A Frost & Sullivan White Paper

Business Case and Benefits of Automatic X-ray Rotation Functionality within Agfa's SmartXR® Offering

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FROST & SULLIVAN

In Collaboration with: AGFA RADIOLOGX SOLUTIONS

INTRODUCTION AND STRATEGIC IMPERATIVE

Frost & Sullivan is a global consulting and market research company with decades of experience tracking healthcare and medical technology innovation trends.

The objective of this white paper commissioned by Agfa Radiology Solutions™ and led by Frost & Sullivan is to present a comprehensive assessment of the current SmartXR® portfolio, focusing on the SmartRotate™ feature offered by Agfa across its Digital Radiography portfolio and highlight the benefits to radiographer workflows.

Agfa's SmartXR® assistant offers predictive workflow assistance, for improved productivity and consistent outcomes. SmartXR® puts Agfa's proven imaging expertise into play. It brings intelligence to the digital radiography equipment at the point of care.

This white paper will focus on elucidating the benefits and use cases of SmartRotate™ functionality that uses deep learning to auto-rotate images based on their content to their standard orientation, providing consistent image presentation without operator interaction.

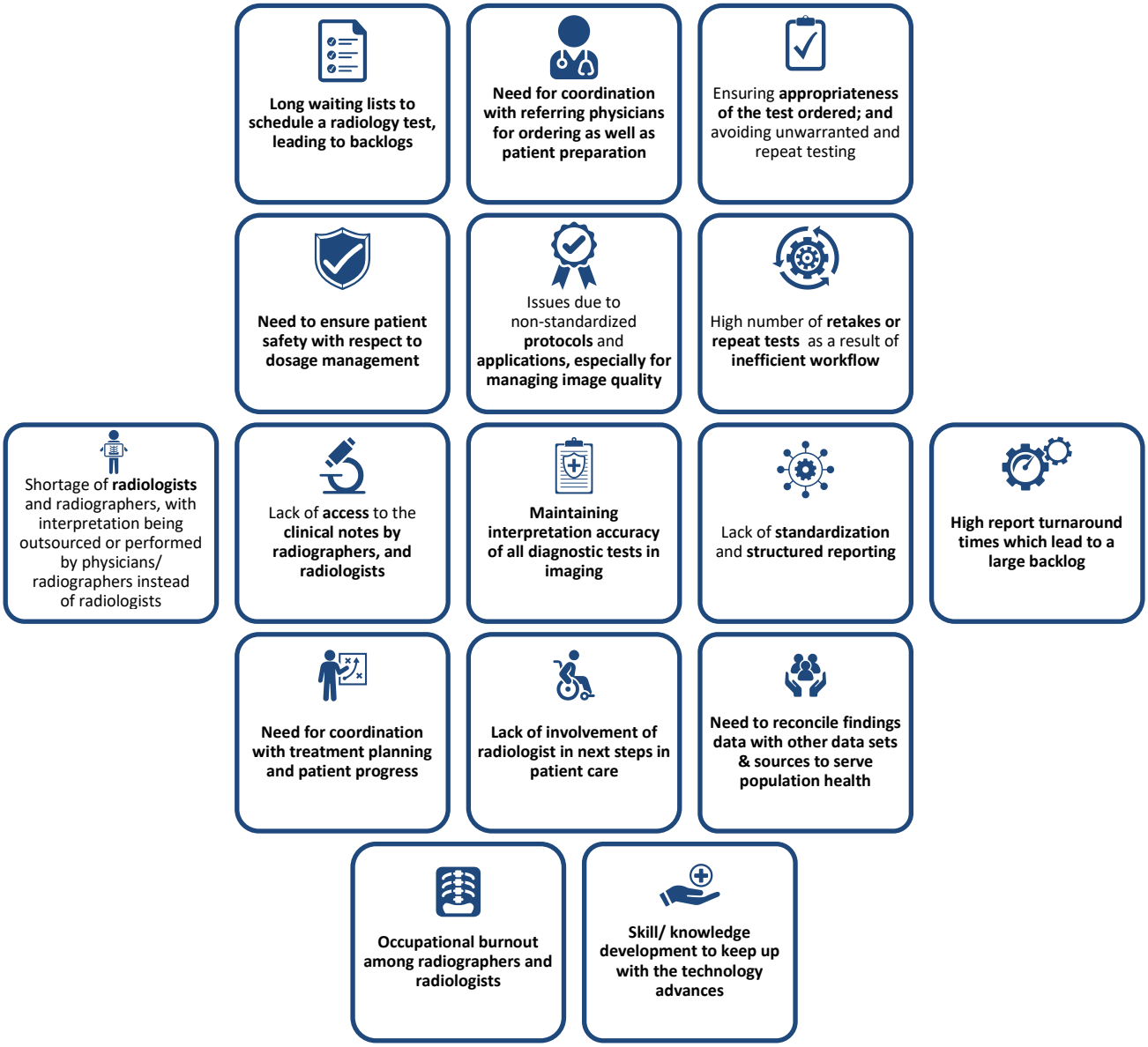
CONTENTS

1. THE CRITICAL ROLE OF DIAGNOSTIC IMAGING IN THE CARE CONTINUUM AND ITS CHALLENGES

Imaging is a critical component in the multidisciplinary system of healthcare delivery. Considering it is often the first step in determining the course of treatment, it plays a role in the diagnostic process for 65-75%[1] of all the patients seeking care. Imaging utilization rates have gone up considerably over the years. For instance, digital radiography procedures posted an annual growth of 8-10%[1] globally, contributing to 930 million procedures in 2021. This is because of the increasing recognition of the impact of diagnostic imaging in contributing to earlier intervention and treatment outcomes, especially after COVID-19.

Even as the role of imaging has grown considerably, several underlying challenges across the imaging value chain are restraining radiology from being utilized to its full potential i.e., increasing workloads, labor shortages, workflow inefficiencies, etc. These challenges need to be overcome for stakeholders to effectively manage the utilization of imaging assets.

Figure 1: Key Challenges in Imaging Value Chain



Enhancing the Image Acquisition Workflow in Digital Radiography

Over the past few decades, advances in digital radiography have significantly improved imaging departments, whether it is faster image acquisition, enhanced image quality, simultaneous viewing and interpretation of images, or the ability to store and share the results with physicians quickly. The real-time application of digital radiography offers radiographers the ability to effectively position and acquire a high-quality image, view the results, and archive the X-ray in a matter of a few minutes.

Image acquisition is an area that is of critical impact for downstream care, as getting the first step correct with an accurate image of high quality reduces interpretation time and increases diagnostic confidence and chances of appropriate treatment. This is also an area where radiographers can enhance patient experience while optimizing the appointment time to ensure better outcomes, i.e., less need for repositioning, retakes, etc.

While there are significant benefits offered by digital radiography, some features are not fully utilized by radiographers due to a lack of an easy-to-use interface or difficulty in navigating the technology. There is substantial potential for care improvement as even a slight efficiency gain in any step of imaging, can have a significant impact on large volumes of radiography exams.

In clinical practice, a significant portion of X-ray images are undiagnostic and require a repeat. A 20%[2] repeat rate is not uncommon when including bedside imaging. But repeats increase the patient's total radiation dose and decrease patient throughput, which puts extra strain on busy workloads and equipment, and escalates overhead costs. Every hospital and imaging department aims to reduce repeated x-ray exposures, and technology that enables the correct positioning, alignment, and dosage during image acquisition can improve the performance of radiographers.

> If you have people with less training, technology can help them get the correct positioning or avoid retakes. It can support them to make sure that the image is consistent, with a good dose. Technology like SmartXR® can offer the solution for this.
>
> **Prof. J. De Mey, Chair of Radiology, UZ Brussels**

2. FOR ASSISTING THE RADIOGRAPHERS AT THE POINT OF CARE

Agfa's SmartXR® brings intelligence to digital radiography equipment at the point of care using a combination of integrated sensors and user-friendly software. It employs 3D machine vision, and deep learning to make the DR equipment more aware of the environment and cater to the needs of both healthcare professionals and patients.

Figure 2: Impact of SmartXR® on Image Acquisition

	FEATURES	OUTCOMES
XR SMART ALIGN	Accurately aligning the panel to the X-ray source reduces image deformation and avoids grid cut-off, resulting in better images. SmartAlign™ uses advanced sensing to give live feedback on the accuracy of tube-to-panel alignment during bedside or out-of-bucky exams.	• Faster accurate alignment • Reduced retakes due to misalignment • More consistent projections
XR SMART ROTATE	Presents the image ready for viewing, automatically by using a Deep Neural Net to interpret the image contents, and then rotates the image accordingly. It results in reducing postprocessing actions, so that the radiographer saves time and can focus on imaging, not rotating.	• Fewer post-processing actions • More consistent image presentation
XR SMART POSITIONING	Augments the LiveVision™ camera stream with smart overlays to project the image area onto the patient's body. The resulting augmented reality image also shows the location of the system's active exposure control cells, to help you avoid retakes.	• Faster positioning • Reduced retakes due to • positioning • More consistent positioning • Continuous learning • Remote repositioning
XR SMART DOSE	SmartDose™ uses 3D machine vision to determine the thickness of the patient and then tailors exposure parameters specifically for that patient's anatomy. It saves time over manual adjustments while avoiding the retakes that can result from incorrect exposure settings.	• Faster dose setting • Fewer retakes • Improved image consistency • Patient tailored dose

3. Demonstrating the impact of automatic x-ray image rotation in Image Acquisition Workflows

This white paper will deep dive into the SmartRotate™ feature and elucidate the impact of the autorotation of images in improving the efficiency of a radiographer, and overall value addition to the imaging workflow.

It is important to send radiographic images based on the approved "Hanging Protocol" of the department. These protocols have proven to increase the accuracy and efficiency of interpretations by providing consistent viewing standards for the radiologist. Part of this protocol includes the standard orientation of the image, as this allows the radiologist to immediately begin the interpretation process without the additional step of rotating the image. It is the responsibility of the radiographer to send images under the correct orientation. To accomplish this, they can either position the detector so the image is initially captured in the correct orientation, or correct by using a rotation button via the post-processing. Most image detectors include a visual indicator that allows the radiographer to position the detector, so the anatomy appears in the correct orientation. That said, there are numerous reasons why the radiographer might fail to properly position the detector. This can be due to time constraints, a lack of training or experience, an inability to see the visual indicator due to a grid cap, etc. In such situations, the radiographer must manually click to rotate the image in 90-degree increments.

Frost & Sullivan Perspective: Illustrative Case in Point

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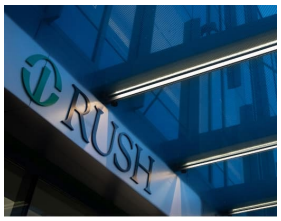
Trauma patients in an emergency department, often require STAT, portable Chest X-rays using portable X-ray units at bedside. The ordering physician waits for the X-ray image to appear on the monitor, while the trauma team continues to focus on assessing the patient and performing interventions.

With SmartRotate™, the radiographer can tend to the patient and remove the image detector so assessment or compressions can continue. They do not have to spend time near the machine after exposure to ensure that the image appears in the correct orientation for the ordering physician to view.

With SmartRotate™, radiographers can avoid the burden of manual intervention required to rotate the image to the correct orientation. The time saved can be especially beneficial in high throughput situations involving multiple trauma exams with numerous body parts. In such exams, it is more efficient to perform all rotation corrections after all images are acquired, as it allows the radiographer to better focus on the patient, rather than the machine. SmartRotate™ allows the radiographer to bypass much of the required post-processing following these, and other exams.

Case Study 1: Rush University Medical Center, USA[3]

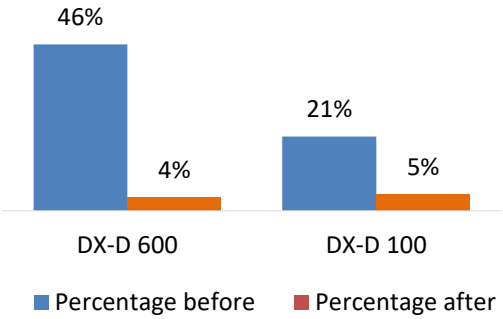


The Rush Oak Brook Surgery Center is an ambulatory surgery center, part of Rush University, in the United States. The center includes six operating rooms, two procedure rooms, and 28 patient bays for pre-surgical preparation and post-surgical recovery for patients who undergo orthopedic surgery, total joint replacement, neuro spine surgery, pain management procedures, general surgery, ear, nose, and throat, musculoskeletal, gastrointestinal and other surgical procedures.

A study was conducted in their imaging centers with two DX-D 600, and one DX-D 100 digital radiography unit from Agfa Healthcare

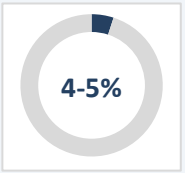
This center performs a variety of X-ray acquisitions including chest, abdomen, bone survey, ankle, foot, hand, wrist, etc. with an average volume of 1500 X-rays per month. The data on the number of manual rotation actions before and after activating the SmartRotate™ feature was collected over a period of 60 days between 2020-2021, to identify the impact of using the SmartRotate™ function.

Manual rotate actions before and after activating SmartRotate™

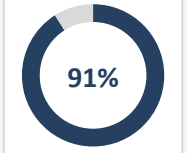


Average Reduction in Number of Image Rotation Actions/ 1000 images with SmartRotate™

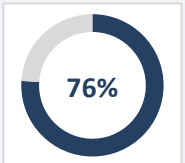
Manual rotations reduced to 4-5% of exposures



91% reduction on a DX- D 600 unit



76% reduction on a DX- D 100 unit



SmartRotate™ functionality results in 20 hours of bedside imaging workload savings per machine annually

As a technologist and manager at Rush University Medical Center, SmartRotate™ has changed the way our team views imaging. SmartRotate™ saves a lot of time without the use of manual rotation; time that can be put towards patient care and maintaining volumes in the department. These benefits were most apparent on our Agfa portable in the ICU where removing extra steps and distractions can be vital to caring for these critical patients.

Stepfanie J. Harvey, General X-Ray Manager, Rush University Medical Center

With SmartRotate™, the radiographer avoids going through each image to make rotation clicks following the exam, reducing the time needed to prepare images for reading and interpretation. This also ensures the images are consistently presented on the RIS/PACS, allowing better comparison with priors, as well as contributing to improving efficiency in the radiologist workflow.

Case Study 2: AdventHealth Diagnostic Imaging Center, USA[4]

AdventHealth's Central Florida Division has more than 35 Imaging and Diagnostic Centres.

A study was conducted in 9 of their imaging centers with ten DR 100 portable digital radiography units from Agfa Healthcare

A variety of X-ray acquisitions including chest, abdomen, ankle, foot, hand, etc. are typically performed in these imaging centers with an average volume of >17,000 images annually. The data on the number of manual rotation actions were collected both before and after the SmartRotate™ feature was activated. This was done over a period of 1 year between 2021-2022, to assess the impact of using the SmartRotate™ function.

AdventHealth's Central Florida Division has more than 35 Imaging and Diagnostic Centres.

- There was a **4x reduction in the number of images manually rotated** per 1,000 images when SmartRotate™ was enabled.
- Images requiring **manual rotation dropped from 17.6% to 3.4%** of total imaging volumes after SmartRotate™ was activated, thus reducing user intervention with the system.
- With SmartRotate™ enabled, a significantly higher proportion of images (41.4%) were identified for autorotation as compared to human intervention (17.6%). This indicates the **flexibility in workflow** realized by the radiographers no longer taking time to position the DR panel in the correct orientation.

> At AdventHealth we deliver on our promise to provide Whole-Person Care every day to every patient. As a Quality Manager and Technologist, I like knowing that I can trust images are being displayed correctly instantly with no manipulation. This is especially important when performing imaging in the ED where providers often perform wet reads. Having confidence that they can view images immediately saves time. This allows the technologists to have a patient-centric mentality without concern about image orientation. With our significant volume, this has the potential to provide substantial time savings over a year. Which as any good manager knows equates to dollar savings through increased productivity.
>
> **Elizabeth Evans, Senior Modality Manager- Diagnostic, AdventHealth Central Florida Division**

4. Commitment to Improving Radiology Workflow

Agfa Radiology Solutions™ aims to enhance radiographer proficiency so they can focus on improving the patient experience. Image acquisition is the first step in this process, and presents an immense opportunity for hospitals not only in terms of time and effort saved and improvements in image quality but also intangible benefits such as patient engagement, high workplace satisfaction, etc.

Agfa introduced SmartRotate™ functionality with this objective and programmed it for chest, abdomen, hand, wrist, foot, and ankle exams first as they are the most common and can provide the largest impact up front. The company is expanding the functionality further by programming for skull, shoulder, humerus, elbow, pelvis, hip, knee cervical, thoracic, and lumbar spine exams, making it an almost comprehensive solution for eliminating detector positioning and manual rotation post-processing while requiring zero additional training. This is increasingly important for radiology departments as maintaining adequate staffing levels continues to be a global struggle. It is important to note that SmartRotate™ is one of the growing numbers of SmartXR® features, and the cumulative impact of the whole smart workflow assistant provides increasing clinical value to radiology departments.

We listen to our customers and today's radiology departments require x-ray equipment with more functionality than image acquisition. Agfa offers intelligent tools focused on improving consistency, efficiency, and safety during the image acquisition process.

X-RAY INTELLIGENCE AT WORK

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Agfa's SmartXR® assistant offers you predictive workflow assistance, for improved productivity and consistent outcomes

SmartXR®: Digital Radiography Meets Artificial Intelligence

Frost & Sullivan uses a unique form of social research called qualitative, quasi-deductive, or QQD research. As such, it utilizes a three-part approach to determine market trends and outcomes, combining quantitative data, qualitative data, and analysts' perspectives to triangulate its conclusions.

Key References:

1. Frost & Sullivan Medical Imaging Growth Generator Database
2. Agfa SmartXR® Brochure: X-Ray Intelligence at Work
3. Data was collected from Rush Medical Imaging Center without SmartRotate™ from May to June 2020 and with SmartRotate™ between October to November 2021. The center processed an average volume of 1500 X-rays on 3 DR imaging equipment.
4. Data were extracted from 10 systems in Advent Health with 6 systems with SmartRotate™ and 4 systems without SmartRotate™ (control group) between November 2021 to November 2022.

- Schedule a meeting with our global team to experience our thought leadership and to integrate your ideas, opportunities, and challenges into the discussion.
- Interested in learning more about the topics covered in this white paper? Call us at 877.GoFrost and reference the paper you're interested in. We'll have an analyst get in touch with you.
- Visit our Digital Transformation web page.
- Attend one of our Growth Innovation & Leadership (GIL) events to unearth hidden growth opportunities.

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