SPECIAL REPORT

November 2014

AGFA HealthCare

DOSE MANAGEMENT

Because life is precious

DOSE MATTERS

A clear path to the future of radiation dose reduction

Reducing dose is on everyone's agenda! Today, only a small proportion of patients receive the lowest imaging radiation dose technically possible. But more and more, across the entire medical community, we are becoming aware of the need to join forces to further improve radiation safety. This is especially important in neonatal and pediatric care, dealing with the most sensitive patients.

We at Agfa HealthCare are committed to playing our part to provide diagnostic image quality at the lowest dose. Our goal is to provide solutions that allow facilities to control and reduce the radiation dose patients receive.

How? By developing solutions that use state-of-the-art technologies to go beyond today's guidelines in order to satisfy tomorrow's needs. Our Fast Forward Digital Radiography Upgrade Program provides hospitals with a step-by-step upgrade path to transition from traditional computed radiography (CR), to cesium-based digital radiography, following the guidelines of EuroSafe and Image Gently. As a leader in medical imaging, we are taking on a key role – collaborating with academia, healthcare providers and research organizations – to understand and contribute to best practices in dose management. Image quality and dose are inextricably linked; we continue to work to find ways to optimize the balance between the two.

But success will require everyone's perspective. In this Special Report, we will explore the issues of dose: the why and the how of dose reduction. In an interview, pediatric radiologist Maria-Helena Smet of University Hospitals Leuven, Belgium explains why the smallest patients – neonatal and pediatric – need the most advanced imaging technologies. She and her team are carrying out testing with Agfa HealthCare to find new ways to reduce dose.

In another article, Jan Leeuws of Agfa HealthCare describes in depth how we are taking on our responsibilities in the field of dose control and reduction. And we'll show you how we are working with others in the care continuum to keep the momentum going and to increase awareness.

Because dose matters – Life is precious!

Caroline Burm
Marketing Communications Manager

Radiation Dose Initiatives

ESR EUROSAFE IMAGING

IMAGE WISELY™ Radiation Safety in Adult Medical Imaging

image gently®

The Agfa HealthCare editorial team would like to thank all those who contributed to this publication.

In profile

JAN LEEUWS
Business Unit Manager Digital Radiography, Agfa HealthCare, Mortsel, Belgium

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Committed to delivering on dose reduction

With dose reduction an increasingly hot topic, Jan Leeuws, Business Unit Manager Digital Radiography, highlights Agfa HealthCare’s ongoing role in driving forward solutions that meet both current and future challenges.

'Agfa HealthCare has long been committed to delivering dose reduction capabilities to our customers,' says Jan Leeuws. 'As one of the first imaging companies to bring needle plate detector technology to the market, both within our CR solutions portfolio and later in our DR solutions, we recognized the need for a balance between high image quality and the management of dose. When we introduced the cesium detector panels, which deliver greater Detective Quantum Efficiency (DQE) and higher image quality at a significantly reduced dose, radiologists enjoyed their first steps on the road to optimizing the balance between dose and image quality. In fact, the dose reduction achieved using our cesium detector can reach a potential of 50% to 60% dose reduction* for both CR and DR.'

Prioritizing neonatal and pediatric patients

However, as Jan explains, achievements in dose reduction are still at a very early stage. 'Currently a small number of X-ray exposures are benefiting from lower dose – so there is still a lot of ground to cover. But, empowering radiologists to lower dose – particularly within the neonatal and pediatric field – continues to inform much of our work as this is the most vulnerable group when it comes to dose.'

Says Jan, 'When a baby or small child is very unwell, they can often require chest X-rays every hour. Optimizing the capabilities to manage dose is, we believe, fundamental to helping the medical field deliver dose reductions in the future.'

A powerful portfolio of dose reduction tools

Agfa HealthCare's dose reduction arsenal comprises a number of well-established solutions as well as more recent additions to the portfolio. The aforementioned cesium phosphor technology is enhanced and empowered by third generation MUSICA image processing software. Renowned for delivering diagnostic value images, MUSICA together with cesium phosphor technology enables radiologists to lower the dose by making it easy to see details for diagnosis.

When allied with the productivity and centralized dose monitoring capabilities

> “Live studies at key healthcare sites across the world are essential to refining and enhancing new and existing solutions.”
>
> **JAN LEEUWS**

of the NX Multi-Modality workstation and the PACS Dose Management solution, this combination of solutions delivers a powerful set of tools for dose control and follow-up.

Empowered by technological excellence

As Jan explains, ‘Clinicians using NX Workstations are able to determine the correct patient exposure and avoid “dose creep”. By capturing the X-ray parameters and keeping statistics, hospital physicians can monitor and manage dose through access to records, charts and graphs generated by the NX Workstation. Exposures can be tracked and monitored for trends, such as an overall drift up or down or even comparisons among technologists.’

Unique color-coded standardized exposure index

The NX Workstation also boasts a unique color-coded standardized exposure index. This appears as green, yellow or red to indicate whether the radiation exposure is acceptable, slightly out of range or dramatically out of range. ‘This Agfa HealthCare proprietary technology provides a simple visual way for technologists to verify that they have a good exposure before capturing the image,’ explains Jan. In addition, the NX Workstation provides a common interface for DR and CR systems, which streamlines workflow, simplifies staff training and helps standardize department operations.

Tracking radiation exposure across modalities, departments and institutions

‘Another dose management tool element is our PACS Dose Management solution,’ explains Jan. It tracks the patient’s radiation exposure across modalities, departments and institutions; provides research-quality data on dose levels and supports hospital’s and department’s efforts to comply with regulations and available guidelines.

Changing perspectives through retraining is essential

Jan is quick to add that, ‘providing improved technological capabilities is just one element of progress; re-training staff is another key factor. Simply presenting staff with dose lowering capabilities and expecting them to immediately adopt a lower dose approach is not realistic’, says Jan. ‘A core part of achieving dose reduction lies in the education and re-training of staff.

At Agfa HealthCare, we have had extensive experience over the years in helping customers transition smoothly from film to DR and all stages in between. We know the value of taking people along with you, of changing mind-sets and adopting a step-by-step approach to digital technology implementation.’

Partners of choice

Of course, Agfa HealthCare does not work alone in developing new capabilities within this area. ‘Live studies at key healthcare sites across the world are essential to refining and enhancing new and existing solutions, as Jan explains. ‘We regularly work with interested parties to assess the practical application of our solutions. Studies are also currently being undertaken on sites in Leuven and Munich, which will help inform how the solutions are further developed. We also actively support organisations such as Eurosafe, ImageGently and ImageWisely.’

Advancing dose management for future needs as well

As to the future, Agfa HealthCare has a range of specialist teams working together to deliver a cohesive dose management strategy and Jan is clear that prevention of dose is better than reduction.

‘Delivering solutions that satisfy today’s legislation or guidelines is simply not enough; we need to anticipate and develop solutions to satisfy future needs too. We are committed to protecting the long-term health of the public and that means advancing our knowledge and understanding of dose management to inform future developments.’ ■

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* Testing with board certified Radiologists has determined that Cesium Bromide (CR) and Cesium Iodide (DR) Detectors when used with MUSICA processing can provide dose reductions of between 50 to 60% when compared to traditional Barium Fluoro Bromide CR systems. Contact Agfa for more details.

In profile

PROF. DR. MARIA-HELENA SMET
Pediatric Radiologist in the Department of Radiology at University Hospitals Leuven (UZ Leuven) and Associate Professor at the Faculty of Medicine, University of Leuven (KU Leuven), Belgium

> “Image quality has two aspects: physical quality and clinical image quality. Physical quality is easier to measure. But the clinical image quality is more personal, based on the viewer’s preferences and needs.”

PROF. DR. MARIA-HELENA SMET
Pediatric Radiologist in the Department of Radiology at University Hospitals Leuven (UZ Leuven) and Associate Professor at the Faculty of Medicine

In small doses

Reducing dose to improve the long-term health and safety of premature babies and neonatal patients

To visit UZ Leuven's new, state-of-the-art Neonatal Intensive Care Unit (NICU), you have to go through special measures, from careful hand and arm washing, to wearing gloves and removing rings, to wearing a gown over your clothes. But these are just a few of the precautions to protect the delicate patients, who face elevated health risks in several areas.

Other actions taken for patient safety are not so visible, yet are just as important, including the ongoing efforts of UZ Leuven's pediatric radiology department to reduce to the minimum the amount of radiation neonates (as well as other pediatric patients) receive. Professor Maria-Helena Smet, a Pediatric Radiologist at UZ Leuven, and her colleagues are spearheading efforts and research into dose reduction and image quality optimization. Along with a multi-disciplinary team, including Agfa HealthCare, she is carrying out the testing of CR and DR modalities to determine which allows the greatest dose reduction while still offering the image quality needed for the specialty. She sat down to explain the research, and why dose reduction is so important in pediatric radiology.

AGFA HEALTHCARE ***How is neonatal and pediatric radiology different from imaging for adults?***

PROF. SMET Imaging is absolutely crucial for many of our NICU patients, who can have a broad range of pathologies, including the positioning and checking of catheters. One baby can require multiple images during a stay here, and may need additional images in the future.

But the imaging can be quite challenging. Between premature babies and other neonates you can have a huge size and weight difference: anything from an extremely premature baby weighing only 500 grams, to a full-term baby that can weigh from 2500 to 4000 grams. And each individual patient will change and evolve over time, rapidly and significantly. The chest of a grown man, for instance, will be essentially the same at 20 years, 30 years, 40 years… and the radiation dose will remain the same. This is not at all the case in pediatric imaging! And the smaller the patient, the more significant the changes.

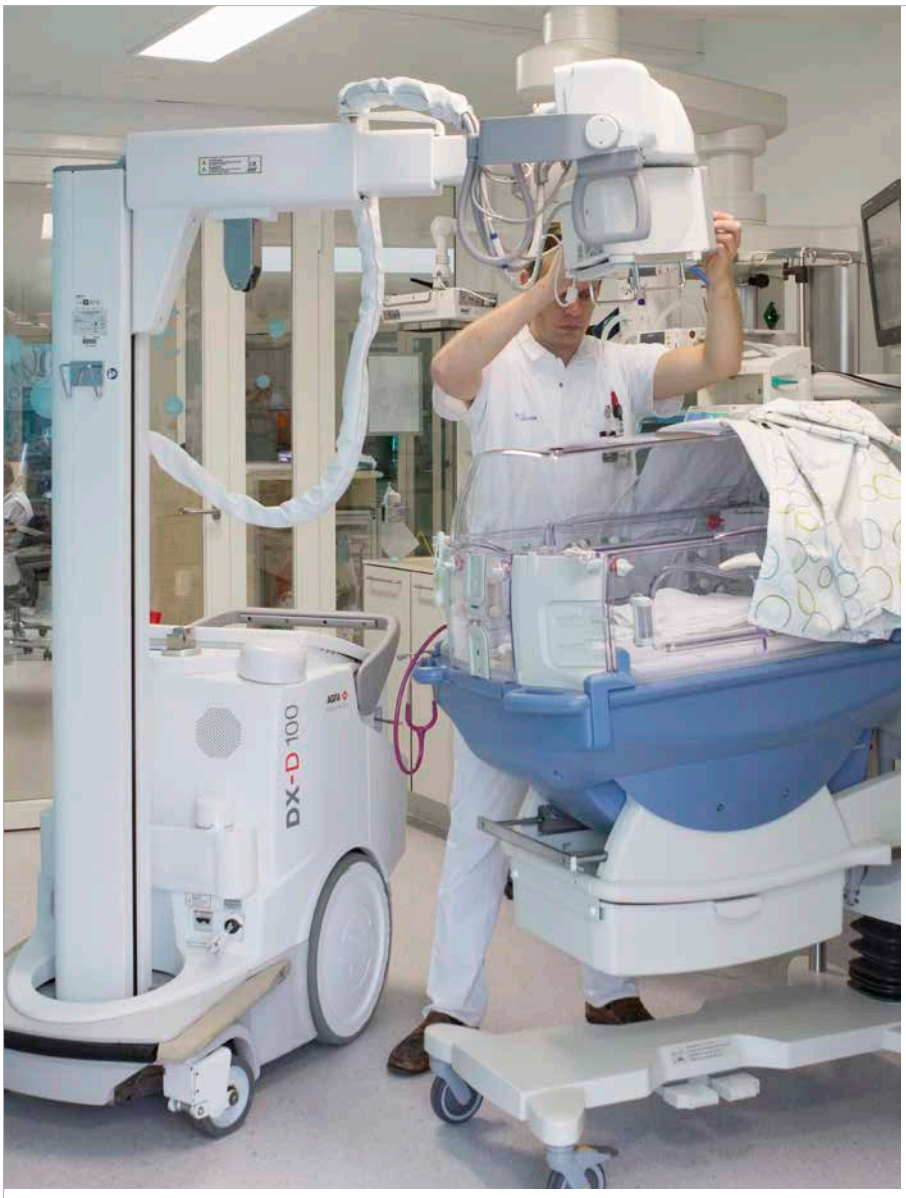
With this smaller size, the structures being imaged are also smaller, as are the catheters. Some of the structures have a high contrast and some have very low contrast. And here in the NICU, we are often dealing with a broad range of pathologies that can be visible in the images. It's a very mixed population.

What's more, their cells are still developing and dividing. DNA repair after radiation is difficult and hence these patients are more susceptible than adults to stochastic effects, such as radiation-induced cancer. Radiation effects are known to appear a long time after the imaging process. The probability of a stochastic effect is proportionate to the dose, but the severity is independent of absorbed dose. And it may occur without a threshold level of dose.

Finally, we must remember that radiation risks are cumulative throughout the patient's life. And while we are very pleased that our NICU and other pediatric patients have ever-greater life expectancies, there is also thus more time for carcinogenic effects to appear.

So we must find ways to lower radiation dose without impacting the quality of the imaging. We have achieved a lot in this area over the 30 years I have been practicing medicine, and I believe there are still dose reductions to be found.

In this neonatal environment, our Agfa HealthCare DX-D 100 has been ideal. We got this mobile wireless DR solution in early 2014. It has proven very convenient, very smooth in operation,



with a short turning circle that is ideal for the individual patient rooms in the new department. The detector fits into the incubator, and we can switch off the batteries when not in use, so battery life is longer. And of course the image quality is very good. In all, it fits right in.

In this context, what does image quality mean to you?

In neonatal and pediatric imaging, the term image quality relates to whether an image allows me, in a clinical situation, to answer the clinician's question. If I can, then the image quality is good or good enough. So image quality isn't really something tangible but certainly has important consequences.

And as we follow the ALARA (As Low As Reasonably Achievable) principle for dose, image quality can even vary for a specific image, depending on what we need it for. An image that is not the 'highest' quality can in a certain case be perfectly suitable for our needs, allowing us to use a lower dose. On the other hand, there are radiologists who prefer to always have 'very high quality' for every image. This attitude does not fit the ALARA principle.

Image quality thus has two aspects: physical quality and clinical image quality. Physical quality is easier to measure: DQE, MTF, SNR, CNR…

But the clinical image quality is more subjective, based on the viewer's preferences and needs. So, despite the physical quality parameters, the radiologist may say: "No, I don't like it, the image quality is not what I want or need." How should we measure that perceived quality? One can make a visual grading analysis, look at statistics, etc., but it's difficult to test on very young patients. We have tested whether we can use the physical quality parameters to predict the clinical perception of image quality. In other words, is there a definable, measurable relationship between them? We found that in the present case, the physical measurements largely predicted the perceived clinical image quality.

There is an additional complication with digital imaging because the clinician is aware when dose is too low, but not when dose is too high. Low dose results in image noise but high dose just gives you very nice images, which can lead to something called 'dose creep' – slowly increasing dose to have ever 'better' images, when in fact images acquired at a lower dose would be sufficient to perform the clinical task. We need to eliminate this.

Of course, you can't push dose reduction too far either. Sometimes it is a question of trial and error.

What tools help you to control and reduce dose?

First of all, we try to take only images that are necessary. For example, we might do an en face spine image but not a profile image, which increases lumbar dose, because we often have enough information from the first image.

Post processing is very important. I worked with Agfa HealthCare to adapt the second-generation MUSICA image processing software for neonatal use, and now I am working with them on the next generation, MUSICA 3. As I said, with these very small children you can have small structures with high or low contrast. MUSICA offers a proper balance between the contrasts, with a better preservation of low contrast details next to high contrast structures. You also need a very stable image processing to ensure standardized images.

Collimation is key, too. Consider an adult chest versus an infant chest. If the technician increases the field by 1 cm on top and bottom, this makes little difference for the adult. But for the infant, the proportional increase is huge! This can account for as much as 70% of the radiation dose.

We have to keep track of the dose each patient has received. For our fixed imaging modalities, we have integrated software that automatically records the technician, the dose, the parameters and the patient. So that information becomes

part of the patient's file. For our DX-D 100, we do the calculations ourselves, but we will add the software soon.

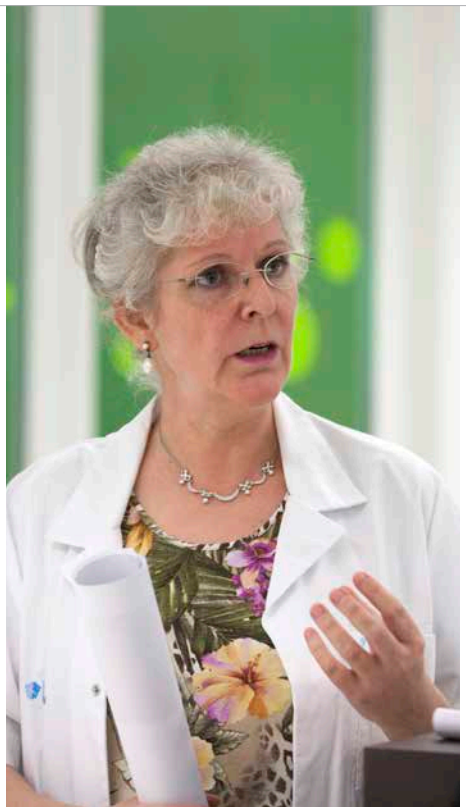
How are you carrying out the modality testing?

We have been testing three Agfa HealthCare detector systems: a CR system using powder phosphor, a CR needle-based phosphor system and a DR needle-based phosphor system. Our goal is to find the optimal parameter settings – the right mAs, the right kV, the right filtration – to allow us to use the lowest acceptable dose for diagnosis.

The testing is quite complex, and we have already acquired a total of 66 phantom images. These images were scored with image quality criteria during three sessions, with every session taking about an hour. As a next step, we performed a comparative scoring test. I work on this in between my clinical responsibilities, and I see it as a necessary and logical part of my job. This makes my job very busy, yet rewarding in terms of scientific insights and quality improvement.

We do have some preliminary results. For example, our results indicate that we may be able to reduce dose with the fine needle phosphor detector compared to the general powder phosphor detector, while still generating acceptable image quality. But we still have a lot of testing to do. For example, we need to subdivide the effect of filtration on image quality.

What's key here is that, like in so much of patient care today, a multi-disciplinary approach will get the best results. To find ways to reduce dose, we can't work in isolation, nor can manufacturers. So our team includes radiologists, clinicians, technicians, engineers, physicists, the manufacturer of the system – even statisticians! We need them all, and we keep in regular contact – that's the best framework for this type of testing.



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While the awareness of the importance of dose reduction has increased in the past years, it has always been an issue. In fact, it was one of the reasons I was attracted to the specialty of pediatric radiology 30 years ago. And we have made a lot of progress, thanks to better parameter settings, digital detectors, better training… Here at UZ Leuven, we already use a quite low dose. The high image quality we get from the needle-based CR and DR indicates that there is still further room to reduce dose. In other types of imaging, we see for example that the speed of CT is increasing, allowing less sedation or anesthesia, and greater throughput. I would also like to see greater availability and increased speed in MRIs – with small children, speed is key!

We have to always remember – the smallest patients are also the most sensitive. We must find the balance between quality and dose. ■

UZ LEUVEN'S NEW NEONATAL ICU

Early in 2014, UZ Leuven opened the doors of its new NICU. This state-of-the-art facility is designed to be family-centered, yet still provide maximum safety and care for the patients. All rooms are now private (32 single rooms and 4 twin rooms), offering better family-infant interaction. The rooms encircle three central bays, from which care staff can monitor each patient and quickly respond to their needs. Family and visitors enter the rooms through the comfortable and welcoming corridor area that runs along the outside of the room, so caregiver and family streams don't cross.

White paper

Optimizing Patient Dose

Agfa HealthCare provides technology and tools for patient X-ray dose reduction

The study outcome shows that substantial dose reductions of up to 60% can be achieved with cesium halide based detectors in either CR or DR systems, combined with the Agfa HealthCare MUSICA Fractional Multiscale image processing software.[1]

Higher image quality with needle phosphor technology translates to equivalent image quality at lower exposure levels!

- DQE of cesium-based detectors is more than double of that of powder phosphor-based CR detectors.
- Needle phosphor detectors are used in Agfa HealthCare's CR (CsBr doped with Eu) and DR systems (CsI doped with TI).

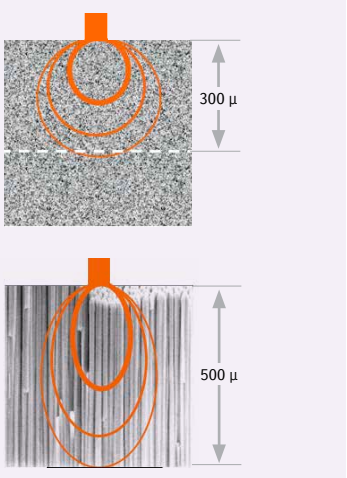


FIGURE 1 Electron microscope images with powder (top) and needle (bottom) phosphors

White paper summary

The ALARA principle (As Low As Reasonably Achievable) will remain the key method used to determine the proper exposure technique for a given examination. However, the technology and the methods used to achieve the lowest reasonably achievable dose will continue to evolve.

New, more efficient technology can have a significant impact on required dose levels. To confirm this, Agfa HealthCare conducted both a technical assessment and an image quality evaluation with radiologists. The goal of this evaluation was to determine by how much patient exposure (and dose) could be reduced while providing the same or similar image quality, comparing conventional BaFBr plate CR systems to CsBr needle plate CR systems and CsI needle scintillator DR detectors using Agfa HealthCare's MUSICA image processing.[2]

Cesium detector

High absorption of the X-ray quanta in the phosphor layer of CR and DR detectors is a prerequisite for good image quality.

The thickness of the powder phosphor layer is limited to less than 300 μm, because of light scattering. This limit to the thickness also imposes a limit to X-ray absorption.

Higher X-ray absorption is possible with the CsBr and CsI needle crystalline radiography detectors, due to the low light scattering, therefore a thicker phosphor layer can be used without jeopardizing the sharpness of the imaging system.

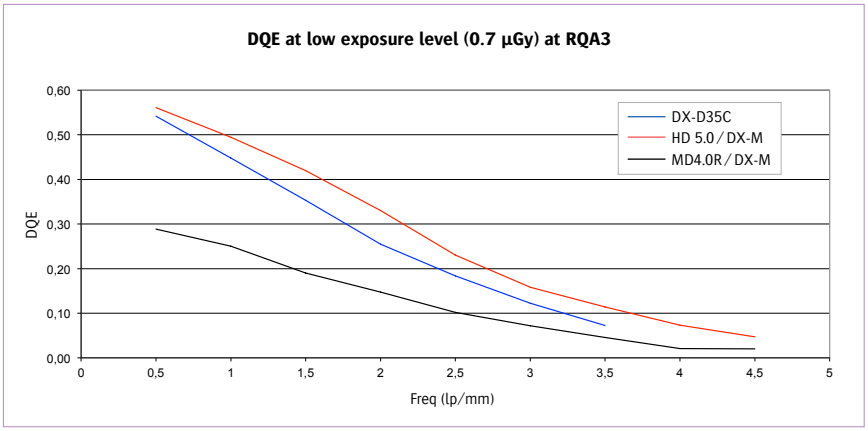


FIGURE 2 DQE measured according to the IEC62220-1 standard for three Agfa HealthCare imaging systems: BaFBr CR (MD4.0R), CsBr CR (HD5.0), CsI DR (DX-D 35C, DX-D 30C). DQE at RQA3 beam quality at ~0.7 µGy.

MUSICA image processing

Due to the strong focus on dose reduction in radiographic imaging, increasing numbers of radiographic images are taken at a lower dose, resulting in higher noise content.

Agfa HealthCare's MUSICA processing is based on a new mathematical multiscale framework: Fractional Multiscale Processing (FMP). It is used to achieve active noise reduction, which results in much more efficient image denoising with preservation of the fine and subtle image structures.

Clinical image quality study

Both the CsI DR detector and CsBr CR detectors with MUSICA image processing showed a substantial reduction in dose when compared to conventional BaFBr CR systems.

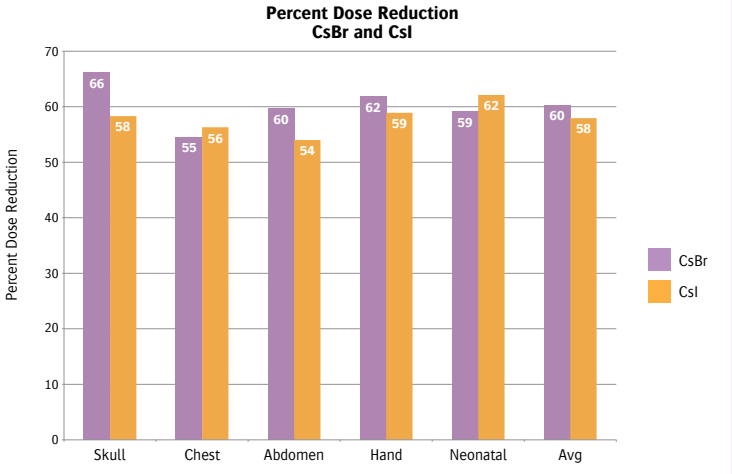


FIGURE 4 The average percentage dose reduction for CsI DR (DX-D 30C) detectors and CsBr CR (HD5.0) plates with the various phantoms

In clinical practice, the improved performance available with cesium phosphors can be used to significantly reduce dose for various types of radiographic examinations where lower dose is critical; for example neonatal imaging.

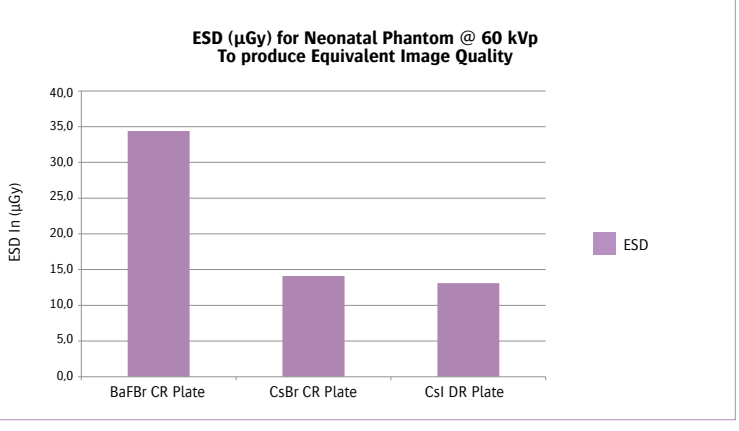


FIGURE 5 The average Entrance Skin Dose (ESD) required for equivalent image quality with BaFBr CR plates, CsBr CR (HD5.0) plates and CsI DR (DX-D 30C) detectors with a neonatal phantom.

Image processing and noise reduction can also play a key role.

FIGURE 3 Neonatal: lungs, liver and skeleton

Up to 60% dose reduction is possible with cesium-based detectors and MUSICA image processing

- Both the CsI DR detector and CsBr CR detectors with MUSICA image processing showed a substantial reduction of between 50 to 60% in dose when compared to conventional BaFBr CR systems.

IEC exposure index & dose monitoring

Agfa HealthCare was the first manufacturer to fully implement the IEC exposure index standard in 2009. When this index is coupled with Agfa HealthCare's color-coded exposure indicator, the technologist receives immediate visual feedback.

Agfa HealthCare's extended dose monitoring software tools enable QC supervisors and physicists to quickly and easily monitor the exposure and dose history of an individual technologist or of any CR or DR system in the department. They can also produce exposure outlier reports, scatter plots and exposure histograms.

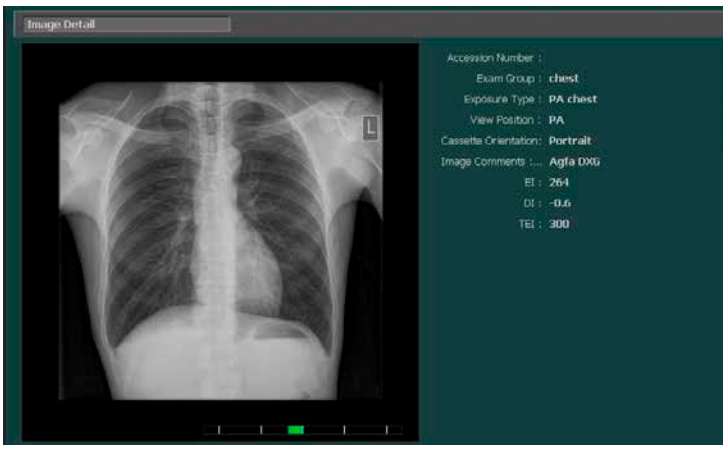


FIGURE 6 Basic exposure monitoring: color-coded exposure

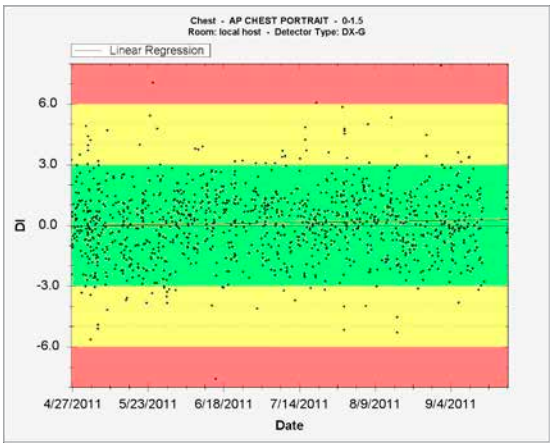


FIGURE 7 Extended dose monitoring: scatter plot

Innovative and market-leading solutions

Agfa HealthCare's digital radiography systems have been implemented and used worldwide since 1993. The huge installed base of more than 50,000 units clearly illustrates the confidence customers have in Agfa HealthCare products throughout medical communities worldwide.

We provide you with innovative and market-leading solutions to keep your systems and technology up-to-date, and to make a significant change in required dose. Whenever possible, cesium halide-based detectors in combination with MUSICA should be used to minimize dose and achieve optimum image quality.

We are committed to being your imaging solution provider for life. ■

[1] Testing with board certified radiologists has determined that cesium bromide (CR) and cesium iodide (DR) detectors when used with MUSICA processing can provide dose reductions of between 50 to 60% when compared to traditional barium fluoro bromide CR systems. Contact Agfa HealthCare for more details.

[2] White paper: Optimizing Patient Dose. Agfa HealthCare provides technology and tools for patient X-ray dose reduction. Authors: Dirk Vandenbroucke, Bruce Apgar, Tom Bertens; Date: October 2014.

How our company contributes to radiation protection
Agfa HealthCare

Towards safer imaging in neonatal & paediatric radiology

Be part of the European Society of Radiology's radiation protection initiative, become a Friend of EuroSafe Imaging. www.eurosafeimaging.org

Long-term health for fragile patients

The reduction of radiation dose is the biggest challenge facing paediatric radiologists today. This is not only due to children's higher sensitivity to radiation, but also to the cumulative effect of the radiation. A premature infant, for example, may undergo 30-40 exams over the course of treatment. In neonatal intensive care units (NICUs) diagnostic radiology is key to effective diagnosis and treatment of these fragile patients. Yet, it's clear that finding ways to reduce radiation exposure for neonatal and paediatric patients makes sense for preserving their long-term health.

Belgian agencies FANC-AFCN (Federal Agency for Nuclear Control) and SCK-CEN (Study Center for Nuclear Energy) conducted a study on radiology doses delivered to babies born before 37 weeks of gestation (report published in 2013). The research followed 285 premature babies in NICUs across Belgium, with birth weight as low as 500g, who underwent a combined total of 830 examinations during their hospital stays.

The study, titled ***PreDos***, measured tube output for every contributing x-ray system in the participating hospitals. For each patient, the number of examinations was extracted from the PACS. The researchers found wide variation in the estimated doses across the hospitals. Causes included variations in exam settings, focus-detector distance and tube output for the different x-ray machines. In addition, there were significant differences in the number of exams each patient underwent.

Another European study from 1997 showed a radiation dose variation factor of 70 across different European healthcare facilities. As premature babies can undergo two to three exams each day, this level of variation is unacceptable. Improving awareness of radiation protection, including through initiatives and campaigns like EuroSafe Imaging, is critical to improving medical radiation safety for all patients.

How to pinpoint the optimum balance between radiation dose & image quality

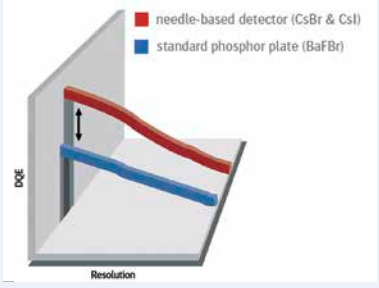
This is the question that Agfa HealthCare is committed to answering. Already, we have developed several tools to support paediatric radiologists – and radiologists in general – in minimising and monitoring patient dose. We have worked together with neonatal and paediatric radiologists to adhere to the 'as low as reasonably achievable' (ALARA) principle, and with hospitals in general, to introduce best practices. We understand that if radiation studies can be performed with less radiation, they should be, and we are committed to empowering imaging centres to do so. Our aim is to advance efforts in dose management because it could, ultimately, have an impact on people's long-term health.

Exposure index standard helps reduce possibility of exposure errors

Agfa HealthCare was the first company to fully implement the exposure index standard into its modalities. Introduced by the International Electrotechnical Commission (IEC) and the American Association of Physicists in Medicine, this standard method for tracking exposure reduces the possibility for exposure errors, as technologists only need to remember one method for monitoring exposure changes, regardless of which vendor's technology is being used for image capture. The exposure index has since become an industry-accepted standard by manufacturers around the globe.

Radiation exposure monitoring with Dose Management

Agfa HealthCare's Dose Management radiation exposure monitoring solution tracks, stores and performs analysis on radiation dose data from multiple modalities. Until recently, dose data was often not automatically recorded, making tracking di cult. Technology innovations and standards are improving the accessibility of this information, and Dose Management can help caregivers and facilities perform patient dose tracking with ease. PACS and modality-vendor neutral, it allows disparate data to be shared and used for analysis, and includes a data modelling tool. Its simple integration with other radiology department systems means dose history can be accessed from anywhere.



High-efficiency needle phosphors for digital radiography

High-efficiency needle phosphors have an important role to play in dose management. In direct radiography (DR), this includes cesium iodide (CsI), while for computed radiography (CR) we offer cesium bromide (CsBr). Their higher x-ray absorption and conversion efficiency offer a higher DQE (detective quantum efficiency) which can lead to higher-quality images and lower dose requirements, improving the optimum balance between dose and image quality.

MUSICA image processing and NX dose management tools

In Agfa HealthCare's solutions this needle phosphor technology is complemented further by MUSICA, a leading image processing tool for optimising image quality. Adding in the productivity and centralised dose monitoring capabilities of the NX multimodality workstation provides a powerful set of tools for dose management.

The NX workstation includes a colour-coded exposure bar which clearly and visually indicates to the radiologist whether the radiation exposure is 'acceptable', 'slightly out of range' or 'significantly out of range'. Exposure can also be tracked and monitored by a technologist for trends, such as upward drfit, downward drift or even variations.

About Agfa HealthCare

Agfa HealthCare is all about achieving optimal image quality. A global leader in the fast-growing market of integrated IT and imaging systems, we offer healthcare facilities a seamless flow of information and a 360° view of patient care. Our unique, holistic approach enables us to provide in-depth clinical know-how and fully integrated hospital-wide IT and imaging solutions for radiology, cardiology, mammography and orthopaedics.

As a leader in medical imaging, we have taken on a key role in understanding and contributing to best practices for dose management. Our teams develop new technologies and solutions that can help reduce radiation dose while delivering high-quality images on the front lines of imaging, and provide smart ways to manage dose appropriately. We see dose management as a logical extension of our expertise, as image quality and dose are inextricably linked. So we will continue to find ways to use our technology to produce high-quality images.

We found the images to be sharper and crisper which help us detect faster and with more ease. MUSICA's detail visualization quality leads to fewer exposures during examination, potentially lower X-ray doses, faster patient turnaround times and more reading and reporting comfort for us.

DR. AZMI BIN NOR
Head of Radiology
Metro Specialist Hospital
Malaysia

I was impressed by DR's potential to reduce X-ray doses to the patient due to its Cesium Iodide detector.

DR. SURENDER REDDY
Owner & Managing Director
Vijaya Diagnostic Centre
Hyderabad, India

The results showed that while the amount varied depending on the type of exam, the average dose on most was 41% lower with the Agfa HealthCare system versus the other systems– an admittedly unexpected result for Zwanger-Pesiri.

DR. STEVEN MENDELSOHN
Chief Executive Officer/
Medical Director
Zwanger-Pesiri Radiology
New York, USA

We get higher-quality and more diagnostically meaningful images with a lower radiation dose.

DR. KARINA HOFMANN-PREISS
Owner & Managing Director
Institute of Diagnostic and Therapeutic Imaging (BDT)
Erlangen, Germany

To reduce radiation dose by almost 60% and still have the same image quality is a significant step forward for Children's Mercy and our neonatal patients.

DR. JAMES C. BROWN
Chairman of the Radiology Department
Children's Mercy Hospitals and Clinics
Kansas City, Missouri, USA

We opted for a cesium iodide (CsI) detector, which we estimated would let us use 30% to 40% lower dose.

PROF. DR. REINHARD LOOSE
Radiologist
Klinikum Nürnberg Nord
Nürnberg, Germany

The Agfa HealthCare CR solution with NIP (needle-based imaging plate system) and MUSICA image processing software is very effective in terms of dose reduction.

DR. LÉON RAUSIN
Pediatric Radiologist
The Citadelle regional Hospital
Liège, Belgium

We can obtain very high quality images, particularly where the patient is lying prone in the ICU. In these cases, we can reduce the radiation dose by 10 to 15%.

DR. HANS BENDER
Head of Radiology and Nuclear Medicine
Bethanien Hospital
Moers, Germany

The Right Dose of Expertise: Best Practices, Best Protection

INTERVIEW WITH **MARILYN GOSKE,** MD, Chair of the Alliance for Radiation Safety in Pediatric Imaging • **KEITH STRAUSS,** PhD, Medical Physicist, Cincinnati Children's Hospital • **MYTHREYI CHATFIELD,** Director of Data Registries, American College of Radiology • **ROLAND RHYNUS,** Executive Director of Radiology, Loma Linda University Medical Center • **AIMEE GALLEGOS,** RT, Radiology educator at Loma Linda • **STEVE DON,** MD, Pediatric Radiologist, St. Louis Children's Hospital

Clinicians, physicists, and other experts share their experience and lessons learned about how to implement and carry out a successful CR/DR dose monitoring program.

By Elaine Wilson

When compared to other modalities, radiation dose associated with CT has generated the most media buzz, public concern, and subsequent hospital administration attention. Still, while radiation dose from computed radiography (CR) and digital or direct radiography (DR) is relatively much lower, the percentage of exams coming from these modalities is much higher. Yet, despite their high volume, CR/DR protocols at institutions may be overlooked.

"With CR/DR, for the concerned party, the volume of procedures is really large," said Mythreyi Chatfield, American College of Radiology (ACR) director of data registries. "For any single exam, the dose is lower than the corresponding CT, but there are many more chest X-rays that are done, compared to CTs. Typically, there isn't the same level of concern with regard to X-rays, so a child might get repeated exams."

According to numerous experts, there is significant variation in how patients, especially pediatric patients, get imaged using CR/DR.

Marilyn Goske, MD, chair of the Alliance for Radiation Safety in Pediatric Imaging, said that ideally, the imaging technique that is used should be based on the size of the body part of the patient to be examined. Previously, the amount of radiation administered was based on age, or sometimes body weight.

Furthermore, there are approximately 40 dedicated pediatric hospitals in the country, but these hospitals perform only about 20% of all pediatric emergency department imaging, said Keith Strauss, PhD, medical physicist at Cincinnati Children's Hospital, where Goske also works as a pediatric radiologist. "Adult hospitals may image a small number of children daily, but that's not the majority of the patients that they image," he said. "Therefore, the majority of kids in this country get imaged in nonpediatric hospitals, which may not be focused on the unique needs of pediatric patients."

It is important to acknowledge that one cannot predict the size of a child from their age. The thickness of the belly of the largest 3-year-old is the same size as that of the smallest 18-year-old, Strauss said. "A pediatric technologist who works with children continually knows automatically who is a large, small, or normal sized 5-year-old. But a technologist who normally works with adult-sized patients who is asked to image kids occasionally, may have a difficult time accurately judging the thickness of a child and what technique to use."

Strauss pointed out that an important challenge of CR/DR is how to produce good quality clinical images with a reduced dose of radiation. "It's similar to a photographer – anybody can take a good picture on a sunny day; you find out who is more skilled when it's dark and cloudy," he said. "Obtaining good quality images with less radiation dose is more difficult."

The Early Days of Film

Before the digital era, X-ray images were recorded on film. If the technologist used too much or too little dose in creating the image, there was an immediate feedback. Too much dose produced a dark image; too little dose resulted in a light image. "With digital imaging, that feedback of the brightness of the image is lost," Strauss said. "The digital imaging receptor compensates for differing levels of dose. So if you are not vigilant, your doses can increase.

"If the dose is too high, the image quality will be excellent," Strauss continued. "If the dose is too low, the image will be unacceptable to the radiologist who will object. So low doses get corrected, but high doses may be overlooked."

For these reasons, digital imagers provide relative dose indicators on the images, and are designed to give information on the relative patient dose. "Unfortunately, these indicators are not

> "While we used the Web-based module on pediatric fluoroscopy as a basis for the campaign, it was a group effort, led by radiologic technologists and a radiology assistant interested in quality improvement. The technologists developed a safety checklist, posters, T-shirts, and other promotional materials to bring the safety message to the department."
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> **MARILYN GOSKE**
> MD, Chair of the Alliance for Radiation Safety in Pediatric Imaging

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>
> **KEITH STRAUSS**
> PhD, Medical Physicist, Cincinnati Children’s Hospital

as accurate as we would like them to be,” Strauss said. “The indicators require some interpretation by the technologist; they are not as foolproof and simple as the old dark/light film was.”

Steve Don, MD, pediatric radiologist at St. Louis Children’s Hospital, described how in the screen-film radiology days, if an exposure was too high or too low, the image was too dark or light and it was obvious to the radiologist and the technologist. “They would put the under- or overexposed image in the waste bin, the quality assurance technologist could look through the bin to see what exams were being repeated, the technologist who took it, and the reason – did the patient move, was it over/underexposed, appropriately collimated,” he continued.

With digital imaging, computers were able to compensate for over- or underexposure. “There’s a desire on the part of the radiologist to want the best-looking image as possible,” Don said, adding that increasing the dose just a little produces a less noisy or grainy picture, which radiologists prefer. The radiologist may make a comment to the technologist, who may in turn incrementally increase the dose. This results in what is known as exposure or dose creep.

A Little Bit of Knowledge

At Oregon Health and Science University (OHSU), there are approximately 14 DR rooms and nine portables, with one or two portables still using CR technology. Noting that many of its CR systems were reaching end of life, the medical center began its conversion to DR around December 2012. According to Thomas Griglock, PhD, medical physicist, administration needed to determine whether it was going to spend the money on brand new CR equipment or take the plunge to DR. After site visits and market research, it chose the latter.

The conversion from CR to DR resulted in an unknown benefit for OHSU: if too much radiation is placed on the DR plate, users will actually get burnout on images because DR is only linear up until a certain point – unlike CR, where image quality has a linear response with dose. As a result, technologists can more readily minimize or completely avoid dose creep.

Yet, even with DR, dose creep and unnecessary patient dose can occur. At Loma Linda University Medical Center, for example, medical physicist Don Farley, PhD, polled staff to determine if they could distinguish between the four different types of digital receptors used at the facility: CR powder/barium-fluoro-bromide, CR cesium, DR gadolinium, and DR cesium. Proper identification can allow the technologist to customize techniques for the different types of receptor and thus optimize patient dose. “DR tends to be more sensitive, requiring less dose than conventional powder CR by approximately a factor of 2, which is similar to what film used to be,” Farley said. “In addition, cesium receptors are more sensitive than gadolinium.”

Polling results showed that technologists seldom distinguish between the four different types of receptors, and therefore could not optimize patient dose and image quality. “We don’t want to throw our technologists under the bus, but when they are in a busy clinical environment, they may grab a cassette and go, then use a technique that will result in a good image regardless of the type of receptor,” Farley said. “You may or may not say, ‘This is a cesium, not a gadolinium plate, so I’m going to reduce my dose because it’s more efficient.’ We found that most of our staff just did what almost everyone does, which results in unnecessary dose and dose creep.”

According to Aimee Gallegos, RT, radiology educator at Loma Linda, the learning exercise produced some nerves, in addition to relief. “In being up front about the problem, techs were able to have the time to sit down

and say, 'Wait a minute. Am I really paying attention to all the details? Is this something that I'm aware of on a regular basis?' It was a wake-up call."

Assembling a Team

According to Strauss, facilities that have a medical physicist working as a team member with the radiologists and radiologic technologists in the department should be better equipped and positioned to manage their patient doses with respect to image quality. When he arrived at Cincinnati Children's Hospital 3 years ago, Strauss discovered that the department's radiographic techniques were inconsistent. "All technologists were not using the same technique for the same exam on the same size patient," he said. "The department implemented a program to standardize the choices of the technologists when they select radiographic techniques. All the technologists are now delivering similar radiation doses to the patient."

The involvement of all staff members is crucial to the success of the program, Strauss points out. "My job in consultation with the radiologists and radiologic technologists was to help define what should be done from a technical standpoint," he explained. "But once the program was established, the department turned to its excellent Quality Improvement (QI) group, whose focus was to help implement the program and make sure it was consistently followed."

Cincinatti Children's QI group has another role in contributing to the digital radiography program at the hospital: continual monitoring of radiation exposure. "They actually look at the doses that are being delivered to the patient on a continual basis, to make sure that each of the technologists is succeeding in following the program, because if they're not following the program, their doses will be different than everybody else's," Strauss said.

> "In being up front about the problem, techs were able to have the time to sit down and say, 'Wait a minute. Am I really paying attention to all the details? Is this something that I'm aware of on a regular basis?' It was a wake-up call."
>
> **AIMEE GALLEGOS**
> RT, Radiology educator at Loma Linda

"So number one, you need to have an action plan," Strauss said. "Number two, you need to have a group of people who can work cooperatively together to implement the action plan. Finally, you need to monitor the program over time to make sure the action plan continues to be effective."

At OHSU, there is no formal committee that discusses issues of dose monitoring, but Griglock doesn't see that as a negative. "I don't know that a formal committee is necessary," he said. "One of the things that ends up happening, especially at large or medium-sized hospitals, is inertia because the committees become too big and too numerous." Nevertheless, the department does have a core group of users and experts who weigh in on various issues, whether it's purchasing a new piece of equipment or optimizing protocols. This informal team normally includes administrators, clinical supervisors, radiologists, and medical physicists.

Launching a Dose-Cautious Program

Robert MacDougall, PhD, medical physicist at Boston Children's Hospital, cautions that the goal of a CR/DR program shouldn't be strictly that of dose reduction. "Dose reduction, on its own, is not an appropriate goal for any department. If you are producing images that don't provide the diagnostic quality for accurate interpretation, that is the least safe situation to be in because any dose to the patient is 100% wasted," he pointed out.

Agreeing with MacDougall, Griglock says when people use the term "low dose," it may be a misnomer. "When you say 'low,' it automatically implies you had 'high' before," he said. "What we have here is what I would refer to as a dose monitoring or, better yet, an exposure monitoring program."

Image Gently is an international campaign that raises awareness, provides educational tools, and advocates for radiation protection for pediatric patients. "One of our goals is to provide educational materials through our website (www.imagegently.org) that are free and open-sourced, and can be used by medical imaging professionals at the point of patient care," Goske said. The Alliance for Radiation Safety, sponsors of the Image Gently campaign since 2007, has a specific initiative in each of the imaging modalities.

"What we try to do through Image Gently is share our learning tools with other centers around the country and around the world," Goske said. For example, Cincinnati Children's Department of Radiology launched an in-hospital campaign called "Right Size, Right Dose," based on an Image Gently-produced online module entitled Enhancing Radiation Protection in Pediatric Fluoroscopy. "While we used the Web-based module on pediatric fluoroscopy as a basis for the campaign, it was a group effort, led by radiologic technologists and a radiology assistant interested in quality improvement," she said, adding that the campaign was augmented with lectures to teach the practical aspect of operating fluoroscopic equipment. "The technologists developed a safety checklist, posters, T-shirts, and other promotional materials to bring the safety message to the department." The hospital hopes to launch a similar campaign for CR/DR.

THE IMPORTANCE OF IMAGE PROCESSING

Image processing software should not be overlooked when considering DR or CR systems to help achieve lower radiation dose. Certain image processing offerings provide multi scale contrast level and noise reduction resulting in more image information, even at lower dose. In addition, the software allows radiologists to modify their techniques by increasing the kilovoltage (kVp) and decreasing the milliampere seconds (mAs), thus lowering the effective radiation dose and reducing dose by at least one third without any noticeable difference in image quality.

Adapting to Change, Getting Staff Buy-in

According to Strauss, radiologists at his institution value the consistency of the images that they interpret. A rapport was developed during the development of the program to make sure their needs (image quality) were being met. "As the radiographic techniques were developed, there was constant dialogue with the radiologists starting with, 'Is the image quality still clinically good?'" he said. "At some point, further reductions in patient dose reduce image quality below

> "We know that DR has up to a 50% dose savings, and that it provides us with an increased efficiency, so we're saying that's a twofer. Getting administration to understand that we need new equipment to help us reduce dose can be a challenge. It is especially difficult when they're trying to figure out how to budget for new beds and other basic needs in our changing financial environment."

ROLAND RHYNUS
Executive Director of Radiology, Loma Linda University Medical Center

clinically useful levels. Care is required to make sure this mistake is not made." In Cincinatti Children's case, the radiologic technologists represented the group that faced the biggest challenge. In recent years, features have been added to X-ray equipment to reduce the patient dose, but these features are difficult to implement into practice because they require significantly different radiographic technique factors. When the department elected to implement these features, the radiologic technologists were asked to abandon the standard radiographic techniques they were comfortable using. "Basically, the new program voided some of what they had been taught in their training programs," Strauss said. "Innovation requires change, and if you think about it, many people have difficulty adapting to change."

"Now, a year later, the radiologic technologists understand the new system," Strauss said. "While they didn't care for it initially, they now understand that it helps them improve patient care."

Meanwhile, pediatric radiologists at OHSU were consulted extensively to ensure that dose was optimized for its dedicated X-ray and RF rooms for pediatric patients. "It's really optimizing the amount of radiation you use versus image quality for the specific diagnostic task, and the only way you're going to do that is to get their buy-in and their willingness," Griglock said. "We're definitely lucky to have three dedicated pediatric radiologists who were willing to help with this, but the most important thing is just keeping lines of communication open." Every time the department seeks to change its techniques or lower its automatic exposure control (AEC) settings, an e-mail goes out to these three radiologists, encouraging them to contact Griglock if there is a single image that is too noisy.

Choosing the Right Equipment

In Roland Rhynus' view, one of the biggest challenges in healthcare today, from a radiology perspective, is the scarcity of capital resources. "It's very challenging for us to go and ask for a quarter of a million dollars for one digital portable," said Rhynus, executive director of radiology at Loma Linda University Medical Center.

Loma Linda is an 800-bed university teaching hospital that is part of a larger campus system including a children's hospital, an orthopedic hospital, and a surgical hospital. The institution currently houses 21 portable X-ray units, which were equipped with CR technology for approximately a decade.

"We know that DR has up to a 50% dose savings, and that it provides us with an increased efficiency, so we're saying that's a twofer," he said. "Getting administration to understand that we need new equipment to help us reduce dose can be a challenge. It is especially difficult when they're trying to figure out how to budget for new beds and other basic needs in our changing financial environment."

Because it didn't have the money in the existing plan to install DR plates everywhere and totally replace CR, Loma Linda worked with its PACS and Imaging partner to implement a partial evolution from CR to DR for the vast majority of imaging procedures. Currently, there is a combination of medical film, CR, and DR. (The medical center has replaced film for 99.8% of its cases.)

"We have variability in the image acquisition products that we're giving to our staff to use, and we're asking our staff to take the time to be alert and aware of which device they are using in order to reduce dose," Rhynus said.

Loma Linda has employed a strategy of placing DR in its most utilized radiography equipment, while CR is used in the older equipment that is rarely used. Pediatric imaging has been totally converted to DR.

In the early '90s, the digital imaging marketplace only had a few players. Fast forward to the 21st century, and there has been an explosion of companies entering the market, each with its own proprietary way of measuring plate exposure. One company might use a logarithmic exposure scale, another a linear exposure scale, and a third, an inverse exposure scale. Technologists need to be mindful of different indicators from different vendors currently in use. "This can cause confusion among the technologists and radiologists," Don said.

In 2010, Image Gently along with the Mallinckrodt Institute of Radiology sponsored a vendor summit that brought in radiologists, technologists, manufacturer representatives, physicists, and the FDA. During this daylong meeting, attendees discussed the American Association of Physicists in Medicine (AAPM) and the International Electrotechnical Commission (IEC) exposure indicator standards that had recently been published. "Through understanding and talking among ourselves at the summit, the manufacturers agreed to adopt the IEC standard as the format in which they will present exposure data," Don said. "That information is very useful because instead of having proprietary data that varies from the vendors, we'll eventually have a single set of exposure indicators so that radiologists and technologists will only have to learn one set of values regardless of the vendor."

Other Ways to Lower Dose

Eliminating unnecessary exposures

According to Goske, the biggest point of emphasis with children is that clinicians should justify every single imaging exam they order. "Bite-wing X-rays are extremely low dose, but we still don't want a child to have a single X-ray if they don't need it," she said, referencing a current Image Gently dental campaign.

Reducing repeat rates through environmental modifications

For pediatric patients, distraction is key to avoiding repeat exams. For example at Cincinnati Children's Hospital, figures on the wall are strategically placed to divert children's attention from the procedure. "It is effective for gaining the cooperation of many kids because they forget they are in a hospital and just become kids again," Strauss said.

Concurring with Strauss, Griglock noted, "Kids who come in here for imaging generally aren't going to be in the best health, and hospitals can be a very scary place when you're that age," adding that the OHSU has worked with the Portland Art Institute to paint each of its pediatric X-ray rooms. Each room has a different theme: a jungle room, an "under the sea" room, and an "outer space" room. Meanwhile, in the waiting room, Disney and Pixar characters are shown with their radiographs; children can see that Buzz Lightyear is doing just fine after getting his X-ray. "We track repeats, especially for pediatrics, and our repeat rate has dropped significantly since we've started to do all this," Griglock said.

Quantifying Results

The ACR Dose Index Registry for CT took between 4 and 5 years of development to get to the point where it is today, with more than 9 million data points. Based on the type of detector and type of exam, individual hospitals are able to get a sense of where they fall in the range of other hospitals that do similar exams.

The ACR is now in the process of building an ACR Dose Index Registry for digital radiography. Chatfield shared that the prototype for the original Dose Index Registry was in fact CR/DR, "but pretty soon after we started thinking about the design, the news stories about CT started to come out, and so we shifted our focus," she said. "So far, manufacturers are still in the process of adopting the DICOM structured report for CR/DR," Don said. "The accumulation of quality assurance data is much easier than other methods, such as looking at spreadsheets or recording all these exposure factors. Having a standard in which to record exposure and having a structured report that allows the data to be acquired automatically and then anonymized, allow for a collection of data from both a point of ease of collection and quickly analyzing the data in one format regardless of vendor."

"With CR/DR, for the concerned party, the volume of procedures is really large. For any single exam, the dose is lower than the corresponding CT, but there are many more chest X-rays that are done, compared to CTs. Typically, there isn't the same level of concern with regard to X-rays, so a child might get repeated exams."

MYTHREYI CHATFIELD
Director of Data Registries, American College of Radiology

According to Chatfield, the CR/DR registry is still in the prepilot stage and progress has been delayed after it was discovered that many scanner manufacturers were not populating data in accordance with standards and were producing incomplete records for analysis.

Don confesses that the endeavor is a long-term proposition that will not be solved overnight. However, he hopes that radiologists will be able to "document to the public that we are doing a good job across the board so that a parent can feel comfortable taking their child to any hospital and get an appropriate exposure examination," Don said. ■

> "Through understanding and talking among ourselves at the summit, the manufacturers agreed to adopt the IEC standard as the format in which they will present exposure data. That information is very useful because instead of having proprietary data that varies from the vendors, we'll eventually have a single set of exposure indicators so that radiologists and technologists will only have to learn one set of values regardless of the vendor."
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> **STEVE DON**
> MD, Pediatric Radiologist, St. Louis Children's Hospital

CHARTING A BETTER WAY

As part of an Image Gently, FDA, and Medical Imaging and Technology Alliance (MITA) children's hospital survey presented at the Society for Pediatric Radiology Annual Meeting in 2012, children's hospitals sent in their technique charts for selected exams. According to Steve Don, MD, the goal was to produce pocket-sized cards that would give reasonable exposure factors and techniques that technologists could use as a reference. "We found variation in their recommended technique chart for an exam," Don added. "This survey wasn't looking at individual patient exposure." Ultimately, the group was unable to produce those pocket cards because there was too much variation among the survey participants.

Results from the survey led to the formation of an ACR subcommittee of the pediatric quality and safety committee (which is under the ACR Commission on Pediatric Radiology) that is seeking to establish reasonable starting point technique charts for common examinations. AAPM Task Group 252, chaired by MacDougall, was formed in July 2013, and is charged with developing the scientific methodology for pediatric techniques for CR and DR. These committees will gather input from all stakeholders – including MITA, the ACR, physicists, radiologists, technologists, and manufacturers. "While children's hospitals may be adept at [building charts based on the selected detector], a community hospital may not have the experience, so it gives them a place to fall back to or start with what people recommend. We hope this kind of a chart will be modifiable for local preference," Don said. "A center that is more tolerant of noise, and we can lower the exposure a little bit; some other centers maybe are a little bit less tolerant, and may need to raise the exposure a little."

Courtesy of Imaging Economics

Zwanger-Pesiri Radiology, New York, USA

Delivering on dose reduction promises

Dr Steven Mendelsohn, Chief Executive Officer/Medical Director of Zwanger-Pesiri Radiology, New York, explains his commitment to dose reduction and why he believes a change in attitudes will be driven by patients rather than radiology professionals.

INTERVIEW WITH DR STEVEN MENDELSOHN, Chief Executive Officer/Medical Director of Zwanger-Pesiri Radiology, **JEANINE SANTORELLI,** Zwanger-Pesiri's Chief Technical Officer and **MARK MORALES,** Lead X-ray Technologist

> "Agfa HealthCare was telling me about the DX-D 300's dose reduction capabilities... Much to my surprise it was able to provide high image quality at a lower dose."
>
> **DR STEVEN MENDELSOHN**
> Chief Executive Officer/Medical Director, Zwanger-Pesiri Radiology, New York, USA

With more than 60 years' experience in the field of radiology, Zwanger-Pesiri is one of the largest non-hospital based radiology practices in the US today. Committed to investing in only the latest technology, its 12 Long Island sites serve 2000 patients a day. Its staff of 60 radiologists comprises a number of specialties including Vascular Imaging, Interventional Radiology, Neuroradiology, Musculoskeletal Imaging, Abdominal Radiology, Cardiovascular Radiology and Breast Imaging. With such a diverse and large patient base and so many radiologists to manage, workflow is a key consideration, which is why the DX-D 300 DR system, with its Cesium Iodide detector technology and immediate image availability, was its solution of choice.

Workflow rather than dose reduction the initial driver

"We installed our first Agfa HealthCare DR solution, the DX-D 300, in our Elmont site in August of 2013," says Dr Mendelsohn. "We chose it primarily because the workflow was so efficient, it was very easy for the technologists to set up and the images were quickly available. At the time, Agfa HealthCare was telling me about its dose reduction capabilities, but, to be frank, I didn't really believe them. But they kept on telling me about it so we decided to set up a study to compare the results.

"We had two competitive units from other suppliers available on the same site, so that provided the ideal opportunity to test out what we were being told."

The study parameters

The study sought to determine if the DX-D 300 required less exposure and patient dose versus two other systems in use at Zwanger-Pesiri Radiology. It also compared the doses used to those used for similar examinations in other facilities, based on available published studies[1]. The study comprised PA Chest, Lateral Skull and AP Hand exposures taken on phantoms used to simulate patient exposures. In each case the phantom was positioned just as a patient would be and the standard exposure made.

Average dose reductions of 41% achieved

The results showed that while the amount varied depending on the type of exam, the average dose on most was 41% lower with the Agfa HealthCare system versus the other systems – an admittedly unexpected result for Zwanger-Pesiri.

Says Dr Mendelsohn, "Much to my surprise, the DX-D 300 was able to provide high image quality at a lower dose. For me, that's great in one way and possibly bad in another. It's good because we can promote our commitment to dose reduction to our patients and now have the figures to prove it, but," he adds laughingly, "it could possibly be bad because Agfa HealthCare will want to raise the price we pay! Although, to be honest, I would be prepared to pay a little more for the level of dose reduction we achieved. Agfa HealthCare has done a really wonderful job with it."

The success of the first DX-D 300 has led to the purchase of another five units, because, as Dr Mendelsohn says, "It's a no brainer. We simply plug and play. They are robust and reliable, with little down time and are competitively priced. Plus, you get the dose reduction."

Dose reduction has become a compelling story

And dose reduction is a subject on which Dr Mendelsohn believes patients are becoming increasingly well-informed. "However you look at it, radiation is not good but we are in global denial about it. Dose reduction has become a very compelling story; all radiologists need to be cognitive of patient dose and aware that patients are becoming better informed and will increasingly ask questions. But, change will ultimately be driven from the grass roots rather than by the radiologists themselves because our financial model does not currently place a premium on it."

Sufficiently concerned was Dr Mendelsohn over the need to reduce dose that six years ago he tried an experiment in dose reduction himself at the Zwanger-Pesiri sites. "As we got new CT equipment in, little by little we began lowering the radiation dose used in our studies. We didn't tell anyone we were doing it and gradually the images became grainier year-on-year. Finally, it got to the point where the radiologists began to comment on it so we asked them: 'Is it still diagnostic quality?' and their answer was 'yes'. So, while radiologists want their images to be crisp and clear, they don't necessarily need to be such high dose to fulfil their role as a diagnostic tool."

The best of both worlds

Dr Mendelsohn does acknowledge, however, that with the advent of Cesium Iodide phosphor detectors and MUSICA imaging processing software used as part of the DX-D 300 solution, Zwanger-Pesiri is now able to achieve the best of both worlds – significant dose reduction while still achieving the high quality images that radiologists have come to expect and are more comfortable working with.

MUSICA

- Intelligent image processing
- Excellent contrast detail
- Automatic, body-part independent

> “Dose reduction has become a very compelling story; all radiologists need to be cognitive of patient dose and aware that patients are becoming better informed and will increasingly ask questions.”
>
> **DR STEVEN MENDELSOHN**

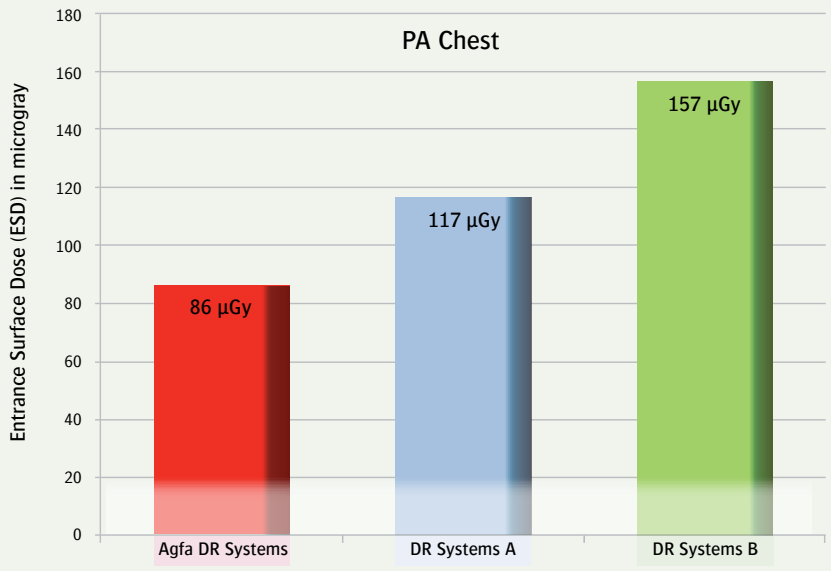
And MUSICA is software that has also proven its worth to both Jeanine Santorelli, Zwanger-Pesiri’s Chief Technical Officer and Lead X-ray Technologist Mark Morales, who works out of Zwanger-Pesiri’s Patchogue site. “With so many sites and such a large population to serve, our biggest challenge is one of workflow,” says Jeanine. “To meet demand, we have a lot of teams that rotate across our sites, so ease of use when switching between solutions is paramount.”

Mark agrees: “The capabilities created by Agfa HealthCare’s NX workstation with MUSICA software – the fact that it’s user-friendly, easy to use when correcting errors, has a fairly standardized intuitive user interface and selfexplanatory color coded dose bar, as well as its dose reduction capabilities – means that we can get the best image in the shortest possible time. It’s what I like to call ‘set it and forget it’ – you hit a button and it walks you through what you need to do. It’s a lot less cumbersome than others I have used.

“Add to that that any time you can get a cassette out of a technologist’s hands you up your productivity and with the DX-D 300 our workflow has sped up. The patient has a positive experience and leaves happy.”

And a happy patient is Zwanger-Pesiri’s ultimate aim, as Jeanine explains. “With the advent of Google and other information sites, patients are becoming more knowledgeable and more prepared to question their dose exposure. It’s great to be able to say that we are using the lowest possible dose for their images. With the automation and accuracy offered by the DX-D 300 with Cesium Iodide detectors and MUSICA, we can speed them through the process and make it easier for referrers to access their information. “Ultimately, it’s all about delivering better quality care for our patients.” ■

Sample of study results



Entrance Surface Dose (ESD) required for a 23 cm chest. The Agfa HealthCare DX-D 300 DR system required 45% less dose than competitive DR System B and 27% less dose than competitive DR System A.

> “It’s great to be able to say that we are using the lowest possible dose for their images.”

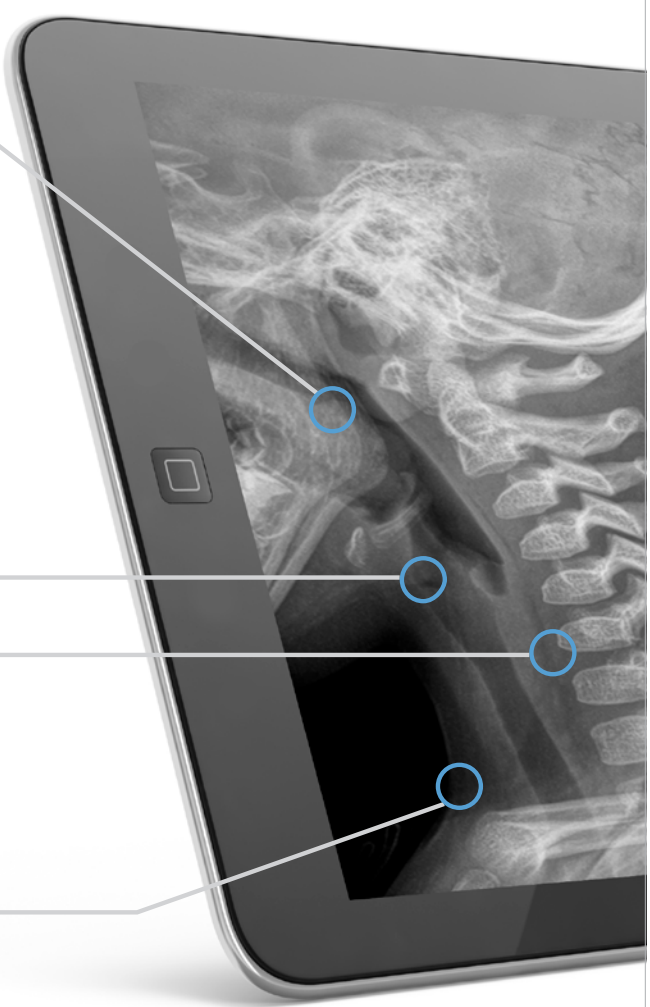
JEANINE SANTORELLI
Zwanger-Pesiri’s Chief Technical Officer

[1] Ernest K. Osei and Johnson Darko “A Survey of Organ Equivalent and Effective Doses from Diagnostic Radiology Procedures” ISRN Radiology Volume 2013, Article ID 204346, 9 pages http://dx.doi.org/10.5402/2013/204346

THE MUSICA SCALE

AGFA HEALTHCARE IMAGE PROCESSING AROUND THE WORLD

Radiologists around the world rely on digital image processing for their diagnoses. This is the scale on which MUSICA, the Agfa HealthCare image processing software, is used: daily, globally.



50,000

TOTAL MUSICA INSTALLATIONS ON CR AND DR UNITS

+5TB

BYTES OF MUSICA DIAGNOSTIC INFORMATION PROCESSED PER DAY

+4,000 HOURS

DIAGNOSTIC READING PER DAY WITH MUSICA

+1,000,000

MUSICA IMAGES READ PER DAY

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