# SPECIAL REPORT

AGFA

# HARDCOPY IMAGING



**WHITE PAPER:**
» Diagnosis – Communication – Care: Hardcopy technology for the digital age

# SPECIAL REPORT

## Hardcopy in a digital world

The different ways imaging environments around the world integrate hardcopy into their quality patient care make for some remarkable stories. In this Special Report on Hardcopy, we bring you the experiences and insights of some highly qualified and respected radiology professionals.

Our voyage starts in Vietnam, where Children Hospital #1 in Ho Chi Minh City faces an ever-growing number of patients. The speed and image quality of an Agfa CR digitizer and DRYSTAR imager, explains Dr. Nguyen Anh Tuan, combined with excellent service, are supporting the hospital's commitment to providing the best quality care.

Moving on to China, we visit the West China Hospital in Chengdu, which had to find a solution to ease the workload of the 1,000,000 images printed each year. After a very competitive tender, says Dr. Huang Lin, it installed 17 print kiosks that let patients print their own images and reports. You definitely want to read about the benefits!

Still in China, we also visit modern, Tier-3 Baoquanling Central Hospital. Hardcopy is used for everything from diagnosis of images by radiologists, to referrals and consultations outside the hospital. Chief Radiologist Chen Jianting explains how four DRYSTAR printers now provide the image quality needed, without the bad odors of the hospital's previous laser printers.

Travelling to the Indian subcontinent, we spoke with a hospital in Mumbai that has placed its confidence in DRYSTAR AXYS for the hardcopies they provide patients and referring physicians. Dr. Deepak Patkar of Nanavati Super Speciality Hospital carried out an in-hospital test of laser versus thermal printers – and concluded that "dry thermal printers offer equal or even slightly better image quality."

Finally, across the globe in Argentina, we find out why successful TCBA Diagnostic Centers uses DRYSTAR printers exclusively for all its hardcopies. Offering reliability and image quality, they support TCBA to provide the right balance of price and quality for the 430,000 diagnostic and imaging studies it carries out each year.

So what do you need to consider when choosing a hardcopy system? We've put together a White Paper explaining the technical aspects; our article in this magazine summarizes the details, and lets you know where you can find more information.

We appreciate the participation of the imaging professionals who contributed to the stories in this Special Report, and hope you will enjoy your journey around the world of hardcopy.

*Benny Jansen*
*Business Unit Manager FPS | HE/Imaging*




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

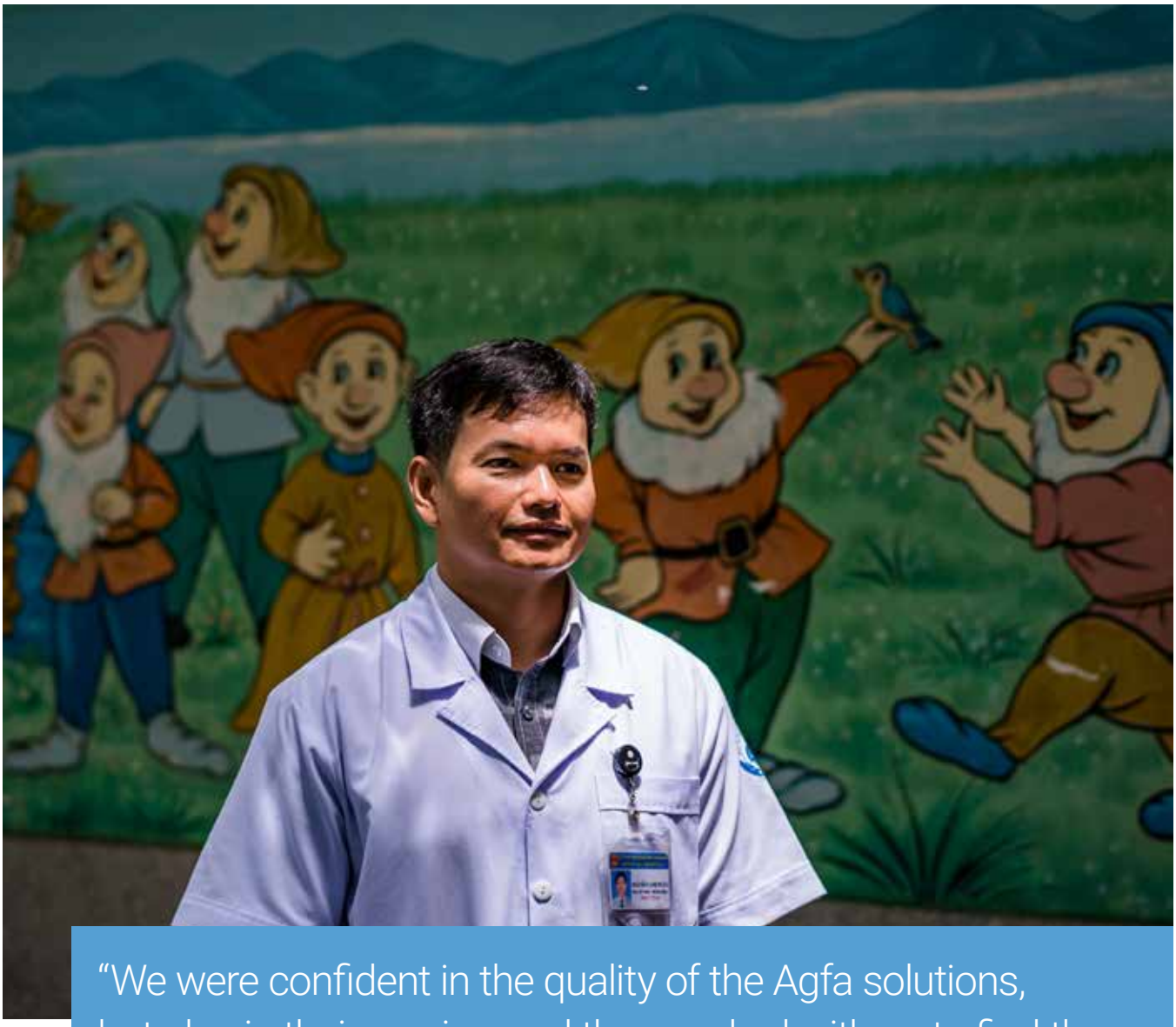
# Fast, reliable imaging for busy pediatric hospital

For Children Hospital #1 in Ho Chi Minh City high-throughput CR digitizer and easy-to-use DRYSTAR imager let caregivers spend more time with the young patients, while getting the detail they need to provide top-level patient care.

**INTERVIEW WITH DR. NGUYEN ANH TUAN,** HEAD OF IMAGING
**Children Hospital #1,** Ho Chi Minh City, Vietnam


"The faster speed of imaging means we can handle more patients, but also can spend more time with them."

**— DR. NGUYEN ANH TUAN**
Head of Imaging



"We were confident in the quality of the Agfa solutions, but also in their service, and they worked with us to find the right answer to our needs."

**– DR. NGUYEN ANH TUAN**

For 60 years, Children Hospital #1, Vietnam, has been caring for children in fast developing Ho Chi Minh City. Growing from its initial 300 beds to its current 1400 beds, the hospital has also seen a lot of evolution in healthcare technology. And when the hospital's radiology department went digital Agfa was there, with the CR 85-X computed radiography (CR) solution and the DRYSTAR 5302 imager. Together, these provide caregivers with fast, detailed and flexible imaging, supported by reliable, responsive service from Agfa. "Agfa is a good partner to us," explains Dr. Nguyen Anh Tuan, Head of Imaging at the hospital and secretary of the Radiology Society of Ho Chi Minh City (RSHCM).

## SUPPORTING CARE WITH TECHNOLOGY

There are two Children hospitals in Ho Chi Minh city: the city's original pediatric hospital, Children Hospital #1, opened in 1966, while Children Hospital #2 opened in 1978. Children Hospital #3 is now being built. Children Hospital #1 faces an ever-growing number of patients – some 5000 - 6000 outpatients and 1400 - 1800 inpatients each day. But the caregivers remain committed to providing top-level care to each one, including radiology services. "We perform X-rays on 500 - 600 patients each day, along with around 30 CT scans," comments Dr. Tuan, who, with 19 years of experience in radiology, is well-known and well-respected within the medical community.

To handle the increasing demand, the hospital turned to Agfa, its long-term vendor of film products, to implement digital radiography. As Dr. Tuan explains, "We knew that the quality of systems in the market was very high, so our main criteria were price and after sales service. We were confident in the quality of the Agfa solutions, but also in their service, and they worked with us to find the right answer to our needs."

## MORE TIME WITH PATIENTS

With their speed and image quality, the CR digitizer and the DRYSTAR 5302 imager are supporting the hospital in its goals for quality of care.

The CR system uses phosphor plates to capture the X-rays, and the latent image is then scanned into the CR reader, which converts it into a digital image that can be viewed on a computer monitor and printed out in hardcopy. "The faster speed of imaging means we can handle more patients, but also can spend more time with them. The small, pediatric cassettes offer very good resolution, and we can preview the images on the workstation, to see they are not over- or under-exposed. The images are sharp and detailed, and the system definitely offers the quality we expected."

Both the CR and the DRYSTAR are conveniently sized, so they don't take up too much space in the busy department, while Dr. Tuan explains that the CR's drop-and-go buffer, which can hold up to 10 cassettes, helps keep the workflow smooth: "Since there are always images for several patients being handled, we don't have to wait around to insert our cassettes: we can just put them in the buffer and go back to the patient or to other tasks."

"The Agfa people are available for us when we need them – even on weekends. This responsiveness is critical: in such a busy hospital, we cannot have our X-ray system down!"

## FAST, MOBILE IMAGING THROUGHOUT THE HOSPITAL

He continues: "Making an image now takes less than a minute. The patient's information is in the radiology information system (RIS), so when the image appears on the workstation screen, we check it and identify the patient. Then we can print it right away on the DRYSTAR imager."

The CR also offers an ideal centralized solution for the hospital's 14 mobile X-ray units: compatible with all existing X-ray systems, it allows X-ray departments to go digital without significant additional investments. "We can cover the whole hospital with a single CR solution," Dr. Tuan explains. "This mobility is very important, as we need to make images in very many different places, such as the ICU, the emergency department, the operating room, etc."

### DRYSTAR direct digital imager

- Reliability and affordability, hand-in-hand
- Consistent and sharp image quality
- Convenient, compact, tabletop size
- Low investment and running costs
- Easy to learn and to use

## RELIABILITY AND RESPONSIVE SERVICE

Above all, Dr. Tuan says that his expectations for after sales service have been met by the dedicated Agfa team. "They gave us the training on how to use the system at our hospital, and it went very well: the solutions are easy to use for both radiologists and technicians," he comments. "And if we ever have any technical problems, the Agfa people are available for us when we need them – even on weekends. This responsiveness is critical: in such a busy hospital, we cannot have our X-ray system down!"

So when other doctors visit his radiology department to ask about selecting imaging solutions, that is exactly what he tells them: "There are very good quality systems available, but you must also focus on the after sales service. Your vendor needs to have good engineers who understand the machines and who are responsive when you call. And the imaging solution must offer good value for money. Agfa provides us with all of this, and I look forward to continuing to work with them and to implement additional solutions as our hospital grows." ■

## CR 85-X digitizer

- Drop and go buffer for maximum productivity
- Suitable for a broad range of applications
- Pediatric-specific cassettes
- Three different image resolution modes (pixel pitch [µm]: 50 - 100 - 150)
- MUSICA image processing for consistent, detailed images
- Easy to use and durable
- Ideal as centralized CR for mobile imaging in busy hospital
- Compatible with all existing X-ray systems

"The images are sharp and detailed, and the system definitely offers the quality we expected."

## Agfa's contribution

Agfa, as a long-term vendor for Children Hospital # 1, was the first to bring digital imaging into the hospital, and helped the hospital find a solution offering high image quality that fit its needs for budget and workflow. Agfa provided training at the hospital on how to use the systems, and now provides after sales service that offers the reliability and responsiveness the hospital expects.

# 1.1 million patients, 1 printing workflow

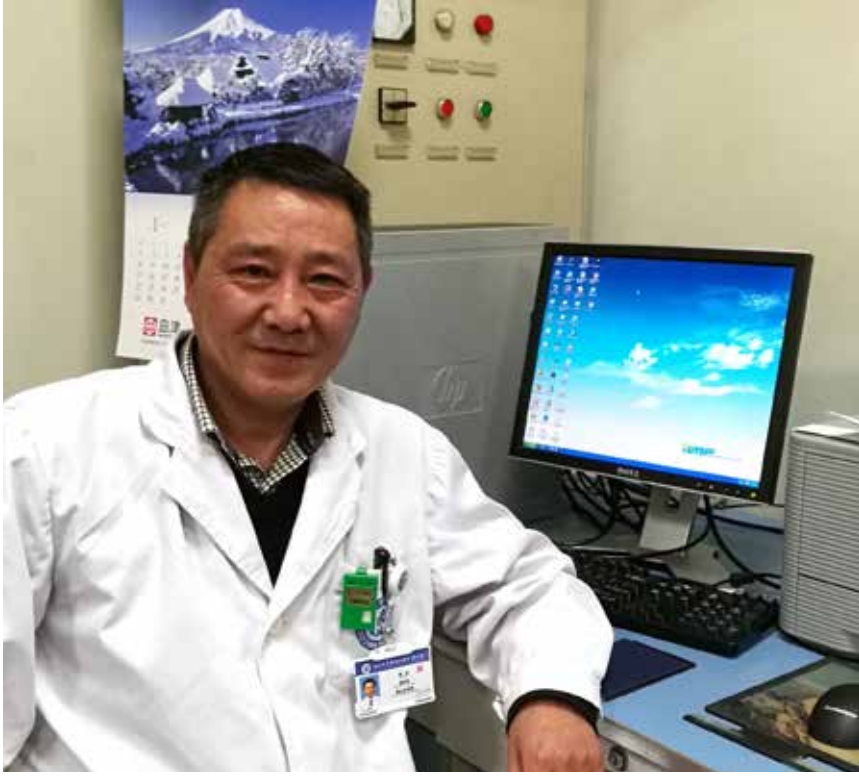
As a large-scale general hospital in China, West China Hospital enhances patient satisfaction, increases efficiency and cuts costs in the long term with Agfa's hardcopy print kiosk*

**INTERVIEWEE WITH DR. HUANG LIN,** CHIEF TECHNICIAN
**Radiology department of West China Hospital,** Sichuan University and 2nd-6th Standing Committee Member of the Chinese Radiology Society, China


"The kiosks help us ease the considerable workload involved in printing out all of the patient images. They automatically match patient and images. They save us time and they improve the satisfaction of patients, physicians and staff."

**— DR. HUANG LIN**
Chief Technician

1,000,000 every year: that's how many hardcopy images are printed out at West China Hospital of Sichuan University in Chengdu. To support this massive effort, the hospital now provides 17 Agfa print kiosks in the outpatient, inpatient and emergency departments, to fulfill the majority of radiology image printing needs in a timely way. And while the patients enjoy the ease of use and image quality of the kiosks, behind the scenes the hospital relies on the connectivity and after sales service to provide a smooth workflow and maximize resources.



## A FAST-GROWING RADIOLOGY WORKLOAD

West China Hospital is a well-respected public healthcare facility, ranked number 2 amongst Chinese hospitals with high reputations. This large-scale general hospital counts 4,300 inpatient beds, and is the main referral center for complex health problems in southwestern China.

In the radiology department, 53 radiologists, 86 technicians and 36 nurses handle imaging for 3000-4000 patients every day. "In 2016, our radiology department reached 1.1 million patients for the year, with an annual increase of 7.34%," comments Dr. Huang Lin, Chief Technician of the Radiology Department of West China Hospital.

The heavy workload includes providing patients with hardcopies of their images and reports. "It used to take three days for a patient to receive films and reports, and two more days for in-patients," recalls Dr. Huang. "We had seven staff members who would match up the patient with the images/reports, and then package everything. This use of medical resources called for a technical innovation."

## SPEED, IMAGE QUALITY AND INTEGRATION

In 2015, the hospital decided to find a solution that would allow it to utilize those medical and human resources more effectively. "The choice of supplier and solution was very competitive, with several foreign and local vendors bidding," comments Dr. Huang. "We used

> "We used four main criteria to evaluate the proposed solutions: printing speed, image quality, ability to integrate with the computed radiography (CR) software, and the availability of maintenance with a timely response. Agfa ultimately won the bid."
>
> **– DR. HUANG LIN**


## Agfa print kiosk

The Agfa print kiosk optimizes the radiology workflow by enabling patients to print out their own images and reports. The attractive console can be easily installed in convenient areas such as the hospital lobby and registration room, the radiology department, the emergency department, etc.

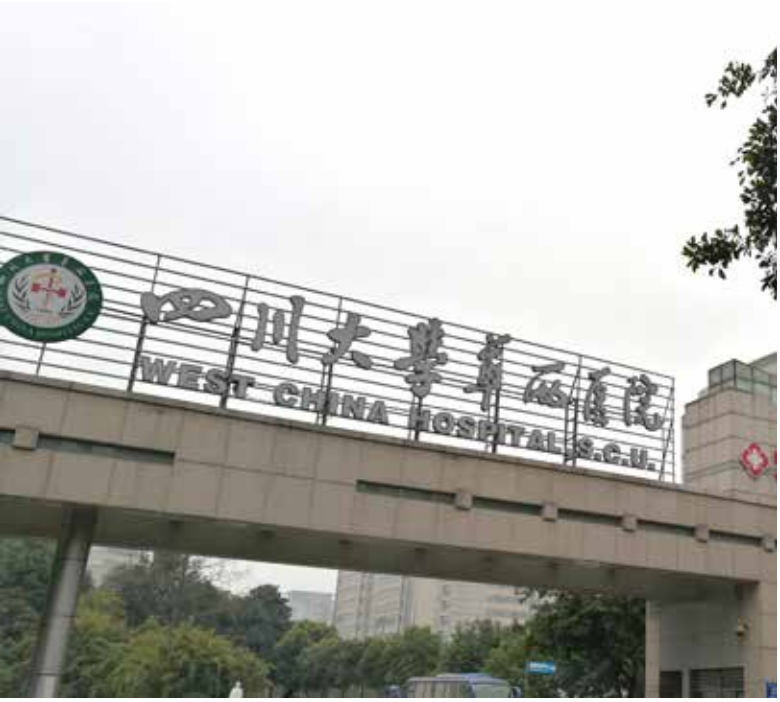
- The vendor-neutral solution integrates with the hospital's imaging modalities and PACS (including third-party), providing image consistency.
- It offers fast image printing speed, decreasing patient waiting time for images and reports, and improving patient satisfaction.
- It automatically links the patient ID to images and reports, helping eliminate the possibility of errors and saving staff time.
- The user-friendly interface makes it simple and pleasant for patients to use.
- Installation is quick and easy, for immediate benefits.
- It uses high-quality Agfa hardcopy film.

four main criteria to evaluate the proposed solutions: printing speed, image quality, ability to integrate with the computed radiography (CR) software, and the availability of maintenance with a timely response. Agfa ultimately won the bid."

The hospital had a long experience with Agfa's solutions and services. "We have been using Agfa CR for 10 years: MUSICA is the top image processing software and has led the development of multi-frequency processing technology," cites Dr. Huang. "After-sales service and response time are equally decisive factors. Service has become the core of Agfa, and they assure that our equipment is well-maintained and operational. Agfa has proved to be a very reliable provider for us."

## IMAGE CONSISTENCY AND INTEGRITY

For the printing kiosk project, the Agfa solution answered all the hospital's criteria. "Agfa's strong conformance with standard protocols such as DICOM and HL7 played an important role in our choice, and has an impact on image consistency and integrity," Dr. Huang explains. "The kiosks integrate with our Agfa CR system and other modalities, as well as our third-party picture archiving and communication system (PACS). Furthermore, the printing technology is mature, with a user-friendly workflow and stabilized image quality. Together with the quick response time and timely maintenance, this makes Agfa the front runner in kiosk printing solutions." Since the kiosks were installed in November 2015, the hospital and its patients have experienced many benefits, Dr. Huang describes. Patients can quickly print out diagnostic reports, reducing their waiting time and increasing their satisfaction. Technicians can focus on core imaging tasks, reducing their work stress. The




## Did you know?

- Chengdu is one of the three largest cities in Western China: in 2014, it had an urban population of over 10 million, while the population of the 'administrative area' was just under 14.5 million.
- The surrounding Chengdu Plain is known as the 'Country of Heaven' and the 'Land of Abundance'. Its Dujiangyan irrigation system was constructed in 256 B.C., and is still in use today, irrigating over 5,300 square kilometers of land in the region.
- Sichuan Province is home to the largest remaining continuous habitat for giant pandas and to more than 80 percent of the world's wild giant pandas.

staff who sorted and packaged images now support other departments, such as the Registration Office, where they help guide the patient flow. The utilization of medical and human resources are optimized, as patients print out the specific images and reports that they need.

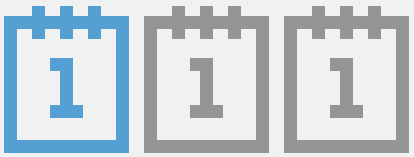
## USER-FRIENDLY AND EFFICIENT

**The workflow for patients is simple:**

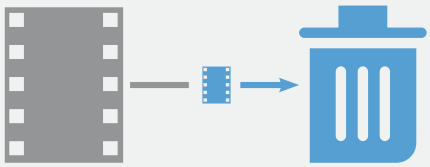
1. After checking in at radiology, the patient receives a paper with a bar code.
2. The patient takes the bar-code paper into the imaging room to complete the examination.
3. After the examination, the patient can see on the kiosk screen that the image will be available for printing in a few minutes.
4. The patient goes to the printing kiosk and scans the bar code. The kiosk prints the image hardcopy quickly.
5. The next day, the patient can print the report on the dedicated report printer.

Specific staff help guide the patients to use the kiosks, to keep the workflow smooth and save time.

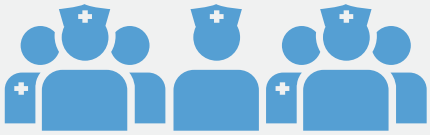
"The kiosks help us ease the considerable workload involved in printing out all of the patient images. They automatically match patient and images. They save us time and they improve the satisfaction of patients, physicians and staff. This patient 'self-service' image printing could be a good reference solution to optimize the radiology workflow for large general hospitals like ours," concludes Dr. Huang. ■




The kiosks helped **reduce the time** to obtain film from 2-3 days to **1 day**.



Wasted/repeated film rate **dropped** from 3.3% to **0.3%**.



**7 medical staff**
who were in charge of printing and packing films were freed-up.

* Hardcopy print kiosk is not available in the U.S. and Canada

# Every patient counts

After an in-hospital test of dry laser versus dry thermal film printers, Nanavati Super Speciality Hospital added 5 DRYSTAR AXYS DDI printers to its cutting-edge portfolio of imaging equipment.

**INTERVIEW WITH DR. DEEPAK PATKAR,** DIRECTOR
**Medical Services and Head,** Department of Imaging, Nanavati Super Speciality Hospital, Mumbai, India


"Quality was absolutely the decision-making criterion we looked at, but the AXYS also offered other benefits we appreciated: compactness, ease of use, environmental friendliness, fast set-up."

**– DR. DEEPAK PATKAR, DIRECTOR**
Medical Services and Head, Department of Imaging

Blessed by Mahatma Gandhi, inaugurated by India's first Prime Minister Jawaharlal Nehru, supported by Mother Theresa, Nanavati Super Speciality Hospital, in Mumbai, India, has remained true to its mission to provide excellent care to all patients, from all backgrounds and all walks of life. This 350-bed facility, housing 55 specialty departments, offers a very broad range of services in practically every field of modern medicine and healthcare.

The hospital's state-of-the-art radiology department is backed by a strong team that is committed to care, research and community, says Dr. Deepak Patkar, Director, Medical Services and Head, Department of Imaging for the hospital. As a specialist in MRI and CT, he aims to continuously combine the possibilities enabled by top technology with "the human touch" that is such a fundamental part of the hospital's care philosophy.

## MRI: TOWARDS RADIATION-FREE IMAGING

Dr. Patkar is convinced that MRI is the future of imaging: "It is radiation-free, meaning it is safe for everybody including children, while hardware and software evolutions continue to increase the speed," he comments. "MRI probably won't replace radiation-based imaging such as X-ray and CT soon, but it continues to move beyond brain and spine imaging into e.g. the musculoskeletal system, the chest, abdomen, pelvis, etc. Just as CT scans have gone from taking minutes, to seconds, to sub-seconds, if MRI follows the same trajectory, it may replace many CT applications."

A major hurdle with MRI is the cost of the equipment and the scans. "In India, around 80% of our patients pay for their imaging exams out of their own pockets. An MRI scan can cost almost half the monthly income of many people, who may therefore prefer cost effective options like X-rays or ultrasounds."

Within this healthcare environment balancing cost and equipment, hardcopies of images continue to hold an important place. "We have PACS in our hospital, so internal physicians can access images digitally. However, some 80% of our patients come from referring physicians, most of whom will have a lightbox but not a computer. And while certain specialists, such as neurologists or spine or muscular surgeons, will be experienced in reading images, most other doctors will not: their areas of expertise lie elsewhere, of course."

An MRI scan can result in a hundred images, he continues. "We select 5-6 representative images that show, for example, the herniated disk or brain tumor, and include hardcopies with the report. So even if the referring physician doesn't know much about MRI or CT, he has a film that is a kind of summary."


## LASER VERSUS THERMAL PRINTERS: AN IN-HOSPITAL TEST

For 14 years, Nanavati hospital used an Agfa wet processing system for these films. But in 2014, the hospital installed a cutting-edge 3 Tesla MRI scanner, and opened a new 10,000 square foot advanced imaging center. In parallel, the radiology department decided to look into dry printing systems. Dr. Patkar and his team took a very methodical approach to select a printer. "We had the three top vendors, including Agfa, install their dry printer in our facility. Two were laser printers and one, Agfa's DRYSTAR AXYS, was a thermal printer," he explains. "Over three months, we tested them in parallel, printing films of the imaging exams on each printer. In the evenings, the vendors' technicians would come on-site and make the window adjustments we requested."

To compare the resulting hardcopies, the images were examined by Dr. Patkar, other senior radiologists, and some referring physicians. "The referring physicians would give their general opinions: which hardcopies they preferred, whether one looked 'too sharp' or 'too dark'. The radiologists, on the other hand, would score each image on characteristics such as brightness and resolution."

"Having conducted this in-hospital test, I am convinced that dry thermal printers offer equal or even slightly better quality compared to laser printers."

## DRYSTAR AXYS dry thermal printer

- High-quality images from a compact, table-top imager
- Direct Digital Imaging (DDI) Technology that provides fast and clean usage, with no complex or expensive moving parts to maintain
- A#Sharp software enhancement for crystal clear DDI images
- Supports a broad range of applications, including CT, MR, DSA and US, as well as CR/DR applications for GenRad, Mammography, Orthopedics, Dental Imaging and more
- Suitable for a centralized or decentralized imaging environment
- Flexible and easy to use, with easy daylight handling
- Comes with two on-line media trays that handle all media types and sizes

## CRITERIA #1: QUALITY IMAGES

In the end, the DRYSTAR AXYS was selected. "Quality was absolutely the decision-making criterion we looked at, but the DRYSTAR AXYS also offered other benefits we appreciated: compactness (space in Mumbai is at a premium!), ease of use, environmental friendliness, fast set-up, e.g. plug-and-play, all at a correct price," he continues. "We purchased in total five DRYSTAR AXYS systems for our hardcopy printing."

"We often discuss which type of printer – laser or thermal – is better, and before we did the in-house exercise, I would myself have said laser printers. But now, having conducted this test, I am convinced that dry thermal printers offer equal or even slightly better image quality."

## FILMS THAT STAND THE TEST OF TIME

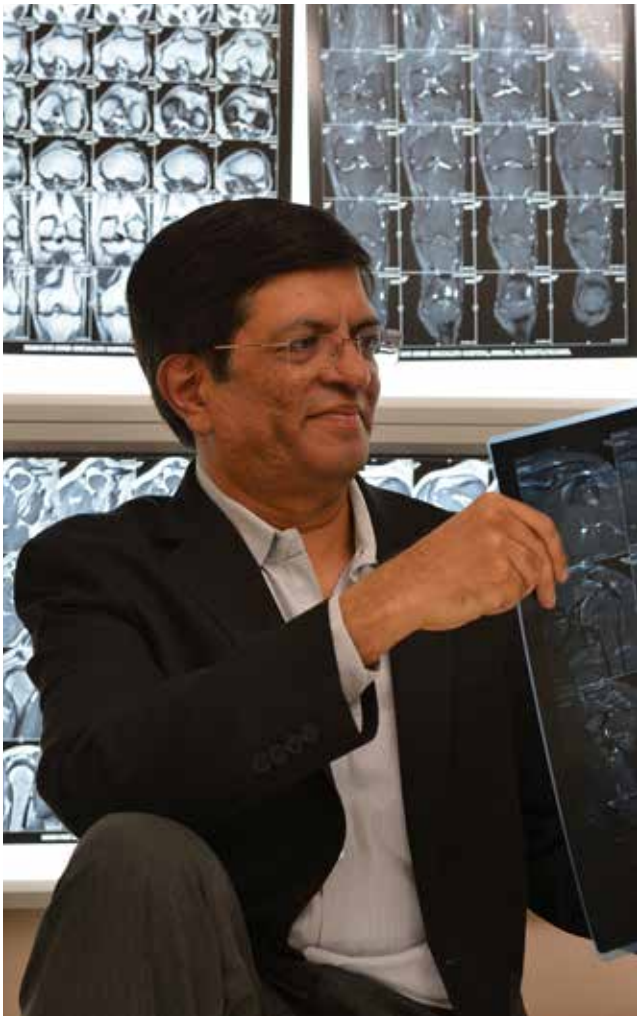
Before switching to dry printers, the radiology department used different brands of film for its CT, MRI and X-ray hardcopies. With the changeover, they decided to switch all films to Agfa's DT2B emulsion film. "It's very important that a hardcopy does not change or darken over time, which makes it hard to compare two images. Determining whether a disease is progressing or a treatment is working can be based on millimeters of change. Light-sensitive films can be problematic as they may darken after a while. But the DT2B emulsion film is almost as light insensitive as laser film, yet with better resolution and brightness."

## DR 400: SPEED AND EFFICIENCY

In February 2016, the hospital again extended its relationship with Agfa, when it replaced its computed radiography (CR) system with the DR 400 direct radiography (DR) solution. "We were one of the first hospitals in Mumbai to have an Agfa CR, some 20 years ago, but with the DR 400, we moved to a completely digital, cassette-less workflow," explains Dr. Patkar. The DR 400 is now a central attraction of the hospital, he says. "It's very fast, which is especially useful with pediatric patients. Repeats are practically zero. Radiation is significantly lower. It gives us better images in less time. Overall, the DR 400 has made a big difference for the speed and efficiency of our workflow." ■

## DR 400

- Versatile, floor-mounted radiography system
- Higher throughput and excellent image quality with a lower cost per examination
- Easy to install and needs limited space
- Can be operated by a single person with minimal training
- Includes MUSICA 'gold standard' image processing software, which is body-part independent and provides excellent contrast detail

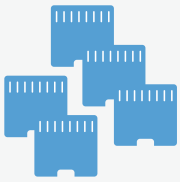


## Did you know?

- In 2014, the hospital opened a 10,000 sq. ft state-of-the-art Imaging Centre to house a 3 Tesla 32 channel wide bore Magnetic Resonance Imaging (MRI) scanner with MR-guided Focused Ultrasound Surgery (MRgFUS) and High-Intensity-Focused-Ultrasound, and a 64 slice Positron Emission Tomography – Computed Tomography (PET CT) with cardiac capability.
- Dr. Patkar collaborates with vendors including Agfa to arrange continuing education courses (CMEs) on MRI and CT around the country. "Learning about MRI is mostly hands-on in India, so to build knowledge you need constant teaching and training. For example, an orthopedic surgeon or general surgeon wouldn't be aware of the correct indications. I organize as well as participate as faculty for various training courses to keep the delegates abreast of what is happening around the world, and to motivate them to give back to the community."
- Mumbai (previously 'Bombay') is the most populous city in India and the 9th most populous agglomeration in the world, with an estimated city population of 18.4 million.

## Seamless service

While quality is always the number one selection criterion for Dr. Patkar, service is definitely the second. "We have built a lot of redundancy in our equipment – we have 5 DRYSTAR AXYS printers, and the older CR could act as a back-up for the DR 400 if necessary – but service remains key," he insists. "We work long days, with our department running from 7 AM till 12 midnight. Then we offer 24h emergency coverage. We handle around 400 patients a day, and the printers are working essentially all the time. What's more, getting around Mumbai can take a long time. If it takes a patient an hour just to get here, they would be very unhappy if we weren't able to provide the imaging service they need. Agfa's technicians understand that this is not a 9 to 5 job. They give us a seamless service. In addition to my work at the hospital, I advise and even partner in standalone imaging centers. When the issue comes up, I am pleased to recommend Agfa, for both its equipment and service."



**5** DRYSTAR AXYS printers

department running from **7 AM till 12 midnight**


**24h** emergency coverage

**400** patients a day

WHITE PAPER

# Diagnosis – Communication – Care:
## Hardcopy technology for the digital age

An image that enables correct and accurate diagnosis: that is the heart of radiology. And hardcopy continues to play a key role for caregivers and patients around the world – even as hospitals and clinics move to PACS and enterprise imaging solutions.

With more and more different types of modalities taking their place in the imaging environment, the question becomes "What does hardcopy need to provide in order to fulfil its role today, for diagnosis, for care providers, and for the patient".

To enhance patient outcomes, hardcopies must offer diagnostic quality and stability. That requires the right technology and material, supported by relevant standards.

## THE RIGHT RESOLUTION

Medical printers can be based on several technologies, including thermography (the technology used by Agfa's DRYSTAR printers), photothermography and microcapsule. Electrophotographic printing and aqueous inkjet – found, for example, in office printers – are inferior for diagnostic images.

To determine the diagnostic imaging quality, **two key parameters** stand out: spatial resolution and contrast detail resolution.

**Spatial resolution** indicates how many pixels are used to construct or print an image. It is usually specified in pixels per inch (ppi). 300 ppi is generally appropriate for diagnosis – in fact, the human eye won't perceive much more without magnification. But for certain applications such as full-field digital mammography, you need a higher resolution (508 ppi) to display all the details. So when selecting a hardcopy printer, make sure you take into account what modalities it will be used with, to ensure that it offers the appropriate spatial resolution.

**Addressability** is sometimes confused with spatial resolution. Addressability is the number of dots that can be printed (dpi), while spatial resolution indicates the amount of detail. However, for contone printers, dpi and ppi can often be used interchangeably.

**Contrast detail resolution,** on the other hand, incorporates image contrast and resolution, to distinguish differences in image intensity. Do you need to diagnose subtle density differences in an image, such as masses in liver or brain tissue? Then you need high contrast detail resolution. But it's important to view the images with the right illumination level, and size and content of the viewing field. For example, if a lightbox is too dark or too bright, the eyes may not be able to adapt to see small contrast differences. The same problem occurs with medical images printed on opaque, reflective materials. These require a too-high level of illumination for viewing, making them possibly suitable for referral applications, but not for diagnosis.

### Medical printing technologies

**THERMOGRAPHY:** imaging technology based on image-wise thermal modulation and development of dispersed silver salt.

**PHOTOTHERMOGRAPHY:** imaging technology based on thermal development of a light-induced latent image in dispersed silver salts.

**MICROCAPSULE:** imaging technology in which heat-responsive microcapsules containing dye precursors are thermally rendered to develop a dye image.

## TECHNICALLY SPEAKING: CONTONE VERSUS HALFTONE

Thermography, photothermography and microcapsule printers all use contone technology, while inkjet and electrophotography ("toner") printers may use halftone technology.

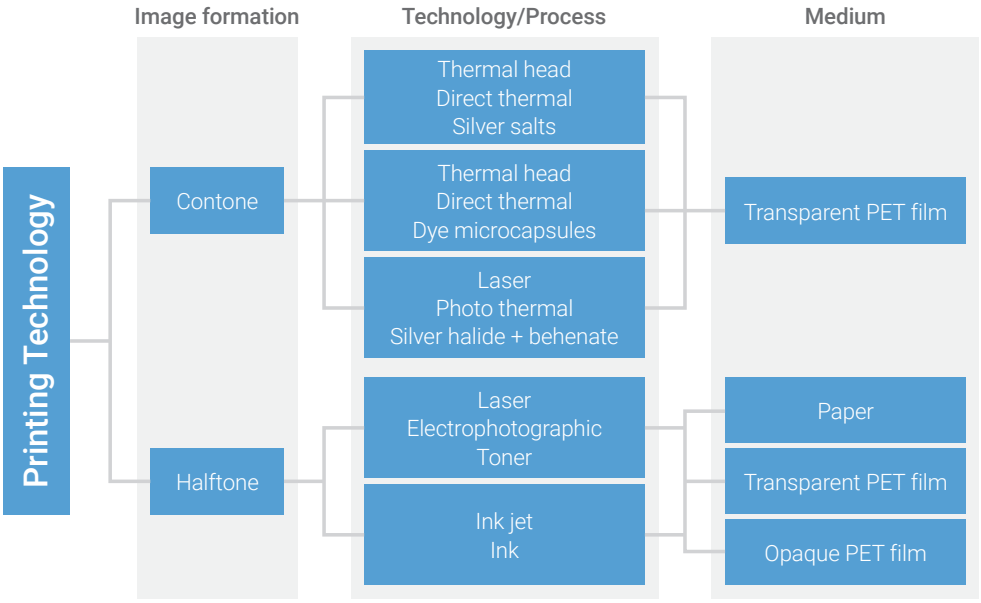
Contone ('continuous tone') technology renders each pixel with quasi-continuous levels of grayscale. Halftone technology attempts to mimic contone performance, by constructing an image point using an array of dots on the subpixel level. But the image structure on the sub-pixel level is substantially different from the continuous tones provided by medical printers. In many countries, therefore, these halftone printers are not approved for diagnostic CT, MRI and X-ray images.

### Medical-certified printers are key

While there are many printing technologies available for you to choose from, not all produce a diagnostic-quality image on a transparent diagnostic film. Contrast resolution, spatial resolution and optimal viewing conditions are all key parameters, but don't neglect the physical properties of the hardcopy material.

Only medical-certified hardcopy printers and film, such as the direct thermal printer and film systems from Agfa, can give you the guaranteed quality you need for diagnostic images, and meet the criteria for safety and performance.

# TECHNOLOGIES FOR MEDICAL HARDCOPY




**Overview of the most relevant printing technologies**

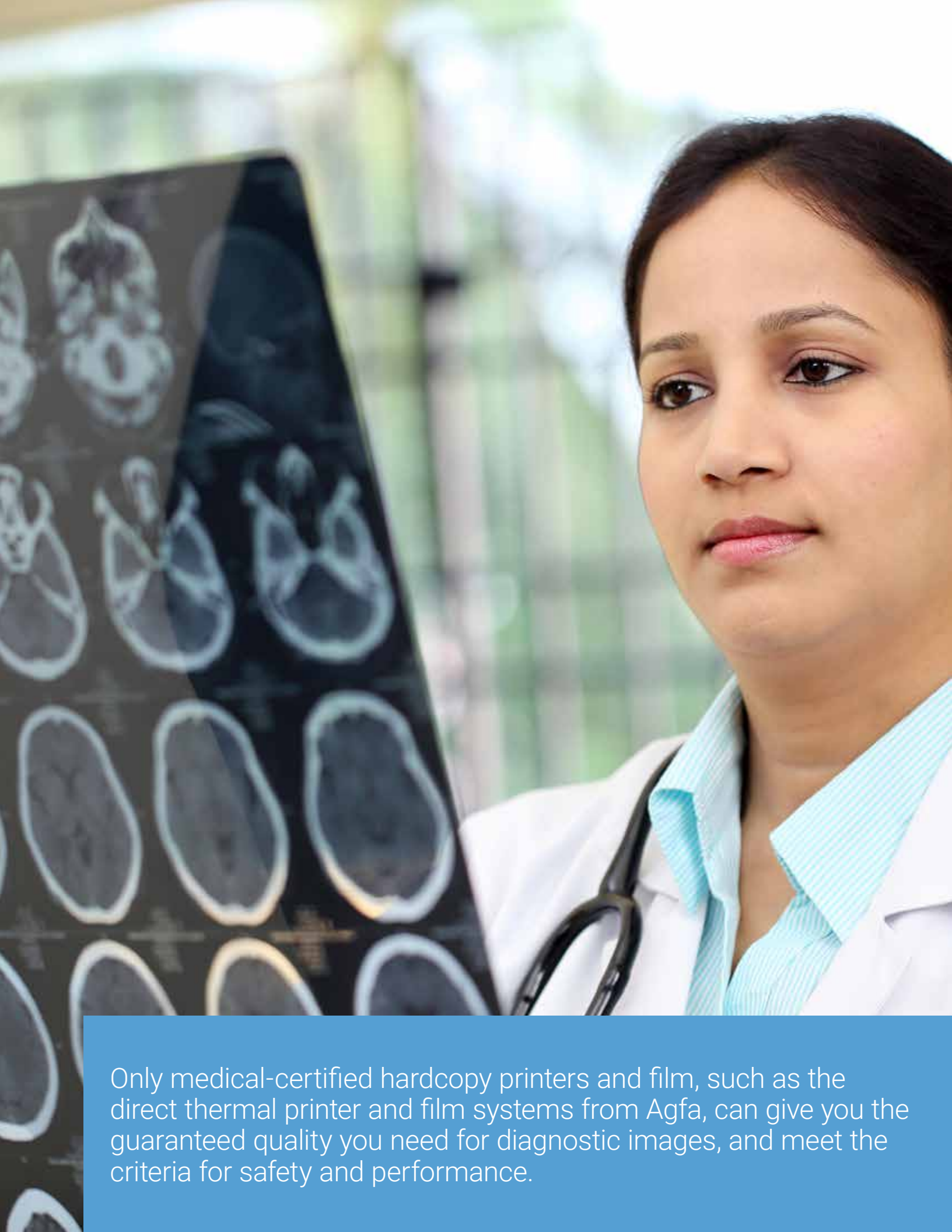
## THE ROLE OF FILM QUALITY

The quality of the film is important for image quality, for handling and for archiving. The **ISO 18939 standard** describes the procedures to ensure a film is suitable for medical imaging. It specifies tests on the physical properties, but also on the image permanence.

Hardcopy material and films, such as those produced by Agfa, have been developed for use with proven medical printers in order to guarantee the physical stability and image permanence required. But some new printing technologies do not offer this proven performance. In humid conditions, for example, images made using aqueous inkjet systems may have less physical stability. Plus, they are vulnerable to blocking in tightly stacked storage situations. You risk partial or even total loss of image information during handling or archiving.

## WHERE DOES DICOM FIT IN?

The DICOM standard is used for diagnostic imaging modalities to manage, store, communicate and print diagnostic images. For diagnostic-quality hardcopies, the printer must support DICOM. While some printers, such as non-medical inkjet or paper printers, may be able to convert and print a DICOM image, they often do not guarantee the quality or the calibration capabilities. DICOM also specifies the light levels for viewing hardcopies, and the European Commission has laid out principles for image viewing conditions (see https://bookshop.europa.eu/en/home/). ■



Only medical-certified hardcopy printers and film, such as the direct thermal printer and film systems from Agfa, can give you the guaranteed quality you need for diagnostic images, and meet the criteria for safety and performance.

# Putting innovation to work for hardcopy:
## DDI and A#Sharp, from Agfa

Direct Digital Imaging (DDI) technology can help ensure controlled, consistent image quality for medical printers. All of Agfa's hardcopy imagers are based on this stable, long-lasting technology. Agfa has further enhanced the DDI advantages with its innovative and proven A#Sharp, which offers sharper image quality and intensified imaging capability.

### DIRECT DIGITAL IMAGING

Direct Digital Imaging is a solid-state technology that provides controlled, consistent image quality in a stable, long-lasting platform. By replacing "old-fashioned" laser optics with solid state, high tech electronics as an innovative printing technology, DDI provides high reliability and lower cost of ownership for customers.

Its use in printers intended for the most detailed exams, such as mammography, confirms the high quality of its resolution.

DDI offers 12-bit processing, creating 4096 grey levels, to ensure a high level of perceptibility. Built-in, on-line macro-densitometers monitor image content and thermal head condition, with intelligent thermal modelling that controls crosstalk. Every image pixel is fully software-controlled, for a more flexible thermal process. The resolution perfectly matches the needs of the applications: 320 ppi for CT/MR/X-ray and 508 ppi for mammography.

DDI enables daylight media to be used and handled without the need for specialist daylight magazines. With its single-step printing process, DDI technology comprises simple mechanisms and a solid state thermal head, enhancing overall reliability and ease of troubleshooting.

The low initial investment and uncompromising image quality and productivity assure excellent quality images for low operating costs.


### A#SHARP ENHANCEMENT FOR DDI TECHNOLOGY

With the A#Sharp technology, Agfa developed a system that enhances the advantages of the Direct Digital Imaging technology with a sharper image quality and intensified imaging capability. To achieve this, Agfa developed an innovative technology to cope with the non uniform temperature response of a thermal system. The high frequency behavior of the thermal system has been improved, without disturbing the mid- and low frequencies in the image. This results in sharper images with a stable and constant density reproduction.

Thanks to this innovative A#Sharp technology Agfa enhanced the image quality. The result is consistently greater diagnostic comfort and quality, ease of use, reliability and long life. ■

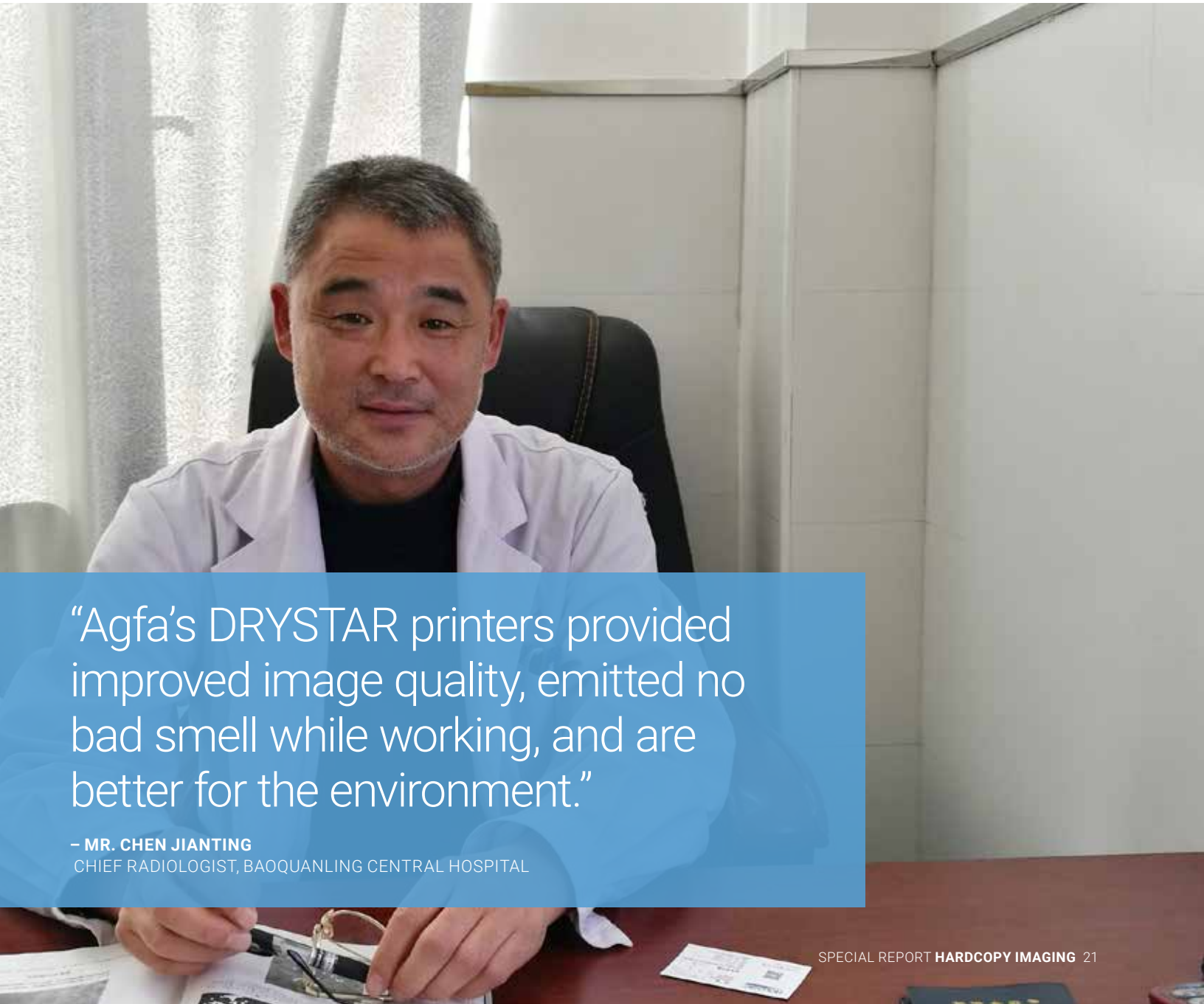
### The advantages of DDI with proven A#Sharp are clear:

- Long life and controlled, consistent image quality
- Enhanced image quality with A#Sharp
- Compact size, for maximum flexibility of application
- DICOM standard, for guaranteed connectivity
- One technology that is appropriate for all applications
- Daylight handling, saving time in daily operations
- Excellent quality with low operating cost
- Low power consumption
- Ecologically friendly, award winning technology
- No smell, expensive odour filters not required
- Fast start-up time
- A technology whose value has been proven around the world!

# Quality imaging supports quality care

At Baoquanling Central Hospital in China, DRYSTAR printers offer image quality and reliability, for delivery of better patient care and staff satisfaction

**INTERVIEW WITH MR. CHEN JIANTING,** CHIEF RADIOLOGIST
**Baoquanling Central Hospital,** Heilongjiang Province, China



"Agfa's DRYSTAR printers provided improved image quality, emitted no bad smell while working, and are better for the environment."

**– MR. CHEN JIANTING**
CHIEF RADIOLOGIST, BAOQUANLING CENTRAL HOSPITAL

> "They are reliable and convenient, and there are no darkroom or chemical disposal costs. With these three key advantages, the DRYSTAR printers have been well-received at Baoquanling Central Hospital."

Evolving from its origins as a military hospital to a large general hospital serving a region of 200,000 people, one thing has always remained constant at Baoquanling Central Hospital in the Heilongjiang Province of China: its commitment to high-quality care for its patients. This focus on quality is the main reason the hospital's radiology department switched to Agfa's DRYSTAR dry printers to make hardcopies of patient images from its computed radiography (CR), direct radiography (DR), CT and MRI modalities.

## Baoquanling Central Hospital


"Agfa provides us with maintenance and support in a timely way, and remains our first choice because its reliability and consistent quality make it a proven provider!"

## PATIENT CARE, EDUCATION AND COLLABORATION

Baoquanling Central Hospital is a modern 'Tier 3' hospital. This Chinese classification covers large (500+ beds) general hospitals that may provide specialist health services, play a big role in medical education and scientific research, and act as a regional healthcare hub. Baoquanling Central Hospital fulfills all these roles, by offering 710 beds, collaborating with Heilongjiang University of Chinese Medicine and Jiamusi Hospital, and implementing a Remote Medical Consultation Center with the high-end military hospital Beijing 301, amongst other initiatives.

Overall, the hospital houses 27 clinical departments and 18 medical departments in its 420,000 square meters of space.

In the radiology department, the 20 staff members – including radiologists, technicians and nurses – keep very busy making over 200 images each day, including around 80 X-ray images, 100 CTs and 20 MRIs. Fast, high quality hardcopies of the images are critical, as Mr. Chen Jianting, Chief Radiologist, describes. "Patients usually need to take films with them for referrals and consultations at other hospitals, so image quality is a must. And as the hospital has no PACS, diagnosis of images by radiologists and clinicians is done exclusively with film."


### DRYSTAR direct digital imagers

- The DRYSTAR portfolio of dry imagers offers excellent image quality, in a convenient, compact size printer. With low investment and running costs, these easy-to-use printers are ideal for all types of imaging departments.

## A#Sharp and DDI

Direct Digital Imaging (DDI) technology can help ensure controlled, consistent image quality for medical printers. All of Agfa's hardcopy imagers are based on this stable, long-lasting technology. Agfa has further enhanced the DDI advantages with its innovative and proven A#Sharp, which offers sharper image quality and intensified imaging capability.


## PRINTER ODOR AND IMAGE QUALITY

This need for image quality had a major impact on the hospital's decisions regarding film and printers. "Before 2006, we used two film processors and traditional screen films, before switching to a laser printer system," Mr. Chen explains. But this solution raised significant problems: "The printer emitted a terrible odor, which created an unpleasant working environment and was unhealthy for our staff. So in 2010, we made the decision to switch to Agfa's dry printers. We now have one DRYSTAR 5503 and three DRYSTAR 5302 printers."

The hospital was clear in its reasons for implementing a dry printer rather than an inkjet printer or another laser printer: "The image quality of inkjet printing cannot be guaranteed," comments Mr. Chen. "And we didn't want to continue having the problem with the laser printer smell. Agfa's DRYSTAR printers provided better image quality, emitted no bad smell while working, and are better for the environment."

The radiology department prints general radiography, mammography, CT and MRI images on the DRYSTAR printers. Supported by their A#Sharp software enhancement for Direct Digital Imaging Technology (DDI), "The printers offer more consistent image quality and faster speed of printing," says Mr. Chen.

The hospital also switched from plastic film to Agfa's films: "This was very important for diagnosis and referrals, because images on plastic film don't offer adequate clarity, and the details of structures are too 'fuzzy'. For the sake of accuracy, large hospitals don't accept plastic film."

## SMOOTH, EFFICIENT WORKFLOW

The DRYSTAR printers and films have proven easy to use, supporting a smooth workflow. "The images are transferred from the workstation to the printer, and printed out directly. There is no smell, it's clean, and the printers are suitable for any type and size of media. Our workflow is more efficient with the improvements from using the DRYSTAR printers. Out-patients usually get their copies within one hour, while in-patients receive them the next day."

In the end, Mr. Chen explains, the DRYSTAR printers have met the requirements of the radiology department: "The radiologists appreciate the stability and consistency, and the printers help us provide the images in a timely way, to keep the patient flow efficient. They are reliable and convenient, and there are no darkroom or chemical disposal costs. With these three key advantages, the DRYSTAR printers have been well-received at Baoquanling Central Hospital and we would certainly recommend them to other hospitals!"

Mr. Chen hopes to continue the on-going relationship with Agfa, potentially with the implementation of an Image Management system and printing kiosk in the future. As he concludes, "We started using Agfa screen film in 1995, and we chose them again in 2010, for the DRYSTAR printers. Agfa provides us with maintenance and support in a timely way, and remains our first choice because its reliability and consistent quality make it a proven provider!" ■

# The value of imaging

With the right balance of quality and cost, Agfa's dry medical printers support TCBA Diagnostic Centers, in Argentina, to deliver clear value to physicians and patients

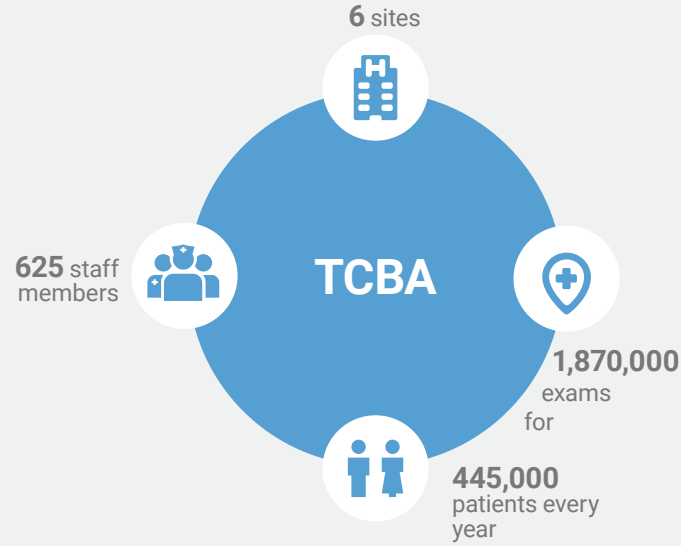
**INTERVIEW WITH CLAUDIO PARADISO,** ADMINISTRATIVE MANAGER
**TCBA Diagnostic Centers,** Buenos Aires, Argentina

"Agfa has accompanied our growth since 2009, and has heard our concerns and issues. It's a mutual cooperation that enables both our companies to thrive!"

**– CLAUDIO PARADISO**
Administrative Manager

Since it opened in 1983, TCBA Diagnostic Centers has been committed to offering high quality diagnostic and imaging services combined with up-to-date technology, in the city of Buenos Aires, Argentina, and beyond. "There were only three tomographs in the whole city when this private imaging center opened; with both a CT scanner and nuclear medicine equipment, it was really in the vanguard," explains Claudio Paradiso, Administrative Manager of TCBA. Through the years, the clinic has continued to invest to stay at the forefront. And playing a key role in satisfying referring physicians and patients alike are its Agfa medical dry printers.

"Reliability is the most outstanding feature of our Agfa dry printers, combined with an image quality that supports the requirements of 250 professionals."




## A PATIENT-CENTERED APPROACH

Over the past 30+ years, TCBA has expanded its reach in the number of clinics, the range of services, and the imaging technologies it offers. The group now has 6 sites and 625 staff members, including 180 doctors and 96 technicians. "We offer tomography, MRI, radiology, ultrasound, mammography, bone densitometry, nuclear medicine, laboratory services, cardiology and PET CT," comments Mr. Paradiso. "In total, we carry out 1,870,000 exams for 445,000 patients every year."

"We aim to use the highest level of technology in Argentina," he continues. But the patient-centric clinic goes further than that: "We focus on our patients, which is why we aim to provide maximum convenience for appointments, and we strive to always provide excellent professional quality."

## SATISFIED SPECIALISTS

The success of this approach is clear, with the clinic doing 430,000 diagnostic and imaging studies annually. The clinic is now a trusted reference center as well, for diagnostic and interventional imaging, and receives requests from all kinds of specialists (mainly outpatient procedures).

The services for referring physicians and patients include hardcopies of the patient's images, describes Mr. Paradiso. The group has a total of two DRYSTAR 5300, five DRYSTAR 5302 and one DRYSTAR AXYS imagers, spread out in the headquarters and the clinics, which it uses for all its printing of grayscale images.

## "IMAGES ARE OUR PRODUCT"

"Images are our product," Mr. Paradiso continues, "and we dedicate special attention to the quality of the hardcopy versions. We have used Agfa dry printers exclusively since 2009. They offered a huge improvement in terms of reliability compared to our previous printers, while maintaining the high image quality standard we require in printed images."

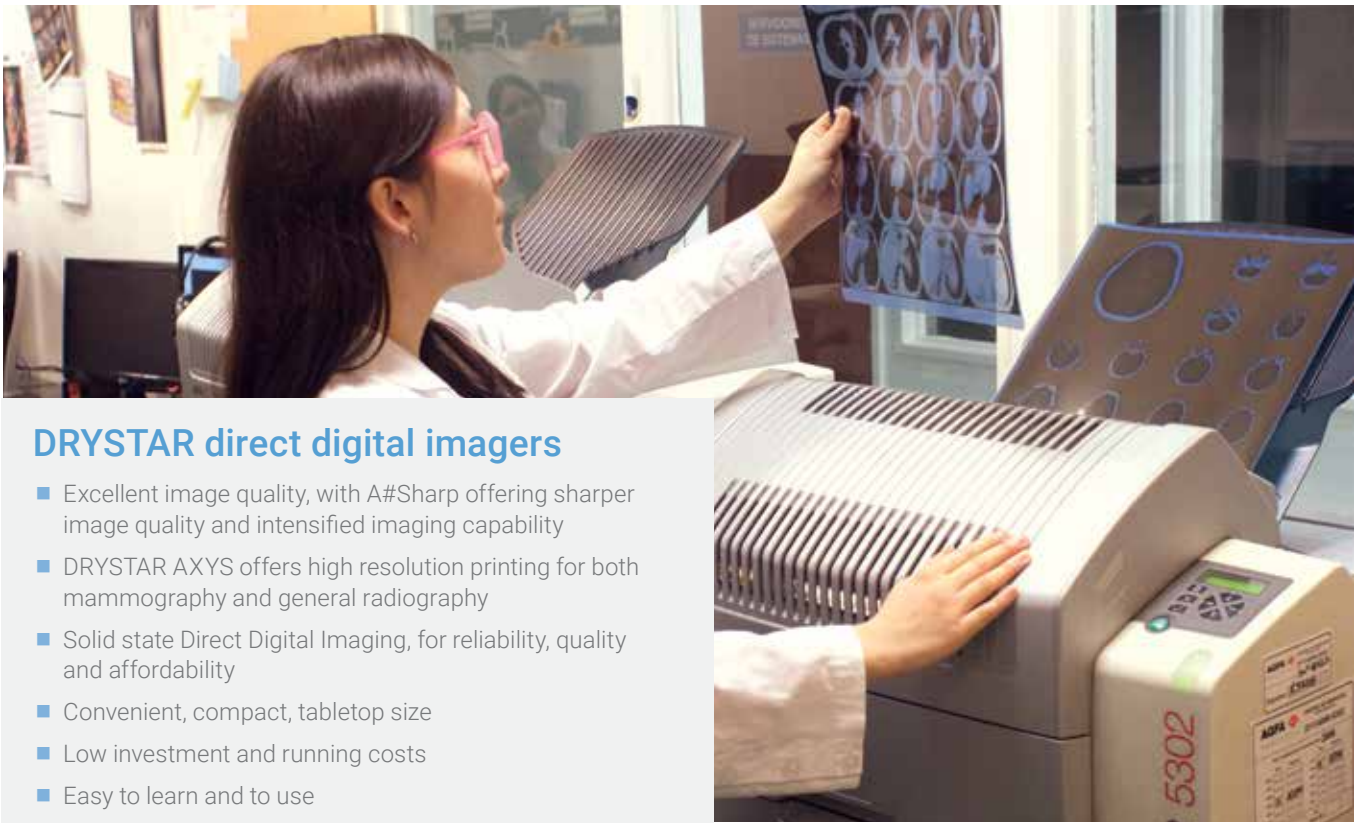
Agfa made switching printer supplier hassle-free, as well, he recalls. "It isn't always easy to change providers, but Agfa was very professional, and ensured there was minimum disruption to daily operations. They trained our medical and technical personnel on how to use the equipment and manipulate images," he emphasizes. "But really, the printers are so user-friendly and easy that our own technical and medical team has been able to transfer their knowledge to train new users, without any difficulty. And Agfa's technical support has been excellent."

### Agfa's contribution

Agfa supported TCBA to change from a third-party supplier of medical printers using laser technology, to exclusive use of Agfa dry printers. Agfa switched the printers with minimum disruption to daily operations of the clinic, and provided training on how to use the equipment and manipulate images to both medical and technical personnel. Agfa has provided excellent technical support since then.

## THE PERFECT MIX: RELIABILITY AND IMAGE QUALITY

In the end, Mr. Paradiso highlights, "Reliability is the most outstanding feature of our Agfa dry printers, combined with an image quality that supports the requirements of 250 professionals! And all while allowing us to solve our dilemma of balancing cost and quality. Agfa has accompanied our growth since 2009, and has heard our concerns and issues. It's a mutual cooperation that enables both our companies to thrive!" ■




### DRYSTAR direct digital imagers

- Excellent image quality, with A#Sharp offering sharper image quality and intensified imaging capability
- DRYSTAR AXYS offers high resolution printing for both mammography and general radiography
- Solid state Direct Digital Imaging, for reliability, quality and affordability
- Convenient, compact, tabletop size
- Low investment and running costs
- Easy to learn and to use


# A hardcopy solution for every need

## Award winning Direct Digital Imaging technology

Whether you need centralized, high-end printing for a large radiology department or a decentralized printing capability for next-to applications or within mobile units, Agfa has the perfect hardcopy solution.

These solutions – among the fastest on the market from print order to fi rst fi lm print – are made possible through the creation and development of our ecologically friendly, award winning Direct Digital Imaging technology.

When you combine this technological excellence with the built-in network connectivity offered by the DICOM compliance of our imagers and specialized media for all environments, you'll understand why hardcopy solutions from Agfa are the first choice for healthcare professionals.

To find out more, visit https://medimg.agfa.com

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