to successfully influence and persuade individuals and groups.

Conflict Resolution

This workshop helps people understand how conflict arises and the driving forces behind our need to win. To enable us to understand how we respond to criticism and challenges in the workplace we will use a simple psychological model known as Transactional Analysis.

Situational Leadership

This workshop explains the key ways to develop your team. Most people who manage teams assume that one good technique will work for all their people. This is not the case and the workshop will develop your skills so that you understand the three most important factors: Identity, Adapt and Partner for Performance.

Motivating your team

What can you do when your team has run out of energy or motivation? This workshop will give an insight into team roles and how the wrong mix can be disastrous. As leaders you will learn how to get the most out of your teams in this time of increasing pressure, stress and change in healthcare.

Writing an effective business case

Many people find writing an effective business case a challenge. This workshop will help you to assess your strategic direction and approach and will give you the basic structure of a new business plan to develop. It will teach you how to construct an effective business case so that you can apply for funds, resources or new people.

How to improve a dysfunctional team

Sometimes we inherit or have suffered a team that is underperforming or performs well but some of the personalities in the team cause great difficulties. This workshop explores strategies for creating a high performing, motivated and functional team.

More information and registration details are on the MIR website: www.mir-online.org

Successful Interventional Radiology Congress

Lisbon, Portugal played host in September to the world's largest and most comprehensive congress on interventional radiology (IR). The CIRSE Annual Congress and Postgraduate Course (CIRSE 2012) was attended by over 6,000 delegates from more than 80 countries – and its innovative and inspirational atmosphere made it a truly unmissable event.

CIRSE 2012 provided over 250 hours worth of state-of-the-art workshops, lectures and debates based around seven main themes - Vascular Interventions, Transcatheter Embolisation, Interventional Oncology, Neuro Interventions, Non-Vascular Interventions, IR Management and Imaging. Select sessions were also streamed live via the internet for the first time.

A wide range of sessions dedicated to neurointerventions were offered. The acute stroke treatment session examined the latest evi-

dence for mechanical thrombectomy and stenting, and the exciting data on new devices such as stent retrievers. Valuable advice on the avoidance and management of complications was also given, as well as tips on how to optimise imaging and diagnosis. Stroke prevention: where do we stand in 2012? examined the preventative role IR can play, with updates on advances in imaging and medical management. A clear indication of patients who may benefit from IR was given, as well as detailed discussion of both carotid and intracranial stenting techniques and outcomes.

As IR has moved from the realm of imaging and palliation towards curative treatments, a thorough understanding of clinical management has become essential. CIRSE catered for this with a number of dedicated sessions. Medico-legal issues and IR featured expert advice on the legal implications of off-label device usage and obtaining informed consent, how to effectively minimise complications and how to best deal with any lawsuits that may arise.

Clinical management of the diabetic foot featured recognised diabetic foot experts, who discussed the impact of the disease and the value of screening, as well as assessment, diagnostic work-up, multidisciplinary collaboration and revascularisation options.

CIRSE also provided dedicated sessions to impart the latest data. Imaging after ablation: what you need to know examined how to best follow-up cancer patients after thermal, radio- and chemoembolisation in the liver, lung and kidney. Vascular imaging discussed the pros and cons of a range of imaging modalities for specific vascular diseases, as well as presenting experimental data on innovative algorithms, such as dynamic CT/CTA for popliteal artery entrapment syndrome.

As in past years, CIRSE 2012 attracted a large industry presence. Cutting-edge devices and equipment were showcased in the well-visited exhibition hall.

The arguably greatest achievement of the congress each year lies in its ability to inspire the experienced interventional radiologist and the novice alike. A special student programme



MANAGEMENT IN RADIOLOGY

Winter Course

January 10–12, 2013, Seefeld/AT

Inspiring Healthcare Leaders

The MIR Winter Course is an interactive and informative programme with its aim to build a practical skill set over a three day period. Each delegate will leave with new insights and practical solutions to implement immediately.

Explore the following key topics

- Advanced Influencing Skills
- Conflict Resolution
- Situational Leadership
- Motivating your team
- Writing an effective business case
- How to improve a dysfunctional team

Ask the expert

In addition, there will be the opportunity for "Ask the Expert" workshops. Delegates will have 1:1 support on confidential areas of their work with the focus to help individuals to uncover issues that exist in their department and to identify suggestions to move things forward.

Tickets are limited. Early registration is recommended.

For further information and registration visit our website www.mir-online.org or contact us: office@mir-online.org

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was held during CIRSE 2012 alongside the advanced sessions giving undergraduate students from across Europe insights into the innovative medical field. The well-received programme was an important investment in the future of the discipline and provided students with complimentary registration and travel and accommodation grants.

Further updates are available on the association's website: www.cirse.org

ECIO Congress



The fourth European Conference on Interventional Oncology takes place in Budapest, Hungary, 19-22 June 2013.

CIRSE is supporting attendance with the ECIO Incentive Programme. This allows radiologists with a full registration for ECIO 2013 in Budapest to invite their referring physician to the conference for free. The first 100 referring physicians signed up will receive free registration and up to €1,000 travel support.

For more information, please refer to www.ecio.org.

IHE



Turkey hosts the European 2013 Connectathon, 15 – 19 April 2013. It is appropriate

that the connectivity marathon is to be held in the city of Istanbul which connects Europe and Asia.

The IHE Connectathon is a five day event whose main purpose is testing the interoperability and connectivity of healthcare IT systems. This traditional event draws participation from across Europe, with more than 90 companies and 300 engineers participating. Also scheduled are a number of parallel events, with daily roundtables and seminars on specific healthcare topics.

The major goal of the Connectathon is to promote the adoption in commercially available healthcare IT systems of the standards-based interoperability solutions defined by IHE. The Connectathon serves as an industry-wide testing event where participants can test their implementations with those of other vendors.

For more information on Connectathon 2013, please visit www.cat2013.org

2013 CARS Congress



The Computer Assisted Radiology and Surgery (CARS) congress is the yearly event for scientists, engineers and physicians to present and discuss the key innovations that shape modern medicine on a worldwide basis.

The CARS Congress Organizing Committee invites you to come to Heidelberg from 26 - 29 June 2013, for an extraordinary event in which scientific/medical presentations as well as stimulating discussions will foster new visions on the future of medicine.

At CARS you will have the opportunity to meet scholars and practising experts in the fields of radiology, surgery, engineering, informatics and healthcare management who have an interest in topics, such as:

- Image- and model-guided interventions;
- Advanced medical imaging;
- Image processing and visualisation;
- Computer aided diagnosis;
- Medical simulation and e-learning;
- Surgical navigation and robotics;
- Model-guided medicine, and
- Personalised medicine.

For more information please visit www.cars-int.org

COCIR



COCIR has recently released three documents:

1. A position paper articulating COCIR views on the General Data Protection Regulation;
2. A detailed contribution providing more insight and concrete examples on healthcare;
3. Suggestions for amendments to the draft Regulation being currently discussed at European Parliament and European Council levels

In addition, COCIR joined the Industry Coalition on General Data Protection Regulation and co-signed the Statement 'Reforming Europe's Privacy Framework - How to find the right balance'.

COCIR continues active discussions with the European Institutions in order to bring attention on potential consequences of the General Data Protection Regulation on the Healthcare sector.

COCIR's main recommendations to improve the General Data Protection Regulation are:

1. Clarify definitions (Art. 4): The use of anonymised, pseudonymised or key-coded data by the healthcare and research sectors

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should be facilitated by the Regulation. Article 4 should recognise that data which cannot identify the data subject (e.g. anonymised data); data which are not directly associated to the data subject (e.g. technical data) or data which require unreasonable time and effort to identify the data subject (e.g. pseudonymised data) are not personal data and are not subject to the Regulation.

2. Maintain clear and separate responsibilities between the healthcare provider and the medical technology provider, as per the

current regime (Art. 28- 33- 34- 77).

The relationship between the healthcare provider and the medical technology provider should be managed by contract, not by law.

3. Reduce administrative burden (Art. 26): In an environment where outsourcing is part of the business mode and care delivery, seeking approval of the healthcare provider before enlisting other medical technology providers generates administrative burden on both sides, without bringing benefits to privacy.

Allow processing of data concerning health

by medical technology manufacturers for maintenance and equipment performance evaluation purposes (Art. 81 - 83): Professionals employed by medical technology manufacturers (technicians, engineers, medical professionals), should be able to access data concerning health for technical maintenance and equipment performance evaluation.

For more information please visit

www.cocir.org

FIRST INTERNATIONAL DAY OF RADIOLOGY



INTERNATIONAL DAY OF RADIOLOGY

AN INITIATIVE OF THE ESR, ACR AND RSNA

The first International Day of Radiology (IDoR) on 8 November 2012 included events and publicity around the world to highlight awareness of medical imaging and the role of radiologists.

The International Day of Radiology initiative was established to highlight the contribution of radiology to safe patient care as well as improving understanding of the vital part which radiologists play in healthcare. The day was organised by the European Society of Radiology (ESR), American College of Radiology and the Radiological Society of North America (RSNA).

The date commemorates the anniversary of the discovery of the existence of X-rays by Wilhelm Conrad Röntgen in 1895.

"We want to celebrate the birthday of our specialty, by showing the world who we are, how well prepared we are, and what we can and are

willing to do for the benefit of our patients," said Professor Lorenzo Derchi, ESR Communication and External Affairs Committee chairman.

The organisers aimed to raise awareness of the essential role the radiologist plays as part of the healthcare team in countless medical scenarios, as well as the high educational and professional standards required of all staff working in medical imaging.

"We want to improve the professional image of the radiologist and the expert behind modern equipment. We want to underline the fact that there are smart people behind the smart machines we are using. Technological advances are important, but more important are the dedication and professionalism of the radiologists who use them," Prof. Derchi said.

"Medical imaging saves lives, resources and time.

Imaging exams generally cost less than the invasive surgeries that they replace and can be used to diagnose illnesses early — when they can be treated most effectively and inexpensively. In fact, the beneficial impact of medical imaging exams on extending patients' life expectancy is actually greater than the negative impact of obesity or diabetes. November 8 is International Day of Radiology, but radiology and radiologists make a world of difference every day," said George S. Bisset III, M.D., president of the Radiological Society of North America.

Oncologic imaging was chosen as the main theme of the day, to reflect the important role that radiology plays in all stages of cancer management, from early detection and prevention, to treatment monitoring. A booklet on oncologic imaging was produced especially for IDoR 2012.

Involvement was encouraged across social media, with sites set up on Facebook, Instagram and a Twitter hashtag so that supporters could join in.

Radiology organisations on all continents participated, including the Asian Oceanian Society of Radiology (AOSR), the Colegio Interamericano de Radiología (CIR), the Royal Australian and New Zealand College of Radiologists (RANZCR), and the Radiological Society of South Africa (RSSA — which also represents neighbouring countries) as well as the International Society of Radiology. The European Federation of Radiographer Societies (EFRS) also supported IDoR 2012. ■

Cardiovascular and Interventional Radiological Society of Europe

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Fourth European Conference
on Interventional Oncology

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CIRSE

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THE INFLUENCE OF DESIGN AND ARCHITECTURE ON HEALTH

Adapting the Environment to Meet Patient and Healthcare Staff Needs



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Architecture and design have been influenced by industrial societies for decades. As a result, public buildings such as hospitals have often been designed to function and look like factories. Clinical practice in hospitals focuses mainly on treating illness while often neglecting a patient's psychological, social and spiritual needs. Environmental qualities that could be considered as psychosocially supportive have not been developed fully.

Salutogenic Design

Psychosocially supportive design stimulates and engages people, both mentally and socially, and supports an individual's sense of control. The basic function of psychosocially supportive design is to start a mental process by attracting human attention, which may reduce anxiety and promote positive psychological emotions. Health processes could be strengthened and promoted by implementing design that is salutogenic, i.e., that focuses on the factors that keep us well, rather than those that make us unwell.

There is a wealth of research to suggest that the quality of the built environment has a significant impact on our health and wellbeing

The aim of salutogenic design is to create environments that stimulate the mind in order to create pleasure, creativity, satisfaction and enjoyment. There is an important relationship between an individual's health and the characteristics of the physical environment.

The holistic viewpoint emphasises multiple dimensions of health, including the physical, psychological, emotional, spiritual and social (Nordenfelt 1991). From a research perspective, health can be divided into path-

ogenic and salutogenic starting points.

Pathogenic research focuses on explaining why certain aetiological factors cause disease and how they are developed in the physiological organism (Antonovsky 1979). The primary aim of pathogenic research is often to find medical treatments (Antonovsky op. cit.).

Salutogenic research is based on identifying wellness factors that maintain and promote health. (Antonovsky 1991). Together, the salutogenic and the pathogenic approach offer a deeper knowledge and understanding of health and disease (Antonovsky 1991). To answer the salutogenic question – what is causing and maintaining healthy people? – Antonovsky (1991) developed the concept of a sense of coherence (SOC). A person with a high sense of coherence chooses the most appropriate coping strategy in a stressful situation. For example, the person may decide to fight, flee or be quiet depending on what kind of stressor the individual is exposed to. Research has shown that it is possible to measure a person's sense of coherence and thereby predict an individual's health (Suominen et al. 2001).

The concept of sense of coherence has three vital components: comprehensibility, manageability and meaningfulness (Antonovsky 1991). A person with a strong sense of coherence scores high on all three components.

According to Antonovsky (1991), the term comprehensibility implies that the individual perceives the surrounding environment and what is happening in the world as coherent. If something unexpected is happening, such as an accident or personal failure, the person who understands why they are happening has a higher sense of coherence than one who cannot. A person with a low sense of coherence perceives himself as unlucky.

Manageability means that people have all the required resources necessary to cope with a given challenge or demand, feel that they are influencing what is happening around them and do not perceive themselves as victims of circumstance.

Meaningfulness is the component that motivates a person's sense of coherence. Antonovsky (1991) believes that a person's sense of meaningfulness is connected to his or her perception that there are important and meaningful phenomena in life.

The Built Environment, Health and Wellbeing

There is an interaction between human health and the built environment. The physical environment is not only vital for good health, but can be a critical stressor for the individual (Dilani 2006). Physical elements in an organisation can contribute to stress, and are therefore essential factors for increasing comfort (Dilani 2001).

Most people in the western world spend the majority of their time in indoor environments. There is a lack of knowledge about how these environments affect health and wellbeing. There is a general belief that humans are always adapting to the environment (Dilani 2001). This theory of adaptation indicates that people become less conscious of the environment the longer they reside or work in that given environment (Carnvale 1992). A general belief is that if one lets oneself be affected by the physical surroundings then it is a sign of weakness.

In order to create supportive physical environments it is crucial to understand an individual's fundamental needs (Heerwagen et al. 1995). It is also necessary for different professional disciplines to willingly cooperate in creating the best conditions for humans (Heerwagen et al. 1995; Lawrence 2002).

Before a zoo is built, it is common practice for architects, designers, biologists, landscape architects, animal psychologists and building specialists to collaborate in creating an environment that optimises living conditions for the animals (Heerwagen et al. 1995). Factors such as materials, vegetation and lighting are taken into consideration. Animals need enough space to eat, sleep and decide when to be social or seek solitude, and even their need for control and choice has been noticed. The aim is to create an environment that will support the animal's physical, psychological and social wellbeing. Iron-

ically, humans do not seem to make the same demands when a workplace is going to be designed.

Heerwagen et al. (1995), created a framework and guidelines for salutogenic design, which highlighted the following factors:

1. Social cohesion with formal and informal meeting points;
2. Personal control for regulating lighting, daylight, sound, temperature, and access to private rooms;
3. Restoration and relaxation with quiet rooms, soft lighting, access to nature and a good view.

In the nineteenth century Florence Nightingale developed a theory of healthcare, which emphasised that physical elements such as noise, lighting and daylight are vital for an individual's health and mood (SHSTF 1989).

In 1972 Levi founded the stress theory, which was later developed by Kagan and Levi (1975). The model describes how the physical environment is the foundation on which society's organisation, structure and function is built and, in the long run, is critical to the promotion of health or disease (Dilani 2001). The model is based on a system that points to a deeper understanding between the physical environment and different human components (Kalimo 2005). The model is used in the field of architecture to integrate design elements with health and wellbeing.

Nature and its Meaning for Health

Most people have a relationship to nature and many people greatly value diverse natural environments. What is it that makes people feel at ease in nature? Does the natural environment affect people in different ways? Is

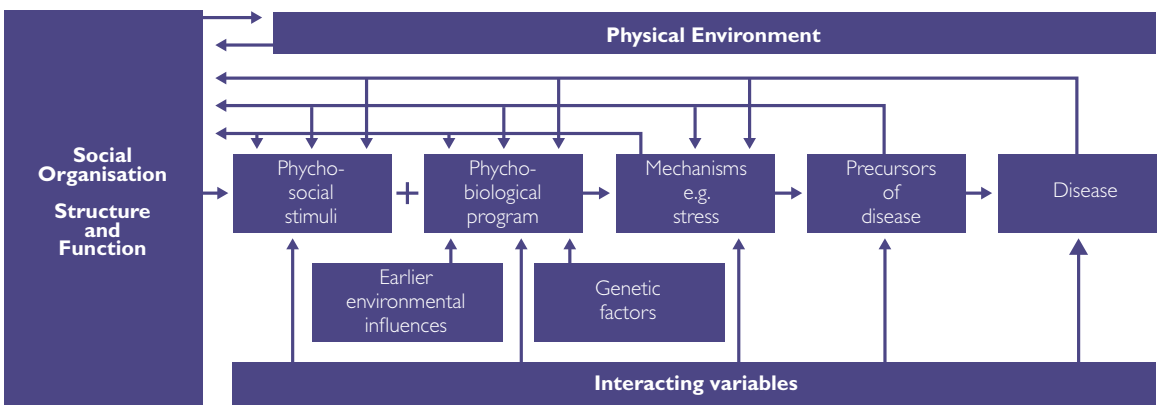


Figure 1
Theory Model for Psychosocially Mediated Disease
(Source: L. Levi, 1972)

it possible to draw any general conclusions about nature's influence on the human being?

The restorative environment should be inviting and well balanced with an aesthetic beauty that allows people to reflect (Herzog et al. 2003). Nature offers various colours, forms and scents, which can encourage humans to forget about their everyday life (Kaplan & Kaplan 1989; Kaplan 1995; Herzog et al. 2003). Natural environments often offer an atmosphere where the individual's needs for harmony and compatibility are met. It is therefore very important that natural environments are accessible at the workplace.

The attention restoration theory (ART) has been tested and confirmed by different researchers (Herzog et al. 2003; Tennesen and Cimprich 1995). Herzog et al. showed that three of the four components: being away; extent; and compatibility, are seen as measurable indicators of how to create a restorative environment. Several studies have also confirmed that human beings perceive natural environments as more restorative than urban environments (Van den Berg et al. 2007). Therefore, when human beings are tired and mentally exhausted, nature is the appropriate place for restoration. Other studies have shown that viewing nature through a window has positive health outcomes (Moore 1981-1982; Ulrich 1984; Leather et al. 1998; Frumkin 2001).

The Influence of Light on Health

There is much research on daylight's positive effects on humans' psychological wellbeing (Evans 2003). A lack of daylight can lead to both physiological and psychological difficulties (Janssen & Laike 2006). A study at a correctional institution in Michigan showed that inmates who had their windows facing the prison yard visited the healthcare facility more often than inmates who had windows facing the forest and farming fields (Moore 1981-1982). Research has also shown that daylight in a classroom is necessary for the pupils to maintain a balanced hormone level (Küller and Lindsten 1992).

Windows can also have positive health outcomes on patients (Verderber 1986; Lawson 2001). For example, the window can contribute to improved health by allowing fresh air and daylight to enter, by providing a view and a link to the outer world, thus satisfying a patient's or prisoner's need for viewing the seasonal variations (Verderber 1986; Lawson 2001). Ulrich and Lundén (1984) showed that hospital patients staying in rooms with windows viewing nature were rehabilitated faster than patients who viewed a brick wall. An-

other study showed that exposure to direct sunlight via windows in a workplace increased the workers' wellbeing and had a positive impact on their attitudes and job satisfaction (Leather et al. 1998).

Rooms without a window can affect human health and wellbeing negatively (Janssen and Laike 2006; Küller and Lindsten 1992; Verderber 1986). One study showed that blue collar workers who worked in rooms without windows experienced more tension and were more negative towards their physical working conditions than workers who had offices with windows (Heerwagen and Orians 1986). Patients in rooms without windows can develop sensory deprivation and depressive reactions and exacerbate perception, cognition and attention (Verderber 1986).

Since daylight positively impacts human physiology, it should be considered rather than artificial daylight which claims to have the same affect. Some research has found that artificial daylight can positively affect peoples' cortisol levels and perhaps contribute to fewer sick days (Küller and Lindsten 1992). Lack and Wright (1993) showed that exposure to lighting at certain times during a 24-hour period can prolong sleep and improve the quality of sleep. Energy consumption and costs can decrease if the individual has the ability to control the lighting levels, which also has positive effects on environmental resources and an individual's general satisfaction (Moore et al. 2004). Küller (2002) suggests that lighting will become more important in the future, especially since it is becoming more common to construct buildings without windows or access to daylight.

Art, Healing and Wellbeing

According to art historians, humans live today in a more aesthetic world, where art, fashion and design offer countless aesthetic experiences (Leder et al. 2004). When a person observes and appreciates different visual scenes, such as a piece of art, complex cognitive and emotional processes arise (Keith 2001). In order to understand the meaning of a painting it is important to understand its different parts before it is possible to understand the whole. During the observation of a painting and in the process of understanding it, a person can for example experience joy, participation, discomfort or interest. These emotional and cognitive responses are called aesthetic experiences, and often lead to positive, satisfying and rewarding experiences for the viewer (Leder et al. 2004).

Art therapy (music, dance, painting and drama ther-

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apy) has a unique potential to reach patients with psychosomatic diseases, who are otherwise difficult to reach with traditional therapeutic methods (Theorell and Konarski 1998). For example, Argyle (2003) showed how a group of people, identified as being in the risk zone for mental disease, participated in different art projects and improved their social and mental wellbeing. The participants testified that the project had strengthened their self-esteem and given them a sense of belonging to a social group. Gardner (1994) also maintains that participation in different art processes can give the individual the tools to express feelings and experiences in a nonverbal way.

The Physical Environment and Productivity

When an organisation's management wants to increase productivity they often focus on employee competence and personal motivation rather than the physical environment and design (Heerwagen et al. 1995). Increased knowledge and consciousness about the relationship between improved health and increased profitability would affect how designers, architects and managers design, build and maintain buildings (Fisk 2000).

For example, an improved indoor climate can improve employee health, decrease the amount of sick days, reduce healthcare needs and increase productivity, which in turn strengthens the human capital and leads to higher company profitability. Ergonomic improvement for employees has also been proven to increase a company's profitability (Fisk 2000).

For example, IBM invested \$186,000 in ergonomic education and implemented extended ergonomic changes, whereby they changed the design of the workplace and various working tools (Helander and Burris 1995). The improvements contributed to better working positions, improved lighting, lower noise levels and better support with heavy work routines. The project decreased sick days by 19 percent, which generated an annual profit of \$68,000. In addition, the changes contributed to higher productivity and improved quality, which led to an annual profit of \$7,400,000. In other words, investments and changes within the physical environment led to profits through an increase in health conditions and productivity (Helander and Burris 1995).

Conclusion

Research has shown that the salutogenic perspective forms a theoretical framework for psychosocial sup-

portive design, since it can stimulate, engage and improve an individual's sense of coherence and thereby strengthen their coping strategies and promote health. To implement psychosocially supportive design it is necessary that the whole organisation understands the meaning of a salutogenic perspective. Knowledge of which environmental factors contribute to health and wellbeing can thereafter be guidelines in making political decisions.

In the process of making decisions it is important to have an interdisciplinary perspective where different individuals with different backgrounds and knowledge work together in this field – such as psychologists, architects, landscape architects, doctors, behavioural scientists and health promoters. Fortunately it is becoming more common to use an interdisciplinary perspective as a central strategy (Barry 2007). For example, the Internet technology sector recruits sociologists, anthropologists and psychologists who can study and explain how a product will be used in different cultural contexts. The application of an interdisciplinary approach to work may challenge existing ways of thinking and may also make research and innovation more democratic and receptive to public input.

Decision makers should take the following factors into consideration during the process of building a hospital: good lighting; positive interior distractions; and access to daylight, nature, art, symbolic and spiritual objects. Other important factors to take into consideration are the individual's need for control over lighting, noise, indoor temperature and the possibility of choosing when to seek social interaction or solitude. It is also important to create attractive and inviting spaces that promote social interaction and social support as well as creating spaces for restoration and private conversations. In order to motivate people to change their lifestyle it is necessary to offer them activities that strengthen their self-esteem and self-efficacy.

In summary, this study has shed light on factors in the physical environment that can promote health, well-being and increase productivity and profitability. Secondly, we encourage decision makers to implement salutogenic design that in turn promotes health and wellbeing. ■

A full list of references is available on request to the Managing Editor Claire Pillar at im-ed@healthmanagement.org

» CONTINUES ON PAGE 16 WITH CASE STUDIES

Cadolto presents the operating room of the future as a cost-effective, rational prefabricated solution

Fully equipped hybrid operating room on display at Medica 2012



Hybrid operating room with Siemens Healthcare Artis zeego angiography system, Operating table, lights, DVEs and Maquet digital OR integration.

The hybrid operating room is the standard of the future, on that medical opinion is largely unanimous. While the combination of conventional operating equipment and angiography has long posed enormous challenges for hospitals in terms of design and construction, now is prefabrication being viewed as a solution: the prefabrication specialist Cadolto, based in Cadolzburg near Nuremberg, is exhibiting a full-equipped hybrid operating room core module at Medica 2012.

Room design challenge

The hybrid operating room is gaining ground everywhere. It is now no longer only cardiologists and heart surgeons who are enthusiastic at the prospect of performing minimally invasive, catheter-based and conventional operating procedures in one and the same operating room; this will sooner or later become the norm in the majority of surgical disciplines. When image-guided diagnostics make their way into the traditional operating

theatre environment, it is not simply a case of installing new equipment. Rather, the hybrid operating room revolutionises the whole layout and equipment of the room. For example, the angiography units require a different arrangement of the operating room staff around the patient. This means that the paths taken by staff, for example in the event of complications, must be carefully thought through. The ceiling mounted screens affect the air flows in the room and also hygiene management. More space is required for ancillary rooms and storerooms, and much more besides.

The first prefabricated solution

In other words: hybrid technology is completely redesigning the operating room. The complex issues which arise have hitherto always been dealt with on a case by case basis by interdisciplinary teams in lengthy, complicated processes. In future, hospitals will no longer necessarily have to shoulder this extremely costly burden for each project. A new room module developed by Cadolto for the first time translates the knowledge of hybrid operating room experts into a rational prefabricated concept. In close collaboration with Siemens Healthcare, Maquet, Trumpf and Philips, the global market leader in high-tech modular buildings has developed a room unit, unique in terms of complexity and design features. Conventional operating room technology, high-end imaging and workflow-oriented room and space management are combined in a hybrid solution that meets the highest current standards in cardiology, heart and vascular surgery, neuro-radiology and neurosurgery.

Hybrid operating room at Medica 2012. Hall 13, Stand A 10.

Cadolto will present its innovative development to the public at Medica 2012, to be held from 14 to 17 November in Düsseldorf. As in previous years, the company can be found at Stand A 10 in Hall 13, where it will have on display two hybrid operating room core modules with a floor area of around 100 m² and weighing over 50 tonnes. The key feature, however, is the "interior design benefit", as the room modules are fully equipped with all the medical facilities and fittings associated with a hybrid operating room - including a Siemens Healthcare Artis zeego angiography unit, Magnus OR table, OR lights, DVEs and Maquet digital OR integration. This will enable visitors to see for themselves the quality and possibilities afforded by a concept that provides a fully developed, cost-effective, compact solution for the operating room of the future.

Specialist in prefabrication in the factory

Cadolto has for many decades been operating on global scale as a leading specialist in the construction of complex, technically sophisticated, modular buildings. The company's key expertise lies in the high proportion of the building prefabricated in the factory. This enables the rapid completion of a turnkey construction project. The company's comprehensive design and consultancy service, factory prefabrication and rapid, cost-effective and high quality completion of construction projects give Cadolto customers the security of a professional partnership.

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know-how modular solution: prefabricated hybrid operating room

CASE STUDIES:

Innovation in Cancer Treatment and Design. Prof. Alan Dilani

Picture 2

Exterior view of lanterns to Radiation Therapy at night



Picture 3

Aerial view of North Western Ontario Regional Cancer Centre

Three skylight lanterns located above the radiation therapy waiting areas provide maximum daylight penetration. Natural elements such as running water; tropical fish and live foliage, serve to complement the quality of care. Places of quiet refuge draw on the warmth of fireplaces. These cosy home-like nooks bring something familiar and comforting from everyday life. Outside is Canada's first Cancer Survivor's Park

North Western Ontario Regional Cancer Centre – an Inspiring Place for Care and Research



Carlo Fidani Peel Regional Cancer and Ambulatory Care Centre

A new era of cancer care was unveiled in 2005 when the 400,000 sq. ft. Carlo Fidani Peel Regional Cancer and Ambulatory Care Centre opened at Credit Valley Hospital (CVH). The organisation was committed to their vision "to be the finest hospital in Canada in the hearts and minds of the people we serve." Transforming these words into reality required a deeply thoughtful response to the individual's physical, emotional and spiritual needs.

CVH's goal was to be an extraordinary place; no-one would be satisfied until the facility's look and feel matched their vision. The resulting design has won multiple international awards.

Sheltering tree-shaped forms combine with natural materials and daylight to give a spiritual dimension to the main lobby space and waiting areas outside the radiation therapy treatment rooms. A steel-columned rectilinear lobby would not provide the life-affirming sense of hope and animation that infuses the space. There is a powerful attraction to this design that draws patients, staff and visitors who gather to share their thoughts and talk through emotional issues. Its function goes far beyond the standard requirement for circulation and waiting areas.

This regional cancer centre provides radiation treatment using six linear machines. A specially designed entrance maze enables the elimination of the traditional heavy, shielded doors at the entrance to the therapy rooms, thus helping to humanise the patients' experience. This approach to design provides a more relaxed and accommodating space for the patient.

Thunder Bay Regional Health Sciences Centre (TBRHSC) serves as a referral centre to 13 community hospitals in north-western Ontario. It is an active teaching site for medical, radiation therapy, medical physics, nursing, pharmacy and oncology fellows. The 69,000 sq. ft. comprehensive Northwestern Ontario Regional Cancer Centre located here is the primary provider of cancer care services in the region.

The equipment sited here includes a linear accelerator and a dual function CT scanner. Ready access to diagnostic tests has allowed the cancer programme to move patients through the system with greater speed and efficiency.

Challenging accepted norms in healthcare design, this facility responds to the highly emotional reality of what happens here. Dramatic use of wood in a three-storey interior space flooded with natural light serves to acknowledge the spiritual dimension of human life. A welcoming glass arcade functions as a central circulation and gathering space that includes a lively café. Conceived as a path through a forest, the main corridor's timber structure is also rooted in the history and culture of the area. A "seasonal river" terrazzo floor pattern composed of fish and other natural forms flows through the space.

Thunder Bay is the first cancer centre in Canada to incorporate direct light skylights within the radiation treatment rooms to lift the spirits of patients and staff. It also is the first hospital in Canada to gain approval for the use of wood as a primary structural element.

Beyond the functional aspects of the project, TBRHSC affirms a belief in the value of designing for the body, the mind and also the spirit.



Picture 4

Sunlight penetrating radiation therapy room



Picture 5

Radiation Therapy waiting area skylights



Picture 6

Radiation Therapy maze entrance

SAFETY FACTORS IN PLANNING AND DESIGN OF THE IMAGING DEPARTMENT



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Safety may be defined as the condition of being safe from injury or loss. Safety in any field is a dynamic and continuous course of action involving hazard detection and correction.

Healthcare professionals need to keep abreast of technological advances, their limitations and risks by carefully examining the risks and finding the most effective workable solutions to manage them. In order to achieve this goal the 3A principle applies:

- Awareness of the problem;
- Analysis of the problem;
- Action plan with corrections.

Hospital safety encompasses human, machine and environmental elements. There should be a systems approach to understand the mechanisms contributing to accidents involving medical equipment. This approach will identify the causes and accordingly solutions to minimise subsequent accidents can be suggested. The imaging department must be designed with safety in mind.

“A dedicated engineering approach is required to ensure effective planning and design of the department”

Design of the Imaging Department

A dedicated engineering approach is required to ensure effective planning and design of the department, taking into account workflow, patient comfort, and prerequisites required for installation of the imaging equipment.

The location of the individual modality should be pre-planned. The room layout plan should indicate the electric supply points, data points, door dimensions for safe patient entry into the room, location of medical gases outlets, air conditioning with high efficiency particulate air (HEPA) filters and so on.

As far as possible the modalities giving ionizing radiation should be planned on one side of the imaging department and the non-ionizing type such as MRI and ultrasound on the other side to reduce radiation hazards.

For MRI installation special care should be taken in designing the RF cage. The surrounding area of this modality should not have installations of multi-parameter monitors or other sensitive devices whose performance is affected by magnetic field.

Since most of the modern imaging equipment designs are incorporating recent advanced electronic circuits, they should

be protected from dust, humidity and temperature variations. This can be achieved by air conditioning the installations.

Heavy floor mounted units such as CT scanners, catheterization laboratory, MRI, PET scanners, linear accelerators and so on require a weight-bearing floor with adequate foundation. The equipment should be mounted on a base plate only with desired mounting anchor fasteners as specified by the manufacturer of the equipment after the curing time for the foundations is over. Any shortcuts will result in vibrations of the unit during its operation and compression artifacts in image, resulting in poor image quality, repetition in diagnostic tests, leading to eventual reinstallation of the unit.

Prerequisites such as height clearances and provision of mechanical supports for preventing sags of the beams should be complete before bringing the unit to the room allotted to avoid damage of equipment due to environmental factors such as dust. Installing such equipment requires special skills and this task should be entrusted to the vendor.

In summary, the prerequisites for installation of imaging department equipment are:

- Electric power supply;
- Back-up power source such as a diesel generator or uninterrupted power supply;
- Proper earthing;
- Room layout with proper shielding/ wall thickness especially for ionising radiation equipment (see table 1);
- Weight-bearing capacity for floor mounted or ceiling mounted systems;
- Temperature and humidity control with proper location of air conditioning ducts;
- Adequate room lighting;
- Emergency off switch.

These aspects should be discussed in detail with the vendor and prepared before arrival of the equipment in hospital. In case of variations, appropriate corrective action should be taken well in advance before the equipment arrives in hospital. These prerequisites may vary from model to model from different vendors. Any shortcuts or omissions may prove to be very costly as well as hazardous.

For ionizing radiation equipment prior approval from the respective controlling authority as per ICRP regulations is mandatory. This involves approval of the room layout plan, wall thickness, door dimensions and shielding.



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Table I

Imaging Equipment Installation Prerequisites

Note:
Lead lining doors is not mandatory for Ultrasound & MRI examination room.

Modality	Room dimensions (LXWXH)	Wall thickness	Weight Bearing capacity	Door Dimensions (HXW) with 0.5 mm Lead shielding	Power requirements
X-Ray	4.5m x 4m x 2.8m	230 mm	1.2 T	2.1m x 1.1m	≥65 KVA
CATH LAB	6.5m x 6m x 2.8m	230 mm	≤3T	2.1m x 1.1m	≥100 KVA
CT	7.3m x 4.4m x 2.8m	305mm	≤3T	2.4m x 1.1m	≥100 KVA
Nuclear Medicine	40 sq.m floor area with height of 2.8m	As per equipment model	≤3T	2.4m x 1.1m	≥100 KVA
Mammography	3.7m x 3.7m x 2.8m	230 mm	≤0.3T	2.1m x 1.1m	10 KVA
Ultrasound	3.7m x 3.7m x 2.8m	230 mm	≤0.3T	2.1m x 1.1m	10 KVA
MRI -3 Tesla	40 sq.m floor area with height of 3.4m	230 mm	≥13T	2.1m x 1.1m	≥130 KVA

Electricity

Micro shock current results from leakage current, which passes from an equipment metal chassis to the ground. When it passes directly through the heart of a catheterized patient, it causes ventricular fibrillation and possible death. Steps to prevent accidents include providing equi-potential grounding to ensure that all conductive surfaces in the room are bonded together and to earth.

The earthing terminal should have proper marking, corrosion proof parts with a smooth finish and no burr of the equipment housing so that if by accident a live wire touches the housing chances of damage to insulation are eliminated and corona discharge can be avoided.

Flexible cables should be used to interconnect different modules with adequate insulation, properly bunched together and routed through a single opening in metal walls of housing with an insulated washer or enclosure

Live parts should be properly secured with desired spacing between the live electrical connection and enclosure so that they are not shifted from their desired position during transportation or vibrations.

For mobile C-Arm image intensifiers trolley wheels should be of conductive rubber material to ensure passage of any discharge to the ground.

Protection against voltage exceeding 40 Volts RMS during normal equipment working should be avoided by laying down conductors away from the chassis and by providing adequate insulation.

Metallic components which do not form part of the operating circuit of installation and equipment operating at rated voltage above 40 volts should be properly earthed if they are likely to come in contact as a result of faults or arcing with components at high voltage.

Leakage currents: This is important and especially in case of medical devices which are in contact with the skin of the patient. IEC 60601 specifies limits for leakage currents. Leakage currents increase with longer mains cord. Incorporating safety measures in designing equipment to prevailing standards (International Electrotechnical Commission - IEC 60601) will ensure electrical safety for patients and end users.

In general, care should be taken to avoid causes of electric shock such as careless use of electricity, faulty electric cords, appliances,

sockets, faulty designs, use of extension cords, poor grounding and lack of knowledge about applications and use of equipment.

Magnetic Field Safety

Magnetic field safety is applicable to MRI installations. Care should be taken to shield the magnet and procedure room from external magnetic interference; ensuring radiation levels specified are not exceeded.

The MRI equipment should not allow RF deposition on patients beyond specified limits. All specific precautions against magnetic radiations should be observed. For protection against fire, the tanks should be cooled with water jets.

Maintain the desired minimum clearances from the objects, such as water cooling systems, wheel chairs, carts, transformers, overhead power lines, vehicles including cars and trucks trains etc., as specified in the installation prerequisites supplied by the manufacturer to ensure trouble free performance of the magnet.

Radiation Protection

Non-ionizing radiation is a significant health hazard in hospitals; it includes ultraviolet, radio wave, infrared, and microwave and laser radiation. Since the eye is most susceptible to damage from these types of radiations due precautions should be taken during usage of such devices. This is of utmost importance while using laser or microwave devices.

Interlocks should be provided for protection against radiation in the event of removal of covers and shields of the unit.

An extensive radiation safety programme is essential to ensure that equipment meets acceptable performance and safety standards. It has been observed that a large percentage of accidents and incidents relating to these types of equipment are mechanical in nature and are not related to radiation injury.

X-Ray and Nuclear Medicine Equipment

Ionizing radiations produce biological effects and are harmful to human tissues

Protection measures

- Use radiation exposures only when necessary and justified;

- Keep maximum distance from source of radiation;
- Reduce exposure time to minimum required;
- Improve shielding with lead lined screens;
- Provide an emergency off switch;
- Ensure that all protective ground wires are connected properly;
- The connection between covers and protective ground wires must be made with screws and lock washers, thus eliminating possibility of all metallic covers which may develop a dangerous voltage in the different components of the equipment;
- Use image intensifier television chain with high power DC x-ray generators to reduce exposure to soft radiation;
- Follow ICRP recommendations for a system of dose limitation;
- The room layout plan should have approval from the regulatory authority.

Equipment offering high frequency has almost zero ripple factor which gives 60% higher radiation dose yield as compared to two pulse X-ray generator and low skin radiation dose, shorter exposure times leading to reduction in kinetic blurring and improvement in image quality. Additionally these type of generators are of smaller size and lower weight, microprocessor controlled with consistency in exposures even at variable mains input ideally suited for the modern imaging department.

Human factors

Risks associated with diagnostic medical equipment often relate to data inputs, manipulation and display. Risks are directly related to the quality and limitations of diagnostic data obtained by the equipment. To avoid these issues it is imperative that proper training programmes are planned by hospital authorities when new equipment with advanced technology is purchased so that technicians are well trained in advance.

Over the last century many accidents have been witnessed due to adopting short cuts in designing, manufacturing, transporting, installing and using equipment. For example, during transportation of a mobile x-ray unit from one ward to another, care should be taken to park the tube head at the lower end of the trolley for mechanical stability.

Many accidents have taken place when precautionary measures were not taken, resulting in injuries and damage to sensitive parts of the unit, thus incurring heavy expenditure. Failures such as the fall of the x-ray tube head due to breaking of wire ropes, or patient's fingers fractured when they were caught between the moving edges of x-ray table or injury to patient while undergoing x-ray examination when the cable hanger dropped and struck in the face were very common.

In order to overcome such a situation the following safety factors should be incorporated:

- The mechanical strength of wire ropes should have a safety factor of 6 (i.e. if a wire rope is carrying a weight of 1 Kg then it should not give way for load of 6 Kg)
- The mechanical installation should have a safety factor of 2 to 3;
- There should be no compromise in specifications for anchor fasteners etc. by providing lock nuts and/or spring washers which carry heavy assemblies. Lock nuts or spring washers ensure that assembly when mounted on a platform does not get disengaged due to vibrations. This is very important in case of mobile units, scanners using moving assemblies such as those in gantries etc.

Maintenance

This comprises the performance of non-functional repairs, component or assembly replacement, frequent cleaning and general servicing in order to prevent improper or inadequate operation. Maintenance helps to prevent failures due to malfunctioning of the equipment and extends the total life span of the equipment. For major equipment like CT, MRI or PET scanners calibration at regular intervals is necessary to maintain their throughput. Calibration is the assessment of equipment performance as mentioned in respective standards of that equipment.

Maintenance can be preventive or corrective. There is a subtle difference between the two. Preventive maintenance involves routine inspection and testing at regular intervals while corrective maintenance involves total calibration and replacement of defective parts. These measures can reduce hazards by uncovering early signs of degradation.

Following the functional testing of any equipment a sticker should be affixed to the equipment describing serial number, location of equipment, the date of maintenance, person involved and next date of maintenance. A separate ledger should be kept recording all the steps taken, parts replaced and duration of the process. This process will help to determine the economical viability of the equipment. A general rule is that when the depreciated value of the equipment is comparable to repair and maintenance costs, the equipment needs to be replaced. The overall life span of equipment is around seven years for electronically-based equipments.

Conclusion

When an imaging department is planned, recently developed products with their requirements must be taken into consideration. A technically upgraded, scientifically planned and designed department with due importance paid to safety aspects will guarantee effective medical care. ■

STARTING AN IMAGING SERVICE IN MOLDOVA



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The state of imaging in Moldova in the early 2000s can be illustrated by a personal anecdote. In summer 2003 a 55 year old woman was in a critical condition and needed urgent surgery. Before the operation she needed an MR investigation. Her son tried to book an appointment at the only magnetic resonance scanner in the country at this time, located in the state owned Republican Hospital. He was advised to wait for three months due to high demand or to pay in cash the double price unofficially, and get the exam the next day. Unfortunately the quality of the MR images was so low that the neurosurgeon requested another MR investigation - in this case in the Ukrainian city of Odessa 180 km away. Fortunately the surgery was successful. The woman in the story is my mother and I am now General Manager of the Centrul de Diagnostic German (CDG) in Chisinau, capital of the Republic of Moldova.

Background

The lack of imaging equipment and professionals, huge queues and corruption illustrates the reality for Moldovan citizens and patients before 2009, when CDG opened.

The main imaging equipment was usually old and poorly maintained, and concentrated in public hospitals (see Table 3). In 2007 there was a single MR machine and eight CT machines in Moldova. Private imaging practice in Moldova usually meant a small office equipped with ultrasound operated by the doctor. The doctor was the owner and the manager at the same time and was assisted by a nurse.

Our aim therefore was to create a modern imaging centre to European standards, with the latest technology, motivated doctors and satisfied patients.



Image 1
Political map of Europe
Moldova in red.

Total population	3,604,000
Gross national income per capita (PPP international \$)	3,360
Life expectancy at birth m/f (years)	65/73
Probability of dying under five (per 1,000 live births)	19
Probability of dying between 15 and 60 (per 1,000 population, 2009)	222
Per capita total expenditure on health (US\$)	190
Total expenditure on health as % of GDP	11.7

Table 1: Facts about Moldova
2010 figures, unless indicated. Source: World Health Organization Global Health Observatory

Origins of the Project

In 2007 German investors founded a medical start-up company in Moldova. I was approached to head the new project. My background is the aviation industry, but I had no hesitation in accepting the challenge of building an imaging centre from scratch.

The project team comprised Professor Zapublin, a neurosurgeon, and three non-medical personnel. We started with the shell of a building, no equipment and no medical personnel.

The Tasks

1. To create and register the Moldovan company as operator of the Diagnostic Centre;
2. To reconstruct and extend the building;
3. To select and hire medical and general staff;
4. To select the appropriate set of imaging modalities of highest quality at a reasonable price;
5. To train the personnel;
6. To obtain the necessary licences and authorities' approvals;
7. To create standard operating procedures;
8. To manage the financial portfolio.

The Building Challenges

Early on the company purchased a former beer restaurant in downtown Chisinau of 700 m². We transformed these premises into a modern diagnostic centre with an additional two floors and a total area of 2000 m².

We analysed the layouts and workflows of similar clinics in Germany and with our partners from BDT Erlangen and Siemens we created optimal workflows and comfortable spaces. These include a common open area for the radiologists, two reception areas, the call centre, four waiting zones for patients (including a zone for children and for very important people) and a cafeteria.

The most difficult challenge was to adapt the existing frame of the building to the desired layout of the rooms and to comply with Moldovan regulations, some of which are outdated.

As Moldova is a mostly agricultural country we had to import a lot of materials, including lifts from Germany, large windows from Greece, linoleum flooring from France, furniture from Poland and Germany, special ceilings from France and heating, ventilation, air conditioning systems from different EU countries. This is the main difference between building such a centre in a industrially developed country and Moldova.

The reconstruction took 18 months between March 2008 and September 2009. We started operating on 19 October 2009.

The CDG philosophy is to keep the patient free from stress, using calm colours in the design, flowers, chillout music in the patient areas, the smell of coffee and paying special attention to patient needs.

Doctors and Medical Personnel

Our research revealed that in 2007 there were just two radiologists in Moldova with MR experience and around 10 with CT experience. The majority of these doctors were in their late fifties.

Our decision was then to select young doctors and to organise their studies and training in Germany at the Siemens reference centres.

From 80 applicants 12 young radiologists were chosen, and trained in radiology clinics in Germany (Frankfurt, Erlangen, Berlin) and at the University of Graz under Professor Riemmuller.

Our staffing levels have continually increased (see Table 2).

	2007	2009	2012
Doctors (radiologists, laboratory doctors, endoscopists etc)	0	14	32
Other medical staff	0	8	27
General staff (reception, call Centre, accounting, management etc)	3	22	32
Total	3	77	91

Table 2: Staffing levels



Images

- Original building
- Exterior
- Interior (2)

Our professional staff benefit from membership of the European Society of Radiology. They also participate in conferences and train in Western European radiology departments. Our radiologists are 35 years old on average. For second opinions we apply to our Partner Centre in Erlangen, Germany.

Imaging Equipment

Our aim was to identify the best equipment for our needs and to negotiate the best price with the vendors. In 2007, given our lack of experience, we hired experts from Germany and UK to advise us. We purchased the following set of equipment: 1.5T MR, 64 Slice CT, two Ultrasounds, one RX, one Mammo. Now we operate ten imaging modalities.

We fitted out the laboratory in cooperation with partners from Munich and Heidelberg, endoscopy with partners from Hamburg, and gynaecology and functional cardio diagnostic. We were among the first in the region to install and operate a RIS-PACS.

	2007 (state owned)	2007 (private)	2012 (state owned)	2012 (private)
MR	1	0	1	7
CT	8	0	11	9

Table 3: Imaging Equipment in Republic of Moldova

In 2012 private centres operated 7 times more MRs than the state run hospitals, while as recently as 2007 there were no privately operated MRs and CTs in the country. As the first such centre in Moldova, CDG has contributed to the development and success of private imaging centres in the country, stimulating others to invest. Moldovan citizens no longer need to travel to other countries to get a high quality exam.

Operational statistics

The waiting time for an investigation is maximum 1-2 days.

Exam Type	2009		2010		2011	
	Total	Per month	Total	Per month	Total	Per month
MR	1086	362	7696	641	9314	776
CT	58	19	3216	268	6969	581
RX	275	92	3404	284	5684	474
MAMMO	183	61	2142	179	6220	518
US	1202	401	12991	1083	16059	1338
TOTAL	3890	1297	37145	3095	53560	4463

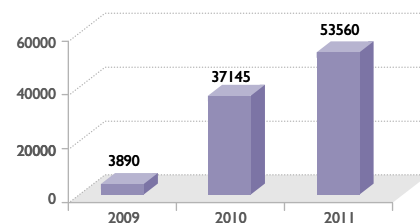


Figure 3: CDG investigations 2009-2011 (imaging only)

Marketing the CDG

Billboards about the CDG appeared close to state hospitals three months before opening. We were the first to develop a successful medical marketing campaign in Moldova. There were several advertisements broadcast on TV and radio, published in the print media and advertisements on popular websites.

At the same time we organised medical presentations to Moldovan doctors in order to explain the advantages of our equipment, and invited hundreds of guests to visit us.

Our website has been recognised as one of the most efficient and attractive among the other few medical institution websites which existed at the time.

The name of Centrul de Diagnostic German (CDG) has become well known among doctors and the general public, and it helps us to promote our services.

Benefits

Moldovan patients can get high quality diagnostic services in their own country in a stress-free environment and at a reasonable price.

Our radiologists can work using leading edge equipment, travel and communicate with their colleagues from different countries, and receive a good salary and bonuses.

The investors and management have realised a dream project in this small East European country. As the first such centre, we have stimulated other companies to invest in medical services in Moldova.

For the Republic of Moldova this diagnostic centre has improved quality of life for its citizens and guests.

Conclusion

Building an imaging centre from scratch is an amazing experience, especially in a country like the Republic of Moldova. But it's definitely possible. Now CDG is the leading diagnostic service in Moldova, with more than 130,000 investigations performed so far. ■



Safe and stress-free
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Mission control

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VACANCIES IN THE MIDDLE EAST

Physicians

Qualifications/Requirements for Consultant Posts:

Board certified in the hospital field with three years' post board hospital experience. Fluent in English.

- Consultant Adult Emergency Medicine
- Consultant Cardiology
- Consultant Cardiology Interventional
- Consultant Endocrinology
- Consultant ENT

- Consultant Gastroenterology
- Consultant Neonatologist
- Consultant Neurology
- Consultant OBGYN
- Consultant Orthopaedic Surgeon
- Consultant Paediatrics
- Consultant Paediatric Neurology
- Consultant Paediatric Pulmonology
- Consultant Paediatric Cardiology
- Consultant Paediatric Cardiology Interventional
- Consultant Paediatric Orthopaedic

- Consultant Paediatric Cardiac Surgery
- Consultant Radiology
- Consultant Thoracic Surgeon

Benefits

- Salary paid tax free
- Salaries from 9,000 to 20,000 euros (dependant on CV) with a lot of opportunities for very well paid extra shifts and overtime
- Severance pay
- Free furnished accommodation with free

recreation, sports and cultural facilities

- Free transportation service
- Up to 7,5 weeks paid annual leave per contract year
- Up to two return airline tickets per contract year (including agreed dependents)
- Free medical care & emergency dental care (including agreed dependents)
- Educational allowance per child (Maximum of three children, four -18 years old)
- Study leave of 10 working days per contract year and CPD courses

Nurses

UNIT MANAGER IN NURSING

Qualifications/Requirements:

Minimum of four years' practice in a nursing managerial position or a Charge Nurse in a hospital with a bed capacity of more than 100. Minimum of eight years nursing experience. Fluent in English.

NURSING SERVICE MANAGER

Qualifications/Requirements:

Minimum of two years' practice in a nursing managerial position or a Charge Nurse in a hospital with a bed capacity of more than 100. Minimum of five years nursing experience. Fluent in English.

HEAD NURSE

Qualifications/Requirements:

Minimum of three years' practice as Head Nurse in one of the areas mentioned below, in a hospital with a bed capacity of over 100. Fluent in English.

- Head Nurse OBGYN/MATERNITY
- Head Nurse Paediatrics Ward
- Head Nurse OR/RR
- Head Nurse Surgical Ward
- Head Nurse Medical Ward
- Head Nurse ICU
- Head Nurse ER
- Head Nurse Nursing Education
- Head Nurse Cardiac Ward
- Head Nurse CCU

Benefits

- Salary paid tax free
- Salaries from 4,000 to 6,000 euros (dependant on CV) with a lot of opportunities for very well paid extra shifts and overtime
- Severance pay
- Free furnished accommodation with free recreation, sports and cultural facilities
- Free transportation service
- Up to 7,5 weeks paid annual leave per contract year
- Up to two return airline tickets per contract year (including agreed dependents)

- Free medical care & emergency dental care (including agreed dependents)
- Educational Allowance per child (Maximum of three children, four -18 years old)
- Study Leave of 10 working days per contract year and CPD courses

CHARGE NURSE

Qualifications/Requirements:

Minimum of three years' practice as Head Nurse in the areas below, in a hospital with a bed capacity of more than 100. Fluent in English.

- Charge Nurse OB/Gynecology ward
- Charge Nurse Surgical ward
- Charge Nurse Cardiac Ward
- Charge Nurse Medical Ward
- Charge Nurse ICU
- Charge Nurse OPD
- Charge Nurse OR
- Charge Nurse Cardiology
- Charge Nurse ENT
- Charge Nurse Orthopaedics
- Charge Nurse Paediatrics

STAFF NURSE

Qualifications/Requirements:

Minimum of two years' practice as a Registered Nurse in a hospital with a bed capacity of more than 100. Fluent in English.

ALL AREAS OF NURSING

Benefits

- Salary paid tax free
- Salaries from 3,000 to 4,500 euros (dependant on CV), with a lot of opportunities for very well paid extra shifts and overtime
- Free furnished accommodation with free recreation, sports and cultural facilities
- Free transportation service
- Up to six weeks paid annual leave per contract year
- Up to two return airline tickets per contract year
- Free medical care & emergency dental care
- Study leave of 10 working days per contract year and CPD courses

Paramedical professionals

Qualifications/Requirements:

Minimum of two years' practice as a Registered Paramedic in one of the following areas, in a hospital with a bed capacity of more than 200, or in an outpatient clinic:

- Audiologist
- Catheterization laboratory technician
- Catheterization laboratory radiographer
- Cardiovascular technologist
- Clinical engineer

- Computed tomography technologist
- Coordinator infection control
- Emergency medical services educator
- Laboratory technologist
- Medical technologist
- Occupational therapy
- Occupational health specialist
- Oral surgery technician
- Paramedic team leader
- Physiotherapist
- Radiology technologist
- Respiratory therapist

- Special procedure technologist
- Transplant coordinator
- Tumor registry technician
- Ultrasound technologist

Benefits

- Salary paid tax free
- Salaries from 3,000 to 4,500 euros (dependant on CV) with a lot of opportunities for very well paid extra shifts and overtime
- Free furnished accommodation with free

recreation, sports and cultural facilities

- Free transportation service
- Up to six weeks paid annual leave per contract year
- Up to one return airline ticket per contract year
- Free medical care & emergency dental care
- Study leave of ten working days per contract year and CPD courses

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Managers

EXECUTIVE CONSULTANT, ORGANISATION & MANAGEMENT (O&M)

Qualifications/Requirements:

PhD, Master's or Bachelor's Degree in Hospital/Healthcare Administration, Management, Business Administration or any other related fields is required. Five years of progressive and senior professional experience in a large hospital, healthcare institution, government institution, corporation or organisation, with at least five years' experience in a managerial field, is required from holders of a PhD. Eight years is required from holders of a Master's Degree, and 12 years from holders of a Bachelor's Degree.

Benefits

- Salary paid tax free
- Salaries from 8,000 till 15,000 euros (dependant on CV*)
- Severance pay
- Free furnished accommodation with free recreation, sports and cultural facilities
- Free transportation service
- Up to 7,5 weeks paid annual leave per contract year
- Up to two return airline tickets per contract year (including agreed dependents)
- Free medical care & emergency dental care (including agreed dependents)
- Educational allowance per child (Maximum of three children, four -18 years old)
- Study leave of 10 working days per contract year and CPD courses

* depending on degrees, certifications and years of experience

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VACANCIES IN GERMANY

Physicians

Qualifications/Requirements for Consultant Posts:

Board certified in the field with two years' post-board Hospital experience. German language (B2 - Mittelstufe).

- Consultant Anaesthesiology
- Consultant Adult Emergency Medicine
- Consultant Cardiology

- Consultant Cardiology Interventional
- Consultant Cardiac Anaesthesia and Critical Care
- Consultant Intensivist
- Consultant Neurology
- Consultant Paediatric Neurology
- Consultant Paediatric Pulmonology
- Consultant Paediatric cardiology
- Consultant Paediatric

- cardiology Interventional
- Consultant Paediatric ER
- Consultant Paediatric Cardiac Surgery
- Consultant Pulmonary
- Consultant Radiology
- Consultant Thoracic Surgeon

(dependant on CV* and position)

- Up to six weeks paid annual leave per contract year
- Educational Leave
- Medical insurance (including agreed dependents)

Benefits

- Salaries from 5,000 to 10,000 euros

Nurses

UNIT MANAGER IN NURSING

Qualifications/Requirements:

Minimum of two years' practice in a managerial nursing position or as a Charge Nurse in a hospital with a bed capacity of more than 100. Minimum of six years' nursing experience. German language (B2 - Mittelstufe).

NURSING SERVICE MANAGER

Qualifications/Requirements:

Minimum of one year's practice in a managerial nursing position or as a Charge Nurse in a hospital with a bed capacity of more than 100. Minimum of three years' nursing experience. German language (B2 - Mittelstufe).

HEAD NURSE

Qualifications/Requirements:

Minimum of two years' practice as Head Nurse

in one of the following areas, in a hospital with a bed capacity of more than 100. German language (B2 - Mittelstufe).

- Head Nurse OR/RR
- Head Nurse Surgical Ward
- Head Nurse Medical Ward
- Head Nurse ICU
- Head Nurse NICU
- Head Nurse ER
- Head Nurse Infection Control
- Head Nurse Nursing Education
- Head Nurse Cardiac Ward
- Head Nurse CCU

Benefits

- Salaries from up to 3,200 (dependant on CV* and position).
- Up to four weeks paid annual leave per contract year
- Educational leave

- Medical insurance (including agreed dependents)

CHARGE NURSE

Qualifications/Requirements:

Minimum of two years' practice as a Head nurse in one of the following areas, in a hospital with a bed capacity of more than 100. German language (B2 - Mittelstufe):

- Charge Nurse Emergency
- Charge Nurse Surgical ward
- Charge Nurse Cardiac Ward
- Charge Nurse Medical Ward
- Charge Nurse Pediatric Ward
- Charge Nurse ICU
- Charge Nurse NICU
- Charge Nurse CCU
- Charge Nurse OR
- Charge Nurse Cardiology
- Charge Nurse Internal Medicine

STAFF NURSE

Qualifications/Requirements:

Minimum of two years' practice as a Registered Nurse in a hospital with a bed capacity of more than 100.

ALL AREAS OF NURSING

Benefits

- Salaries from 2,300 euros (depends on the CV* and the position).
- Up to four weeks paid annual leave per contract year
- Educational leave
- Medical insurance

* depending on degrees, certifications and years of experience

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EFSUMB RECOMMENDATIONS ON CONTRAST ENHANCED ULTRASOUND IN NON-HEPATIC APPLICATIONS



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Contrast-enhanced ultrasound (CEUS) is a revolutionary technique that greatly improves the diagnostic capabilities of conventional ultrasound. Due to its wide availability in Europe and its relatively low cost there has been exponentially increasing interest in the clinical applications of CEUS.

The first studies on the clinical use were published at the beginning of this century using Levovist® as contrast material (Bertolotto et al. 2000; Burns et al. 2000). Later, sulphur hexafluoride (Sono-Vue®) was marketed in Europe, opening the era of real time low mechanical index (MI) examinations.

Microbubbles contrast agents registered in Europe are licensed only for cardiac, liver, breast and vascular applications (Sono-Vue®). Levovist® is also registered for vesico-ureteric studies, but is practically no longer marketed, and is expected ultimately to be no longer available. Thus, lots of daily non-hepatic applications continue to be off-label and patients should be informed and must consent to the investigation.

Clinical guidelines and recommendations

The European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) released the first CEUS guidelines focused mainly on liver applications in 2004 (Albrecht et al. 2004). The update of the clinical recommendations on liver and other organs was published in 2008 (Claudon et al. 2008). During 2008, an evidence-based medicine guideline addressing diagnostic imaging of focal liver lesions was produced by the Italian Ministry of Health providing recommendations in keeping with those of the EFSUMB guidelines (Filice et al. 2011).

Following the rapid innovation and progression of a number of new CEUS applications and supportive scientific articles, EFSUMB decided to divide the update of the guidelines into non-hepatic and hepatic applications. The former have already been published (Piscaglia et al. 2012). The latter, prepared in conjunction with the World Federation of Societies for Ultrasound in Medicine and Biology (WFUMB), are expected by late 2012.

The clinical recommendations are based on comprehensive literature surveys and/or on expert committee reports and/or on the views of a panel of expert authors, providing

a recommendation level (RL) for each indication, at least for the non-hepatic document (Piscaglia et al. 2012), based on the levels of evidence provided by the Centre for Evidence-Based Medicine, Oxford, UK (Piscaglia et al. 2012).

General Considerations for Contrast Agents

CEUS has a number of distinct advantages over CT and MRI: it can be performed immediately, without any preliminary laboratory tests, and provides information in real time. Moreover, unlike contrast materials used in CT and MRI, microbubbles are blood pool agents with a purely intravascular distribution (D'Onofrio et al. 2005). The small diameter of the microbubbles (2.5 µm) allows their transpulmonary expulsion, without any renal or hepatic excretion. Due to the excellent safety for patients their administration can be easily repeated. Intracavitary applications such as intravesical administration can also be performed.

In general, microbubble contrast agents are very safe with a low incidence of side effects, as they are not nephrotoxic and do not interact with the thyroid gland. Life-threatening anaphylactoid reactions have been reported with a rate of less than 0.002% (Piscaglia and Bolondi 2006; ter Haar 2009). However, they are not licensed in pregnancy and breastfeeding is a contraindication in some countries.

Some general recommendations are that resuscitation facilities should be available; caution should be exercised for off-label use in tissues/patients in which/whom damage to the microvasculature may have serious clinical implications (i.e. eye, brain, neonate and children); and caution should be exercised in patients with severe coronary artery disease and pulmonary hypertension.

CEUS studies are subject to the same limitations as other types of ultrasound. As a general rule, if the baseline ultrasound is very suboptimal, CEUS may be disappointing.

SonoVue® (introduced in 2001 by Bracco Spa) is the main agent in general use in non-cardiac applications, reported in almost all of the referenced articles. Its recommended dose is 2.4 mL, but it can be increased to 4.8 mL or decreased to 1.0 mL or less, depending on the sensitivity of the equipment used, the type of transducer and the organ under investigation.

CEUS Detailed Reporting

The most important applications of CEUS detailed reporting in the mentioned guidelines can be briefly summarised as follows.

Microbubble-specific software (with $MI \leq 0.3$) that filters all the background tissue signals, making the vascular enhancement only due to the presence of microbubbles, is required for the CEUS examination [10=7MDO]. Competence ensured by adequate training is a prerequisite to achieving correct diagnoses (Education and Practical Standards Committee, European Federation of Societies for Ultrasound in Medicine and Biology 2006; European Federation of Societies for Ultrasound in Medicine and Biology 2010).

Enhancement patterns are described during subsequent vascular phases (i.e. arterial, portal venous and late phase for liver lesions), similar to contrast enhanced CT (CECT) and/or MRI (CEMRI), taking into account the contrast distribution, described as homogeneous or heterogeneous and, in this case, if non-perfused regions exist, and the degree of enhancement. This is usually compared to the surrounding parenchyma or to the paired organ when available, if the target of the study is a focal region in a parenchymal organ, thus defining the target as hyper-enhancing, iso-enhancing, hypo-enhancing or non-enhancing. For targets that have no background tissue it is important to describe the presence or absence of enhancement and its distribution.

Hepatic Applications

CEUS has been largely demonstrated as an accurate imaging modality able to provide detection and characterisation of focal liver lesions (FLL) with close diagnostic agreement with CECT or CEMRI (Beissert et al. 2002; Albrecht et al. 2003). Portal and late phase enhancement give important information regarding the behavior of the lesion: most malignant lesions are hypo-enhancing while the majority of solid benign lesions are iso- or hyper-enhancing (Albrecht and Blomley 2001; Strobel et al. 2001; Dill-Macky et al. 2002; Wilson et al. 2000; Hohmann et al. 2003; Albrecht et al. 2000; Quiaia et al. 2002; Leen 2001; Quiaia et al. 2004; Blomley et al. 2001; Bryant et al. 2004; Dietrich et al. 2004). Thus the late phase is mainly used for detection of malignancies and the arterial phase mainly for characterising FLLs (i.e. hyper-enhancement with “chaotic vessels” in hepatocellular carcinoma, rim enhancement with rapid and marked wash-out in cholangiocarcinoma, peripheral globular or rapid homogeneous enhancement with progressive centripetal

complete filling in cavernous or capillary hemangioma respectively, and homogeneous persistent hyper-enhancement with centrifugal filling with or without a central scar in focal nodular hyperplasia). As a consequence, CEUS is indicated in all patients with uncertain liver lesions, particularly if incidentally detected on routine US in chronic hepatitis or liver cirrhosis, in patients with a known history of malignancy or in patients with inconclusive MRI/CT.

CEUS can also be used for the immediate assessment and follow-up of local ablative treatment (Cioni et al. 2001; Cova et al. 2003). Care should be taken not to misinterpret the perilesional hyperemic halo (normally found within the first 30 days after treatment) with a residual viable tumour.

Non-Hepatic Applications

1) Pancreas

The pancreatic application of CEUS is mainly addressed to the characterisation of focal lesions, distinguishing between their solid and cystic nature (RL:C;5), and defining their relationship with the peri-pancreatic vessels (RL:B;2b) (Dietrich et al. 2008; D’Onofrio et al. 2007; Faccioli et al. 2008; Grossjohann et al. 2010).

Ductal adenocarcinoma typically presents as an hypo-enhancing mass in all phases, due to the desmoplastic reaction (RL:A;1b) (D’Onofrio et al. 2006; Kersting et al. 2009; Numata et al. 2005; D’Onofrio et al. 2012).

Neuroendocrine tumours typically show a homogeneous hyper-enhancement in the arterial phase, owing to the rich arterial vascularisation, even if negative at Doppler study (Dietrich et al. 2008; D’Onofrio et al. 2004; Malagò et al. 2009). In larger tumours, necrotic avascular areas result in heterogeneous enhancement (D’Onofrio et al. 2004; Malagò et al. 2009).

CEUS improves the differential diagnosis between pseudocysts and cystic tumours, the first containing non-vascularised debris (RL:A;1b) (D’Onofrio et al. 2012; Rickes and Wermke 2004). Mucinous cystadenoma is a potentially malignant lesion usually appearing as a round macrocystic tumour, with irregular thick wall and internal enhanced septa and nodules (D’Onofrio et al. 2007; D’Onofrio et al. 2012; Rickes and Wermke 2004). Serous cystadenoma is a benign lesion, typically presenting with a lobulated pattern with centrally oriented thin vascularised septa (D’Onofrio et al. 2007). The microcystic type may mimic a solid lesion owing to the number of hyperenhanced septations (D’Onofrio et al. 2010). In cases of intraductal papillary mucinous neoplasm, CEUS is able to differentiate between perfused (nodules) and non-perfused (clot) inclusions (Itoh et al. 2005), but MRI still remains the method of choice

for its characterisation (D'Onofrio et al. 2010).

CEUS can also have a role in evaluation and follow-up (Ripolles et al. 2010) of inflammatory pancreatic pathologies after CT staging. In severe acute pancreatitis, necrosis presents as non-enhanced areas (RL:A;1b), while mass-forming and autoimmune pancreatitis has been reported to show similar enhancement to the normal parenchyma (D'Onofrio et al. 2006).

CE endoscopic ultrasound is a new method which combines the advantage of high resolution US of internal organs with the administration of microbubbles (D'Onofrio et al. 2010). It can be used in cases in which significant artifacts impede transcutaneous visualisation, with the same recommendation levels.

2) Kidney

The renal application of CEUS is mainly addressed to the detection of parenchymal ischemia or infarction (hypo-perfused or non-enhancing area) (Bertolotto et al. 2008), which differ from cortical necrosis (non-enhancing area with preserved hilar vascularity) (Correas et al. 2006; Bertolotto and Catalano 2009) (RL:A;1a). Moreover, CEUS is a useful method to differentiate between cystic and solid lesions (RL:B;2b), especially hypovascular tumours (Tamai et al. 2005), solid tumours and pseudotumours (showing in the latter the same enhancing features as the surrounding parenchyma in all phases) (Correas et al. 2006; Mazziotti et al. 2010) (RL:B;1b) and bland venous thrombus (non-en-

hancing) from tumour invasion (enhancing). Although a precise differentiation between benign and malignant solid lesions is not possible, CEUS can characterise cystic lesions (RL:A;1b), precisely depicting the potential enhancement of wall, septa and solid components (Quaia et al. 2008; Clev-ert et al. 2008; Park et al. 2007; Ascenti et al. 2007). It allows an accurate assessment of percutaneous ablation therapies (Hoeffel et al. 2010) (RL:B;1b). On the other hand, the role of CEUS in renal infections is still debated (RL:C;5).

3) Other Applications

CEUS can be also used in the evaluation of other organs usually studied by US, more or less improving the characterisation of focal or diffuse pathologies. The most important applications are for the gastrointestinal tract (especially in inflammatory bowel diseases), stable minor abdominal trauma patients, and vascular structures (especially for potential complications after intervention, i.e. endoleaks). However, many limitations still exist and only a few papers are present in the literature.

Microbubbles can also be used to assess the tumour response after anti-angiogenic therapy both by qualitative and semi-quantitative analyses (Lassau et al. 2005; Cosgrove and Lassau 2010). For an accurate description of these methods and applications, we recommend the readers to refer respectively to a recent technical publication from EFSUMB (Dietrich et al. 2012) and the published complete guidelines (Piscaglia et al. 2012). ■

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COST OPTIMISATION IN PET/CT SCANNING



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PET/CT scanning is a diagnostic method that enjoys increasing acceptance both in the scientific world and among practitioners. Its value derives from the increased quality of examinations compared to classical imaging methods. PET/CT scanning is, however, rather cost-intensive, which has curbed adoption of the method.

Cost efficiency is one of the main criteria for public healthcare systems when adopting a new method. Now that the diagnostic proof of concept is established, it is a key to optimise cost efficiency to maximize the healthcare-economic benefit of PET/CT. Only when it becomes clear that costs are reduced to a minimum can it be expected that health insurance organisations step in with a reliable rebate scheme.

Cost Categories

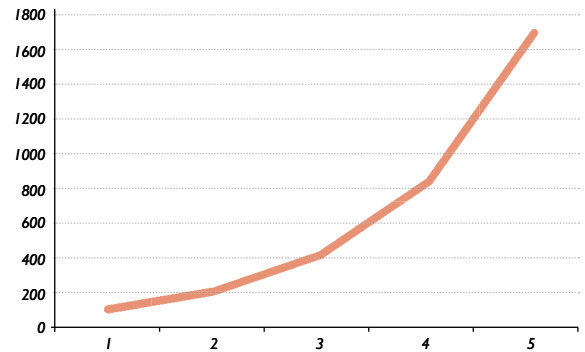
The overall cost of a PET/CT examination can be analysed in three categories: fixed costs, quasi-fixed costs and marginal costs.

- **Fixed costs** comprise the PET/CT device itself which has a fixed price (purchase / lease) no matter the utilisation, rent of premises and personnel employed independent from the number of examinations actually conducted.
- **Quasi-fixed costs** comprise items which are widely fixed but vary with the utilisation of the device. Power, for example, is widely fixed as the PET/CT device has to be run all the time. Further, peak power consumption occurs with every examination.
- **True marginal costs** occur only in examinations with contrast enhancement, markers and other equipment. Using tracers like FDG is particularly interesting as they degrade during the day and thus the marginal costs per examination depend on the time of the day. This aspect is further analysed below.

Marginal Costs of FDG

FDG is used as a tracer in PET/CT to detect lesions. Each patient receives a dose of FDG upon examination. Thus, the cost for FDG is marginal per PET/CT examination. However, FDG is delivered to healthcare facilities once a day and degrades over the storage period. The degradation process is rather quick; the half-life of FDG is 110 minutes. In Germany, the cost of FDG is 30 cents per MBq.

Assuming a dose of 350 MBq per patient yields initial costs of €105 which increase over time as follows:



Assuming a PET/CT device can be used to examine eight patients a day (i.e. one hour per patient starting immediately upon delivery of the FDG) yields total FDG costs of €3,938 per day. These comprise €105 for the very first examination and €1,260 for the last examination, the average cost per examination being €492. As FDG degrades a higher amount has to be purchased for late examinations so that enough MBq is left after the degrading process. This makes late examinations more costly than early ones. This effect also has to be kept in mind when analysing the effect of patients arriving late or even not showing up.

By contrast if the facility runs two PET/CT devices and thus can examine the eight patients as before in half a day this reduces the cost for FDG significantly. The first two (parallel) examinations again will cost €105 each. The last two examinations will only cost €315 each. This yields an average cost for FDG of €97 per patient, provided all eight patients can be treated within the first four hours. This is only 40% of the original cost and ensures savings of €2,360 per day (€295 per patient). Assuming 200 workdays per year this yields annual savings of €47,200 per year for FDG.

Conclusion

When optimising the cost of PET/CT such saving potential has to be kept in mind. Considering the significant potential savings on an annual basis it would be worthwhile to further examine the option to establish clusters for PET/CT which run several PET/CT devices but potentially only on a part-time basis. ■

APPLICATION OF THE BALANCED SCORECARD IN RADIOLOGY

The enormous cost pressures in the healthcare sector and the introduction of diagnosis related groups for the reimbursement of medical services has forced many radiological departments and practices to become more efficient by optimising their workflow in providing diagnostic and therapeutic services. As a central provider of services, a radiological department has to cater to the needs of different groups, including patients, referrers, its own staff, and the hospital sponsor. Patients and referrers expect short wait times for appointments, a high-quality diagnostic or interventional procedure, and rapid reporting of findings. The department's personnel expect attractive working conditions.

What is the Balanced Scorecard?

Presented by Kaplan and Norton in the early 1990s, the Balanced Scorecard (BSC) was initially developed for use by manufacturing companies. The BSC is a management tool aimed at linking a company's long-term strategies and its short-term operational activities. To this end, several concrete objectives are defined and assigned to one of four perspectives, namely customers, finances, processes, and learning and growth. Measures are then assigned to these objectives

to gauge the degree to which a target is reached. The set targets are linked to concrete initiatives to be taken to attain the set targets.

In addition, BSC involves an analysis of cause-and-effect relationships between the strategic aims, going beyond a system of mere key figures. A strategy map with cause-effect chains is used to visualise relationships between strategic aims and the different perspectives.

The basic idea of a BSC is to group objectives by perspective (see Figure 1). There are four main perspectives:

1. **Financial perspective:** Focuses on enhancing the cost structure and using assets to return greater productivity.
2. **Customer perspective:** Aims to increase a company's market share by focusing on the customer's perspective and defining how customer loyalty and satisfaction can be enhanced.
3. **Internal business processes perspective:** Aims to develop better product and service characteristics.
4. **Learning and growth perspective:** Aims to identify what needs to be improved in ongoing processes and which new strategies need to be initiated in order to ensure long-term success over competitors.



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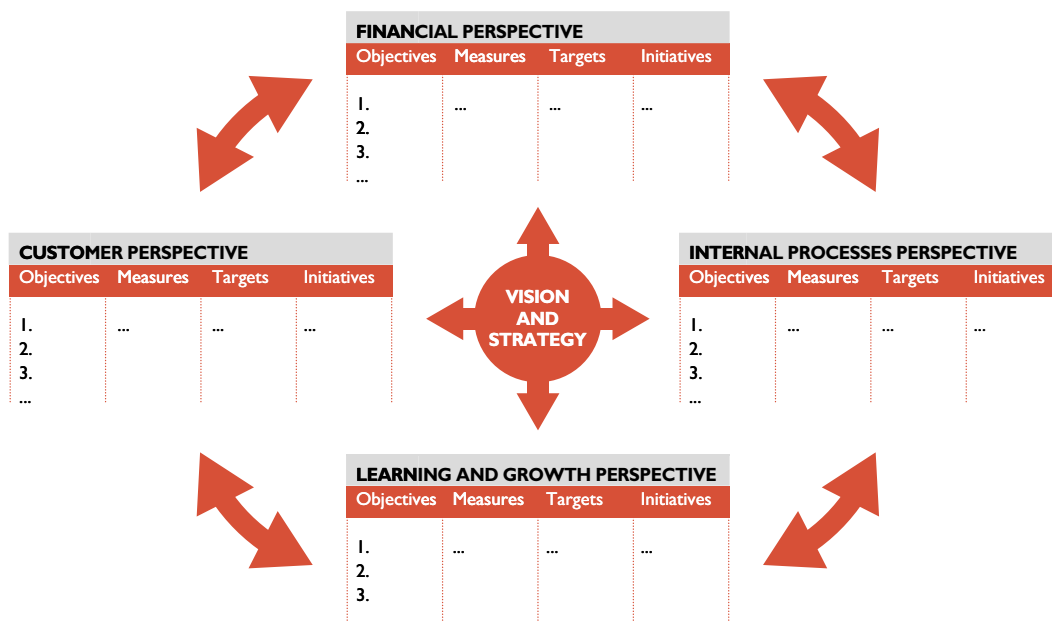


Figure 1

The Balanced Scorecard (adapted from Kaplan and Norton: Using the Balanced Scorecard as a Strategic Management System. Harvard Business Review 1996; 74: 75-85)

Use of the Scorecard in Radiology

Balanced scorecards can also be used in hospitals and other healthcare facilities. As a comprehensive management tool, a BSC provides a useful systematic instrument for dealing with the increasingly complex delivery of radiological services and at the same time unifying different interests.

For the concrete application of a BSC in a radiological department, a number of objectives that are derived from the long-term strategy are assigned to each of the four perspectives. Each objective is assigned a measure, for which in turn targets are attached. The extent to which the objectives are actually being achieved can be monitored and followed over time. Table 1 gives examples of objectives that can be subsumed under each of the four perspectives when using the BSC in a radiology department.

Advantages of the Balanced Scorecard

The use of a BSC ensures that all the data necessary to achieve a set target are collected; it provides an overview on the current performance status of the department or practice just like the cockpit in a plane. For specific groups of staff, the measures and targets can be adjusted in terms of content and level of detail. For example, for an interventional radiologist it is relevant to know how much expensive implants embolisation material is used and how long it takes on average to perform a vascular intervention. Administrative staff are more interested in the use of office supplies or radiologist report turnaround time.

Any changes that possibly lead to undesired developments are identified early; hence the BSC also functions as an early-warning system. Information overload should be avoided by limiting the number of set targets (e.g. 20).

Table 1

Perspective	Objectives	Measures	Targets	Initiatives
Customer perspective	Satisfaction of patients	Satisfaction questionnaire	>95% of patients are satisfied	<ul style="list-style-type: none"> Develop questionnaire Train staff in customer friendliness and service orientation
	Satisfaction of referrers	Finalised radiologist report turnaround time	<24 h after examination	<ul style="list-style-type: none"> Random measurement of duration Establish service hotline for inquiries Appoint responsible persons
Financial perspective	Keeping to the budget for staff and disposables	Expenditure in proportion to total budget	Exceeding the target budget by a maximum of 2%	<ul style="list-style-type: none"> Assign numbers of staff to modalities according to budget proportion
	Optimising revenues	Number of examinations per unit of equipment and year	e.g. 12,000 CT and 7,000 MRI examinations	<ul style="list-style-type: none"> Evaluation of examinations in terms of cost-to-revenue ratio; if possible, focus should shift to examinations with a favourable ratio irrespective of reimbursement
Internal business processes perspective	Highest quality of examinations and reports	Image quality	>99% of all examinations with at least good image quality	<ul style="list-style-type: none"> Define criteria for assessing image quality for different imaging modalities Appoint responsible resident or senior physician
		Number of repeat acquisitions necessary	<0.02% of all examinations involving radiation exposure	<ul style="list-style-type: none"> Error analysis Arrange discussions between physicians and technicians
	Optimal utilisation of equipment	Idling equipment	<10% from 8.00 am to 6.00 pm on Mondays through Fridays	<ul style="list-style-type: none"> Optimise patient scheduling Appoint patients with time leeway
Learning and growth perspective	Staff satisfaction	Measurement	>90% at least moderately satisfied staff	<ul style="list-style-type: none"> Annual talks with staff Training measures Install a "complaints box"
	Staff qualification	Staff fluctuation Staff flexibility (physicians and technicians) for working in different workplaces	< 3% / year Should be skilled to work in >90% of workplaces of the department	<ul style="list-style-type: none"> Analysis of causes Broad induction training when hiring Establish a system of constant rotation

The cause-and-effect chains visualised in a BSC help each staff member understand how seemingly small improvements can help in achieving a set target. In this way, a BSC allows all staff members to internalise the overarching strategy and “makes strategy everyone’s job”.

An interventional radiologist, for example, can make an important contribution to lowering costs by carefully selecting disposables and using them sparingly. This is an example of how an individual staff member can help improve the financial perspective. Training of non-physician staff to firmly establish awareness of the service character of their work helps in enhancing the customer perspective if a patient feels well taken care of.

Already established control instruments and quality management systems can be integrated into a balanced scorecard by incorporating them under the customer, internal business processes, and learning and growth perspectives.

Implementation

Initially establishing a BSC is time consuming, as is their ongoing use in the routine clinical setting. It is important that all staff members support the use of this management tool and are involved when objectives are being defined.

Resistance may be encountered from different staff groups when first implementing a BSC. This is because different measures that are being taken to reach an objective challenge the status quo. If the objectives are too ambitious, staff may feel overtaxed. Staff motivation may be improved and maintained by implementing a system of incentives rewarding staff with a bonus for achieving stipulated targets.

Risks

The measures to be taken to attain specific objectives may be conflicting or lead to conflicts among different staff groups. If, for instance, the target of optimally utilising facilities and minimising examination times is not achieved, different staff groups may blame each other. Causes for not attaining this aim may also lie outside the radiology department, such as delay in in-house patient transport or patients arriving late for their appointments.

The benefit from using the BSC in a radiology department is crucially dependent on an adequate selection of objectives and key figures and the measures chosen to attain a set objective. There is a general risk that the objectives defined may be unsuitable for ensuring the long-term success of a radiological service or that the measures taken are unsuitable in attaining the objective. Another danger is that key figures tend to be defined based on data from an earlier period, meaning that the past is paramount while current trends or changes may be ignored.

“The use of a balanced scorecard ensures that all the data necessary to achieve a set target are collected. Just like the cockpit of a plane it provides an overview on the current performance status of the department or practice”

Conclusion

Establishing a Balanced Scorecard requires staff time and financial resources. There are limits to its application. Despite these disadvantages, however, the BSC is also a beneficial management tool for a radiologic department or practice, enabling comprehensive strategic management of the diversity of radiologic services to be provided and taking a comprehensive approach toward a variety of needs. ■

RECOMMENDED READING

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MANAGING RISK IN COMPLEX HEALTHCARE ORGANISATIONS: USE OF A RISK REGISTER



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Risk is inherent in all aspects of life, and healthcare is no exception to this. Healthcare provision is a complex business, with numerous interactions with outside agencies and, of course, ill patients, many of which are unplanned and involve several healthcare professionals.

Whilst risk cannot be excluded, it is crucial to the success of any healthcare provider that they have a systematic process whereby risks of all types may be identified, assessed, and recorded. Once identified, actions to mitigate these risks should be undertaken and recorded, with clear mechanisms for escalation, and there should be an organisational infrastructure that ensures there is central overview, or governance, of these processes.

“The risk register plays a key role in deciding the allocation of resources, both human and financial, in a transparent fashion”

However, it is crucial to bear in mind that managing risk comes at a significant cost, and it is the balancing of these risks and costs that defines the success of an organisation in terms of its ability to deliver high quality healthcare within a financially constrained environment.

Categories of Risk

Risks in healthcare may be categorised into several major groups:

- potential harm to staff;
- potential harm to patients;
- potential loss of a service or facility;
- unsafe staffing levels;
- financial loss;
- loss of personally identifiable information;
- unfavourable media coverage
- and threat of litigation.

Given the sheer number and variety of risks to the organisation, it is imperative that there is an agreed, uniform system in which different types of risks may be graded and catalogued, in order that they be compared and prioritised. In order to achieve this, we utilise a common risk register across the entire hospital.

The Risk Register Scoring System

The risk register in use in our organisation comprises a simple two-part scoring system. First, we ask the question “what is the likelihood of an event / harm occurring?” This is termed the likelihood score, and is graded 1 (rare) through to 5 (will undoubtedly happen or recur, possibly frequently), as shown in Table 1.

Second, the consequence of the harm is assessed (consequence score), also graded from 1 (no harm/ negligible) through to 5 (death / catastrophic), an abbreviated version of which is presented in Table 2. A grading chart is produced for each of the major areas of risk listed above. The product of the likelihood and consequence scores produces a relative risk rating number (RRN), from 1-25, for each individual potential risk. Risks are then categorised into low (RRN 1-7), moderate (RRN 8-15) or high (RRN 16-25). These may be alternatively referred to as green, orange and red risks, as shown in Table 3.

The level of risk identified is linked with the risk review frequency such that red risks require review every 3 months, whereas green risks require annual review.

Managing the Risk Register

The entire process is managed electronically, with an online risk register accessed through the hospital intranet system. Users register on the system and have a unique password. They may then add new risk assessments, or search for, view, edit, and update existing risk assessments, which are stored electronically in a central database which is fully auditable.

Structuring different risks from across a large and complex organisation in this manner allows comparison of risks that vary greatly in nature. Each area of the organisation should be aware of, and have mechanisms for, dealing with risks pertaining to their department. This tool helps organise and prioritise these into a manageable structure, which can be utilised in departmental and organisational governance meetings.

Mitigating Risk

Many risks may be mitigated through attention to departmental practice and processes. For example, risks regarding the loss of patient identifiable data may be significantly reduced through staff education and training, adherence to clear departmental procedures, and the provision of confidential waste bins.



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Similarly, embedding a routine, safety first approach has long been the bedrock of good surgical practice. Ensuring that hospital notes are available, obtaining informed written consent well in advance of the procedure, marking the site of surgery in advance, and counting the swabs and instruments in use, are just a few examples of this. Diversion from these routine practices undoubtedly will lead to substantial risks.

Whilst some risks may be dealt with within a particular department, others may require escalation to more senior boards within the organisation. Examples of this might include the need for significant investment or involvement with other departments, and these risks can be readily highlighted for escalation within the risk register and brought to the attention of the appropriate authority.

The Role of the Risk Register in Resource Allocation

In the current financial environment, there will always be a greater demand for investment from the various departments within the healthcare organisation than there is money available. Clearly, investment boards and others with financial responsibility will need to consider many competing issues in deciding how these limited funds are distributed. A balance will need to be struck between delivering the organisational strategy and plans moving forward, and mitigating the risks identified within the current system.

In our organisation, the risk register plays a central role in such decisions. Within radiology, this can play a significant role in securing the often sizeable capital investments required to replace ageing or failing equipment. For example, an ultrasound machine that has been in use for several years may start to suffer a significant deterioration in image quality such that subtle lesions are no longer identified. Hence, although the basic service can be maintained, there remains a significant risk that an important lesion may be missed, leading to significant patient harm in the longer term. The risk register helps to convey this to non-specialist teams deciding on resource allocation, and compare with other risks in the system.

Moreover, where reorganisation of services is proposed, the register can be applied to each project to identify the potential risks that they may carry, whether they may be financial, reputational or otherwise.

As with all systems, this is potentially open to an element of ‘gaming’, overplaying the likelihood or consequences of a risk in order to achieve the desired outcome. Whilst this may produce short term gains within a particular department, it is likely to be detrimental to the organisation as a whole as this will lead to inappropriate resource allocation and consequently limit the opportunities elsewhere. For this reason, ‘red risks’ requiring significant resource may be investigated further to confirm their rating status.

Conclusion

In summary, the risk register enables the organisation to have oversight of all risks within the organisation, covering all areas of practice, and monitor progress against them. The risk register plays a key role in deciding the allocation of resources, both human and financial, in a transparent fashion, and we have found this invaluable in managing the complex, high risk environment in which we work. ■

Table 1

Likelihood score	Likelihood Score	Descriptor
	1	This will probably never happen/ recur
	2	Do not expect it to happen / recur
	3	Might happen / recur occasionally
	4	Will probably happen but is not a persistent issue
	5	Will undoubtedly happen / recur possibly frequently

Table 2

Consequence Score	Consequence Score	Example domains
	1	No harm/ minimal harm Loss / interruption of service / facility for <8 hours
	2	Minor harm requiring first aid, or additional therapy Loss / interruption of service / facility for 8-24 hours
	3	Short term harm, moderate increase in procedures Agency reportable incidents Loss / interruption of service / facility for 1-7 days
	4	Permanent or long term harm directly related to the incident Temporary loss of service / facility for > 1 week
	5	Death directly related to the incident (not underlying condition) Permanent loss of service / facility

Table 3

Relative Risk Rating	Likelihood Score	Consequence Score				
		1	2	3	4	5
	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	5	5	10	15	20	25

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COMPUTED TOMOGRAPHY

The future of prognosis

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The Computed Tomography (CT) equipment industry is the second largest of the diagnostic medical imaging market. CT equipment stationed at hospitals and imaging centres caters to numerous clinical applications such as cardiology, oncology, neurology and musculo-skeletal applications. It detects infarctions, tumours, trauma and calcifications. The CT market is a diverse one with various product types of different specifications, catering to a wide array of needs and demands. Increased prevalence and awareness of diseases like cancer and coronary artery disease has contributed to market growth.

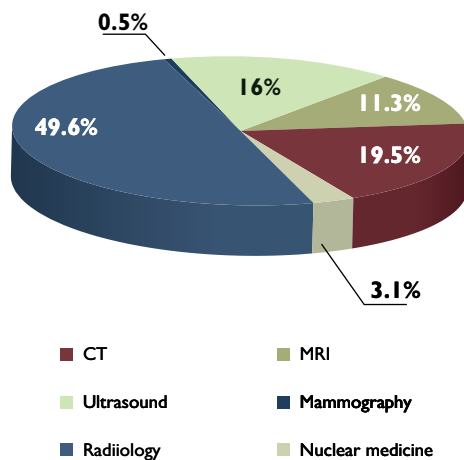


Figure 1: Total Computed Tomography Market: Share of Diagnostic Imaging Equipment Revenue (Global), 2011

Rapid Technical Change

The market is volatile in terms of technical change. There are a number of new products being introduced in the market regularly. These products have superior features in terms of reduced scanning times, lower dosage levels and fine image quality. In years to come, numerous premium and super premium CT systems will be flooding the market, thereby sparking demand for high slice CT systems. Single and dual slice CT systems will become obsolete and they will be replaced by these high slice CT systems. This is an important factor that will drive market growth for the entire term of the forecast period.

The capability of CT to integrate into an existing workflow process is a major advantage, which helps in its market penetration. Digitisation and transition to electronic health records require a workflow process that is efficient and fully automated.

Non-Invasive Procedures

Rapid advances in imaging technologies have led to increasing number of diagnostic procedures becoming non-invasive. There is a shift of preference to non-invasive diagnostic methods. For example, cardiac computed tomography angiography is now a preferred screening method that has replaced traditional coronary angiography due to the side effects of the invasive method.

Barriers to Growth

Competition from MRI and other imaging modalities will affect CT's growth. CT's potential growth requires validation of its claimed diagnostic efficiency. Moreover, dose reduction strategies will have to be tested and proved to be effective in achieving their goal. More white papers and publications that prove the robustness of the modality in accurate diagnosis and successful implementation of the various dose reduction techniques on a large scale need to be in place for CT to have a competitive hold on the market. Lack of these features will lead to preference for other imaging modalities over CT. Proven invasive diagnostic methods may also be chosen by physicians and patients to avoid risk.

The CT Market

The CT market is highly price sensitive. The market is strictly regulated by the degree of technical change and pricing parameters. The unit shipment of the CT market has been increasing continuously for the past few years. The high demand rate for new CT equipment due to increasing awareness among physicians and patients is the reason for the constant increase in the number of installed bases across Europe. This is expected to grow with the introduction of technologically superior vari-

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ants in the coming years. The market is highly concentrated with a limited number of market participants.

The European CT market was calculated to have revenue of US\$532.6 million in 2011. 2012-2013 will witness increased growth rate. This is due to the fact that more than 65 percent of the installed CT systems in Europe are older than ten years. This favourable replacement cycle contributes to increased market revenues.

Cardiac imaging is shaping up to be the major clinical application that CT caters to, and a 16 slice CT system is considered necessary for the same. Hence, single

Growth of higher slice CT scanners

Germany, Italy and the United Kingdom will contribute to the market revenue of CT in the coming years, as a major portion of the installed base in these countries is more than 8 years old. They can be expected to contribute to the growth of 64 slice CT scanners. The growth of higher slice CT scanners will be primarily due to Scandinavia and the Benelux countries that are considered to be technology adopters. ■

“In years to come, numerous premium and super premium CT systems will be flooding the market, thereby sparking demand for high slice CT systems.”

and dual scanners will soon become obsolete. Advanced clinical applications such as neuroimaging require a premium or super premium CT scanner for effective prognosis. This, along with price optimisation of the high slice scanners, will result in the growth of that segment.

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Pour les membres de la Société Française de Radiologie, le journal fait partie des avantages liés à leur adhésion.

Review of MIR Annual Scientific Meeting

Milan, Italy (Oct. 11 - 12, 2012)

Milan in Italy was the venue for the 15th Management in Radiology Annual Scientific Meeting. 134 delegates came from more than 15 different countries across the globe, welcomed by Prof. Peter Mildemberger, Chairman of the MIR Subcommittee of the European Society of Radiology and Prof. Lorenzo Derchi, Chairman of the MIR Meeting 2012.

Radiology's future was a continuing theme. Prof. Stephen Baker (USA) spoke on the imminent revolution in radiology and how to prepare for it now. He noted that of all medical specialties, radiology is the one most dependent on the interpretations revealed by the output of machines and, like pathology, nearly always less directly and personally related to interactions with patients. He asked if technology might become our superior, following developments in computer-aided diagnosis. Other challenges are image interpreting by non-physicians. He urged radiologists to demonstrate their virtuosity by narrative reporting, and being physically present at on-ward case consultations.



Quality Issues

How to improve quality of radiology services and radiologists was one focus. Prof. Elisabeth Shouman-Claeys (France) reported on implementation of lean methods in diagnostic radiology. All staff are involved in improving quality by identifying waste and eliminating it, whilst remaining flexible and able to change.

Prof. Charles Kahn (USA) described the American College of Radiology's initiatives in using radiology data to improve radiology performance. Dr Pablo Valdés Solís (Spain) reported on the Spanish Radiological Society's scheme to measure and manage the competency of radiologists. Dr.

Richard Fitzgerald (UK) closed the session by looking at how to assess radiologists' reporting speed and patient safety. He noted that while technology has enabled more reporting we have little understanding of what our limitations are.

number of examinations residents have to perform and the time spent in ultrasound before the end of their training. The survey will be published shortly with action points. Prof Derchi concluded that training programmes should include an indication of



Prof. Elisabeth Schouman-Claeys (France) & Prof. Charles Kahn (USA)

Keeping Ultrasound within Radiology

The growth of mobile imaging technology has been a challenge to radiology to demonstrate its cost-effectiveness. Prof. Dr. Hans-Peter Busch (Germany) explained how his hospital set up a centralised ultrasound laboratory. Their approach is simple: for the patient it is one problem, one appointment and one solution or answer from the imaging centre.

Training in ultrasound was the topic of a presentation by Prof. Lorenzo Derchi (Italy). The European Society of Radiology (ESR) did a survey in 2011 looking at the

the minimum numbers of scans which should be performed as supervised scanning, and incorporate recommendations to evaluate interpretative skills.

Prof. Lorenzo Derchi, on behalf of Dr. Michel Claudon (France), spoke on the cost-effectiveness of contrast-enhanced ultrasound (CEUS), and urged radiologists to take their place as the best-suited specialist to integrate CEUS into complex patient diagnostic workflows.

Benchmarking

Dr. Martin Maurer (Germany) explained the



L-R: Prof. Moshe Graif (Israel), Prof. Peter Mildenerger (MIR), Prof. David Koff (Canada), Prof. Yves Menu (France), Prof. Remy Demuth (France) & Dr. Philip Gishen (UK)

value of benchmarking as a tool for personnel management. It provided staff with a view of their own role in the whole process, so that they ended up taking more responsibility for fulfilling tasks.

Dr. Bernd May (Germany) addressed benchmarking productivity of medical employees. Measures could include the number of radiologist reports in a time period and these can be compared between types of hospital. However, simple measures do not take into account other use of time such as management, training, research and teaching. In addition, the structure of clinical overhead time differs between modalities. Other factors impacting productivity include mobility of patients, infrastructure and the availability of trained radiologists.

Dr. Mansoor Fatehi (Iran) spoke about the role of analytical informatics in radiology. Detailed data is not easily accessible, but tools are being developed such as digital dashboards to supply and display metrics for the management team to use and act upon. He presented examples of metrics which can be used in radiology management.

A lively discussion of benchmarking followed. Questions were asked about how to judge the quality of the diagnostic reports, and the pros and cons of external as against internal benchmarking.

Radiation Dose and Appropriateness

Prof. Peter Mildenerger (German) explained new concepts for dose registration and analysis. He encouraged radiologists to become familiar with opportunities for



Prof. Lorenzo Derchi (Chairman, MIR Meeting 2012)



Prof. Peter Mildenerger (Chairperson, MIR Subcommittee)

dose documentation, and include IHE REM (Radiation Exposure Monitoring) in requests for new devices. Laura Coombs (USA) described the American College of Radiology's dose index registry, which enables participating facilities to compare their practice to similarly sized facilities. The registry is intended to provide peer review and quality assurance. Prof. John Carrino (USA) gave an illuminating talk on how to decide between CT, US and MR in the emergency room.

In the UK, the Royal College of Radiologists has published referral guidelines for doctors, iRefer. Dr. Nicola Strickland (UK) explained that these guidelines are designed to make the best use of radiology, with appropriate examinations and information for referrers about radiation dose.

Workflow and Workload

Professor Jarl Jakobsen (Norway) looked at considerations when redesigning a workflow in the hospital. He advised that particular focus should be given to what is going on amongst those staff with very frequent interactions. Workflow needs to look at administrative as well as clinical processes.

Dr. Daniel Boxer (UK) talked about a new method of radiologist timetabling his team

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implemented when they moved to a new hospital. Using this new scheduling system improved productivity by 25% and gave radiologists more control over their time, with the ability to respond to modality shortfalls.

compact and hand-held devices and more advanced IT. Full tissue characterisation and micro-resolution had not yet been accomplished so radiology risked retaining its current passive observer role leading to relative stagnation. Radiologists risked ceding ground to nanotechnology and artificial intelligence.



Dr. Sergey Morozov (Russia) and Dr. Lucian Florea (Romania)

Dr. O. Dicle (Turkey) spoke of the many factors which affect the radiologist's workload. Technology has not necessarily reduced the workload, and interpreting more than a certain number of examinations in a day may increase the error rate. For the future he predicted increasing control of demand via guidelines, the spread of teleradiology, decreased delegation to radiographers and sonographers with increases in new modalities and imaging techniques.

The Future of Radiology

The meeting ended with a stimulating debate on "The future of radiology." Prof. Moshe Graif (Israel) predicted more integrative imaging, multi-modality suites, more

Other speakers in the debate pointed to skyrocketing demand for services due to ageing populations, living longer with chronic disease and as cancer survivors. Prof. David Koff (Canada) compared radiology to the aviation industry: when there were aviation accidents, the industry worked hard to prevent these.

Dr. Yves Menu (France) talked about a faster decrease in conventional radiology accompanied by the growth of ultrasound. Generation Y radiologists want a better work-life balance so demand for radiologists may well increase. Another factor is that doctors are asking more and more for imaging as a pre-clinical step.



Ian Maynard (Canada)



Prof. Elisabeth Schouman-Claeys (France)
Editor-in-Chief of our French issue



Prof. David Koff (Canada)



Prof. Moshe Graif (Israel)

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Further Information

Many of the presentations are available on the MIR website www.mir-online.org

Dates for your Diary

10-12 January 2013

MIR Winter Course, Seefeld, Austria

9 March 2013

MIR@ECR, 1pm to 5pm, Vienna, Austria.

10-11 October 2013

MIR Annual Scientific Meeting, Nice, France.



Laura Coombs (USA)



Dr. Nicola Strickland (UK)



Alexander Gutu (Moldova) and Prof. Jarl Jakobsen (Norway)

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RADIOLOGY IN JAPAN

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In Japan, as in other countries, radiologists play a crucial role in high quality medical care in daily practice. This article summarises the current state of radiology in Japan, and describes the Japan Radiological Society (JRS), which is a leading society in the Japanese radiological field. Under the leadership of JRS, the radiology field in Japan focuses on globalisation. The last section introduces the current education and training system for developing board-certified radiologists in Japan.

Radiologists in Japan

The work of radiologists in Japan includes diagnostic reporting, imaging protocol management, radiation exposure control, interventional procedures, planning radiation therapy and patient care. In an era of rising demand for healthcare and an ageing population, radiology in Japan is suffering from a workforce shortage.

Radiology in Japan is characterised by a large number of imaging units and a relatively small number of radiologists.

The number of radiologists in Japan is 8,610 (board-certified diagnostic radiologists 4,753, radiation oncologists 927 (2012), which comprises three per cent of the number of total physicians. The number of both radiologists and physicians per million population is the lowest among 26 countries investigated in a 2007 survey (see Figure 1). The number of radiologists per million population in Japan is 36, which is only one-third of the average number of all countries. In contrast, the number is high in Greece, Denmark, Italy and France.

In spite of the small number of radiologists, Japan has a dense distribution of imaging units, because there is no limit on the installation of expensive equipment and devices. This contributes to good accessibility for patients for advanced imaging technologies with relatively short waiting periods.

The number of multidetector row CT (MDCT) in Japan has been increasing every year, and it reached approximately 8,000 in 2010. In particular, the proportion of MDCT equipped with more than 64 detectors has been rising in the last several years (see Figure 2).

The number of MRI scanners in Japan is also increasing, but slowly in the last several years. A recent trend is that the number of MRI with low magnetic field strength (0.5T or 1T) is decreasing whereas those with high magnetic field strength (1.5T and 3T) are increasing. The total number of MRI scanners in Japan is around 6,300 (2011), and there are more than 300 3T MRI units (see Figure 3).

The number of radiologists per CT/MR unit is 0.3, which is one-tenth of the average number of 3.3 among 26 countries. Only a quarter of institutions with MDCT scanners and MRI scanners hire board-certified radiologists. Consequently, radiologists interpret only 40 % of CT/MRI examinations.

When considering this demand for professional interpretation of advanced imaging, more radiologists and better healthcare insurance coverage for diagnostic imaging are necessary to bridge this large gap between the number of radiologists and imaging units.

Figure 1

Comparison between the number of radiologists and physicians per million population in 26 countries: for both Japan is among the lowest. (Source: Nakajima Y, Yamada K, Ima-mura K, Kobayashi K. JCR News 2007, 161: 13-14 based on 2007 data from the OECD)

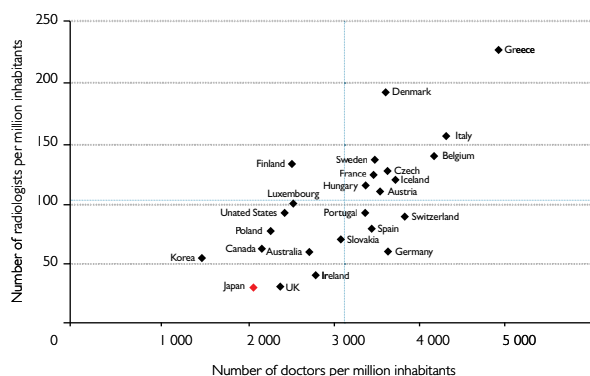


Figure 2

Number of multidetector CTs in Japan

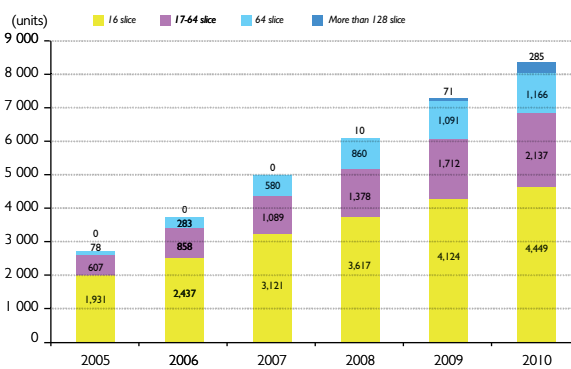
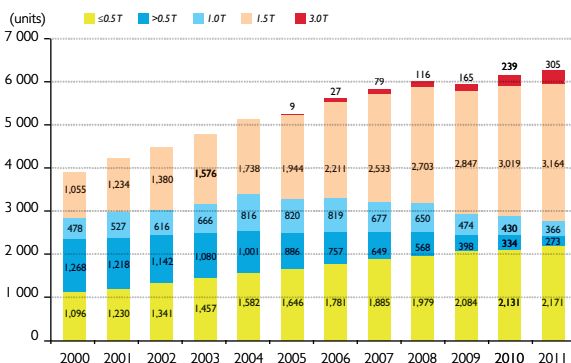


Figure 3

Number of MRI scanners in Japan



Japan Radiological Society (JRS)

JRS was established in 1934 and is the leading official society in the field of radiological science in Japan. The main aim of the society is to promote radiological science in collaboration with various related societies. Two hundred and fifty representatives are elected by more than 8,600 members, and 16 board members of directors are elected from the representatives.

The main activities of the society are to:

- 1) conduct scientific meetings in spring and autumn;
- 2) publish scientific journals in English;
- 3) operate the Japanese specialty board in order to certify radiologists;
- 4) promote research in radiological science;
- 5) support activities for protection against radiation hazards;
- 6) collaborate with related societies or associations.

The annual JRS meeting is held in April in Yokohama. The 2012 meeting brought together 4,822 radiologists, 338 medical students, 3,749 technologists, 507 tech-students, 577 physicists, and 1,053 businesspersons. A total of 133 companies were involved. The programme comprised 14 special lectures, 4 international sessions, 6 symposiums, 4 workshops, 35 educational programs, 449 oral presentations, 110 educational exhibitions, 205 electronic exhibition, and 28 luncheon seminars. The Technical Exhibition at the JRS annual meeting remains the top healthcare exhibition in Japan. More than 20,000 people visited the exhibition hall during the meeting.

JRS is now focusing on the development of international cooperation for the mutual progress of radiological science. As a first step towards globalisation, JRS started to display all slides of oral presentations in English in the JRS meeting from 2012. Communication with the Radiological Society of North America (RSNA) and European Society of Radiology (ESR) was started, and collaborative sessions with those societies were held in the last meeting. The JRS also has started a cooperative relationship with the French Society of Radiology (SFR).

The Japanese Journal of Radiology (JJR) is the official journal published by the JRS. The scope of this journal encompasses, but is not restricted to, diagnostic radiology, interventional radiology, radiation oncology, nuclear medicine, radiation physics, and radiation biology. An exchange programme of free online journal access between Japan and other countries will be promoted as an activity for globalisation.

Japanese Board of Radiology Training Programme

The Japanese Board of Radiology was established in 1966 to promote formal radiologic training and to elevate the standard of radiologic practice. Today, there are 5,680 board-certified radiologists in Japan.

There are two periods of training, each followed by a board examination. For the first three years after the junior resident programme, the trainees must receive education and training to be a general radiologist in diagnostic radiology as well as in radiation oncology. After the first period, trainees must pass the first examination regarding basic knowledge on diagnostic radiology, including nuclear medicine, radiation oncology, physics and biology, in written form.

The next two years after the first examination should be spent in training in more practical form in diagnostic radiology, nuclear medicine or radiation oncology. After this, trainees must pass the second examination, and choose either diagnostic radiology including nuclear medicine or radiation oncology for their board specialty. Examinations regarding clinical knowledge and skills for unsupervised clinical practice are given in both writing and oral form over two days.

All the successful trainees who have passed both the first and second examinations are given the certification of the Board of Diagnostic Radiology or Radiation Oncology.

The main training hospitals must be qualified in all diagnostic radiology, nuclear medicine and radiation oncology. These hospitals should be equipped with digital television, MDCT, MRI (> 1.5 T), angiography, mammography, SPECT, High-energy LINAC, CT-simulator, and PACS. There should be more than three board-certified diagnostic radiologists and one board-certified radiation oncologist, and 200 beds in the hospital. In order to improve the quality of board-certified radiologists in Japan, many efforts need to be made in human and technological aspects.

The Future

The future of radiology in Japan depends on whether we can fill the large gap between the number of radiologists and imaging units. To attract future radiologists, it is necessary for us to maintain high-quality radiology practice. Education is the basis for developing outstanding human resources. The future of radiology in Japan depends on whether we can continue to utilise and further improve the training programme for the radiology board under the strong leadership of JRS. In future, globalisation is a key concept for radiology in Japan, and much more interest will be paid in cross-border communication and exchange of advanced knowledge and technical innovations. ■

KEY CONFERENCES & EVENTS

FEBRUARY 2013

9 – 14 **SPIE Medical Imaging**
Florida, US
www.spie.org

MARCH 2013

7 – 11 **European Congress of Radiology (ECR)**
Vienna, Austria
www.myesr.org

APRIL 2013

14 – 19 **113th Annual Meeting of the American Roentgen Ray Society**
Washington, US
www.arrs.org

15 – 19 **13th Annual IHE-Europe Connectathon**
Istanbul, Turkey
www.connectathon2012.org

21 – 26 **Radiology in Venice**
Venice, Italy
www.radiologyintl.com

MAY 2013

1 – 4 **Global Embolization Symposium and Technologies (GEST) Europe**
Prague, Czech Republic
www.gest2013.eu

2 – 5 **14th World Congress of the World Federation for Ultrasound in Medicine and Biology (WFUMB) including Latin American Foundation for Ultrasound**
São Paulo, Brazil
www.wfumb.org

JUNE 2013

4 – 7 **European Society of Gastrointestinal and Abdominal Radiology (ESGAR) Annual Meeting**
Barcelona, Spain
www.esgar.org

19 – 22 **European Conference on Interventional Oncology (ECIO)**
Budapest/Hungary
www.ecio.org

26 – 29 **CARS 27th International Congress and Exhibition**
Heidelberg, Germany
www.cars-int.org

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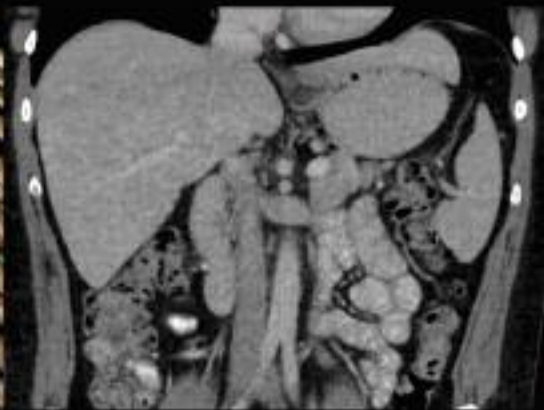
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