



GE Healthcare

# Radiography Buyer's Guide



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# Key Considerations in Digital X-ray Today

The new frontier of X-ray is rapidly developing and as such, it's become increasingly important — and complex — for buying committees to determine precisely what measurements they should use to make decisions on new and upgraded X-ray equipment.

The introduction of Artificial Intelligence and the trend of lower radiation dose paired with higher image quality expectations across a fleet, represent the new complexity in buying decisions. When evaluating different equipment and whether to replace everything at once and on what schedule, there's much to consider. What are the benefits of standardization? How do I evaluate different manufacturers? How do I determine if AI can have a real impact on my department? Should I base my decision solely on price? How can I get the most for my budget with a return on investment that delivers results?

## Exam Focus Areas

For rooms that need to serve a wide patient population and different exam types, you want a reliable system that can efficiently accommodate all patient types that is also built to deliver clinical excellence. For example, a bariatric population with high throughput may need a higher power generator and a bariatric table with static and dynamic weight limits that ease patient positioning and offer dignified patient exams.

For the ER and trauma centers where mobility is limited, portable machines must be ready when needed, be easy to move, be highly reliable and maintain connectivity for image capture and routing. They also need to easily provide visual confirmation without being impaired by the glare of overhead lights. Consider what technologies will allow your team to get clinical results as quickly as possible and help triage cases so that intervention is well-timed and successful.

*There aren't any one-size-fits-all answers, but this guide will walk you through the questions to ask, tradeoffs you may be able to make for your facility and how to find the best path forward for your needs.*

For areas such as the NICU, portables must deliver clinical answers at the lowest dose possible, operate near-silently, provide unique clinical capability to assess line and tube placement and be able to safely position near heat lamps and provide the right SID for Imaging.

In Orthopedics, it's especially important to consider foreign objects such as metal implants, screws and plates when considering image quality and reducing artifacts. Querying vendors on specific ways they accommodate for these in their image quality, reconstruction and image consistency can help you tease out true differentiators in MSK imaging options.



## Image Quality

Healthcare facilities know the negative impact that less-than-optimal images have on operational efficiency. That's why hospitals rank "improving image quality" among their top priorities<sup>1</sup>. But how do you prioritize what Image Quality means to your facility? Below you'll find some considerations based on the makeup of your organization.

Two key considerations for facilities with a high volume of chest and abdomen exams are detector size and noise reduction. First, determine what detector size will best serve your patient population. Larger detectors can decrease the risk of anatomy clipping. Smaller detectors may increase clipping risk but are easier to move around an exam room.

Noise reduction and contrast enhancement are important second considerations for large chest and abdomen exam facilities. Investigate how vendors account for noise and contrast in their image processing and ask for sample images that you can view on your PACS system.

If you have an orthopedic facility or your facility images a high volume of extremity cases, the detector resolution becomes even more important to your needs. Higher resolution detectors can often show more fine detail in the small areas where it's both difficult and important to see as much as possible. How prospective vendors manage metal implants is also a critical consideration for these facilities, as they can impact image quality and consistency across images.

Image consistency is increasingly important to both radiologists and technologists, especially in the presence of foreign objects and exam variations. While many vendors attempt to achieve consistency in their image processing, there are some differences in how that consistency is achieved and how it aligns to your organization's requirements. Some vendors rely on the performance of their core algorithms while others use Artificial Intelligence on top of core image processing. Understanding what approach best suits your needs requires examining the outcomes.



## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT IMAGE QUALITY

- What is the DQE & resolution of the detector?
- What image processing algorithms are available to enhance the images, such as EMI reduction, grid-line suppression, etc.?
- Are your image processing algorithms configurable?
- Is Artificial Intelligence used as part of the image processing? How is it used?
- Is there any risk of image artifacts introduced by Artificial Intelligence?
- Can the algorithms using Artificial Intelligence be configured to achieve the desired image look?
- What is the consistency of the image processing, and how are you measuring it?
- Does the image look change when there are changes in dose, changes in positioning, or when metal objects are present?
- How are metal artifacts mitigated in the images when metal is present?

*Ask prospective vendors to see sample images of the following exams in order to identify the system that will deliver the best results for your needs: (1) extremities with and without metal implants, (2) chest exams of different patient habitus, and (3) variations in positioning and techniques.*

<sup>1</sup> Source: IMV 2019 X-ray/DR/CR Market Outlook Report © 2019 IMV, part of the Science and Medicine Group

## Clinical Outcomes

How do you prioritize what clinical outcomes are most important for your facility? Below you'll find some considerations based on the makeup of your organization.

In orthopedic settings, missed fractures, seamless treatment planning and dose management are significant problems facing healthcare facilities and the patients who depend on diagnoses and treatment. X-ray systems that offer digital tomosynthesis help improve clinical diagnosis of doubtful findings seen on routine radiographs by removing superimposition and overlying structures. Not all digital tomosynthesis solutions are

alike. Be sure to evaluate the most recent version available and consider the solutions that offer the least impact to exam workflow and the most impact to positive clinical outcomes.

For Thoracic specialties, there are many advanced options available for X-ray systems. When considering Dual Energy and bone subtraction solutions, each has pros and cons, and tradeoffs. Some solutions may have next to no motion artifact, but also require a high dose of radiation due to the nature of the image capture process. Others can be delivered at lower dose but have too much motion in the bone image. Because they are drastically different, it's important to analyze performance between software-based solutions and solutions that deliver images acquired at two energies. If possible, get input from radiologists who have access to both types of images. Consider whether visualization of bone calcifications or fractures in the bone image of a Dual Energy solution is useful to your patient population, and whether both AP and Lateral images are necessary.

For any advanced applications, it's best to ask prospective vendors to supply sample images so that you can see the differences for yourself.

## Workflow Improvements

Driving workflow improvements across your X-ray department can deliver gains in technologist experience, department efficiency and patient experience. In fact, a recent GE survey of 1,900 X-ray patients in the US showed that, more than on-time appointments or technologist interaction, total exam time had the biggest impact on patients' overall satisfaction with their exam.

When looking for workflow efficiencies, consider unexpected places. Not only can the system itself drive workflow efficiencies, but innovations around image quality can reduce post-exam processing time by the technologist, easing some of the pressure in high-throughput facilities.

*One evaluation by GE showed an up to 87% reduction in time to review and adjust brightness and contrast using AI-powered image processing. This equated to removing up to almost a full minute from the post-exam workflow.<sup>2</sup>*



## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT CLINICAL OUTCOMES

- How will my diagnostic capabilities improve?
- Will radiologists notice a positive change in diagnostic confidence?
- How much time is spent on image reconstruction in digital tomosynthesis?
- How much time do technologists spend on annotation and image adjustment for digital tomosynthesis?
- How many clinical papers have been published using the vendor's specific solution?
- Are there motion artifacts in the Dual Energy images that impact clinical use? Can the technologists adjust the technique used for the Dual Energy exam?
- What is the quality of the bone image delivered in Dual Energy?

<sup>2</sup> GE data on file.

Radiologic technologists have a high rate of on-the-job injuries – everything from back injuries and shoulder pain to hand and wrist problems. In fact, nearly one-third of practicing radiologist in the U.S. report job-related lower back pain.<sup>3</sup> The repetitive movements and heavy lifting while positioning patients can create strain over time. X-ray systems that are designed to be easier to move and intuitive to use provide a better experience.

If your facility has high patient throughput or room efficiency concerns, consider an autopositioning solution that is tied to the patient worklist so the system works with your technologists to speed throughput, instead of being a factor in slowdown. Autopositioning may also work for you if you're managing technologist injuries due to manually positioning systems on top of their patient positioning effort.

If you're in a low throughput facility and don't need autopositioning, there are economical solutions that are capable of complex positioning and workflow improvements that deliver excellent clinical images. Be sure to evaluate prospective vendors on their portfolio offerings that offer significant benefits without an autopositioning option.

### Patient Experience

Patient Experience puts the patient at the center and then meets them where they are — not just medically, but emotionally and socially — to design a holistic strategy. Imaging's impact on patient experience goes beyond the critical interaction between provider and patient.

Standardizing with the latest X-ray technology speeds exam times and lowers patient dose. Advanced applications can provide greater insights than what traditional 2D X-rays provided in the past. This leaves hospitals with greater diagnostic confidence while providing extra time — and more accurate information — to address patient experience in every setting. Ensuring your X-ray equipment can serve a broad patient population that aligns with your patient demographics is critical to delivering care with dignity.



## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT WORKFLOW AND TECHNOLOGIST SATISFACTION

- What impact does this system have on my technologists?
- What is the training program post-purchase?
- Is there a significant change to workflow? How quickly will my team adjust to those changes?
- Can detectors move from room to room without requiring a service technician or biomed?
- Can detectors charge in the wall and table buckys in the room? In the bins on a portable system?
- How fast can you preview images, see final images, reprocess, and complete your exams?
- How easy is it to drive the portable system to various clinical area – ER, OR, Surgery, NICU, Outpatient Centers?
- How easy is it for Technologists to use?
- Can technologists seamlessly transfer between different types of systems with minimal retraining?

*Did you know: 60% of X-ray patients report that the quality of the X-ray equipment impacts their overall satisfaction with the healthcare facility<sup>4</sup>*

<sup>3</sup> Source: Radiology Business, Anicka Slachta, March 23, 2018.

<sup>4</sup> A recent GE survey of 1,900 X-ray patients in the US.

If you measure patient experience by tracking dose and repeats as an impact to your patients' satisfaction, consider a system that makes it easy to not only track repeats but develop insights into patterns that can be addressed through additional training or changes to standards of care.

If your patient experience is measured by connection between the patient and the technologist, consider technology that enables or heightens the connection in the exam room. Technologies like an in-room camera that delivers integrated live video to the workstation enables technologists to connect with their patients, even when not in the room. In fact, 69% of patients report that being monitored by the technologist throughout the entire exam through a live video feed was appealing to them.<sup>6</sup>



## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT PATIENT EXPERIENCE

- How will this system help my facility meet current and future satisfaction goals?
- How do you balance image quality and dose?
- What features does the X-ray system provide for improving patient comfort and care?
- Are there features that enhance the safety of patients and technologists during the exam?
- Does the system provider have tools that enable you to analyze repeats/rejects & dose?
- How does your equipment serve bariatric, pediatric, geriatric, and special needs patients?



## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT SERVICEABILITY AND RESPONSE TIME

- How many OEM service field engineers are located in the area?
- Does your service provider use OEM-certified parts?
- Where are the service provider's parts depots located?
- How long does it take for parts delivery?
- How fast is your service response time?
- What is the rate of system fix for the first call?
- What times and days is technical support available?
- What parts availability metrics are available?
- What is the expected service plan for these systems?
- What kind of uptime commitments are available in your service agreements?
- Does the supplier have the ability to remotely monitor, diagnose and address system issues?
- How will the supplier work with your Biomed team to provide the training and support necessary?

### Serviceability and Response Time

Because service significantly changes your total cost to own, make sure your service partner has a reputation for delivering the best. They should back that up with commitments to deliver uptime and responsiveness, as well as how many field engineers they have in your area. Ask for a map showing coverage in your region. Time to delivery of parts is another key metric when evaluating a service provider. Make sure you also see a map to understand the parts depot that will service your parts needs.

<sup>6</sup> A recent GE survey of 1,900 X-ray patients in the US.

## Artificial Intelligence

Artificial Intelligence in healthcare is more accepted by the patient population than many might guess. Fifty four percent are comfortable with its use, and 24% are neutral.<sup>7</sup> When you consider solutions that leverage Artificial Intelligence for results, ask prospective vendors how they see Artificial Intelligence enhancing workflow, delivering image quality to your facility's specifications and improving clinical outcomes for your patients.

What are the clinical gaps, workflow gaps and error-prone or mundane activities that need solutions in order to improve the performance of your radiology / imaging department? Can AI-driven technology provide solutions to these problems?

There is a lot of buzz around Artificial Intelligence. A quality vendor partner can help you identify outcomes tied to your goals.

### **ASK PROSPECTIVE VENDORS HOW THEY SEE ARTIFICIAL INTELLIGENCE ENHANCING WORKFLOW, IMAGE QUALITY AND CLINICAL OUTCOMES.**



## AI

## QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT ARTIFICIAL INTELLIGENCE

- Was the algorithm trained on a diverse dataset from multiple sources?
- Are the results of the algorithm(s) vendor agnostic?
- Is your region / patient population represented within the algorithm(s) training dataset?
- Were the algorithms trained and validated on a system similar to the one you would be using?
- How long does it take for the result to be provided once the images are sent?
- Does the AI solution run on the X-ray device, within an on-premise server or in the cloud?
- Consider the IT infrastructure necessary to implement such solutions into your workflow
- What is the development / release cycle of prospective vendors?
- What is the vendor's business model for their AI solutions? Pay per use / per click? One time upfront fee? Monthly / yearly subscription fee?
- Are there plans to release additional models in the future that will add value to your facility or address specific clinical needs within your department?
- What are the performance specifications for the vendor's algorithms?
- Some specific specifications to ask about are: AUC (Area Under ROC curve), Sensitivity/Specificity/Positive Predictive Value (PPV), & Negative Predictive Value.

<sup>7</sup> A recent GE survey of 1,900 X-ray patients in the US.

## Cybersecurity & Technology

Making sure your X-ray systems are protected from cyberattacks is becoming increasingly critical to choosing a vendor for your next purchase. Between protecting patient data integrity, privacy and system availability, healthcare providers have a lot to manage. When evaluating prospective vendors, look for cybersecurity packages that are designed to protect your assets and your patients without disrupting workflow.



### QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT CYBERSECURITY & TECHNOLOGY

- What features does the X-Ray unit provide against cyber security attacks?
- What features does the X-Ray unit provide to meet cyber security regulations?
- What is the data encryption standard used?
- What security feature is provided for data transfer across networks?
- How secure is your detector connectivity?
- Does your vendor offer obsolescence protection to ensure the OS is supported with security patches?
- What is the operating system used?
- How do you manage OS security for the life of the system?
- How easy is it to connect your X-Ray unit to HIS/RIS and PACS workflow?
- Are there any interferences with your detector connectivity for image transfer?
- How reliable is the connectivity between the X-Ray unit and the detector?
- How do you manage technology obsolescence especially regarding IT hardware and software?

## Effective Radiation Dose

Patients are more aware of the radiation associated with X-ray, and hospitals rank dose management as a key priority<sup>8</sup> and are looking at methods and technology to mitigate these risks while still gaining image quality that will deliver results. Standardizing on high DQE detectors (detectors that deliver equal or higher image quality at lower dose) can help meet that need. It's equally important to drive best-in-class reporting of dose exposure without placing an unnecessary burden on administration for creating those reports. Having standardized, easy to access reports makes it easier to collectively lower dose exposure hospital wide.

*Patients care deeply about dose. “Radiation exposure” was the largest reported concern by X-ray patients, and many reported feeling uninformed about their dose risks.<sup>9</sup>*

<sup>8</sup> Source: IMV 2019 X-ray/DR/CR Market Outlook Report © 2019 IMV, part of the Science and Medicine Group

<sup>9</sup> A recent GE survey of 1,900 X-ray patients in the US.



# Considerations for Evaluating an X-ray System

## Clinical Setting

The best way to understand how equipment will fit with your exact imaging needs is to see it at work in a similar setting. Ask your supplier for a facility using the equipment you're considering. There, you can observe a normal interaction with the machine. Also bring a technologist along to ensure you have input from a critical stakeholder.

## Headquarters Demonstration

A visit to the prospective supplier's headquarters gives you the added benefit of interacting with product development, engineering, service and sales to evaluate different systems and their ability to meet your needs. This isn't just an important purchase – it's a relationship and being able to interface with the teams behind the product provide deeper insights to the underlying technology. In addition, your feedback can be instrumental in further product development to meet ever changing clinical needs.

## Construction

In terms of overall cost, construction is a variable that can substantially affect the price. When evaluating equipment, think about the construction needs to support it, which may drive your new vs. upgrade decision.



### QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT CONSTRUCTION

- What is the construction cost and timeline?
- What does the installation timeframe look like?
- What is the project management lift that is expected from me and my team?
- Is there enough access for stretchers through doors and around corners?
- Can the room be somewhat flexible to accommodate imaging technology advances and new procedures that come with additional equipment?
- What is the transition plan for a new system? What is the expected downtime?

## Total Cost of Ownership

With any new radiography equipment, evaluate not just the purchase price, but also the total cost to own over the life of your equipment. Do prospective suppliers have a proven track record for innovation and upgrade solutions that will grow with your needs? Do they do preventative maintenance and yearly inspections? These can add utility to your machines and cut down on costly repairs. Hospitals can gain three or more days of extra uptime for each connected X-ray system that is maintained and well monitored remotely by an invested vendor partner. Ask if your supplier has remote performance monitoring, to help you avoid problems before they impact availability.



### QUESTIONS TO ASK PROSPECTIVE VENDORS ABOUT TOTAL COST OF OWNERSHIP

- How will this affect my current detector pool? Use and cost management?
- Can I expect to see an increase in my physician attraction/retention rates?
- Is it possible for this system or for an advanced application on this system to enable ROI?
- Can I do more with less to offset declining reimbursement?
- What will the total specific cost impact be, both upfront cost and total cost of ownership, including downtime and construction cost? Ongoing service costs?
- How long do I expect to retain the system and how will it benefit evolving patient and x-ray demands?

# Upgrade or Replace?

The age and technology level of your X-ray equipment will factor into whether you will want to upgrade or replace with new machines. The vast majority of customers have transitioned to digital radiography either through replacement or through extending the life of their CR (computed radiography) systems with digital retrofit or upgrade kits. However, as technologies become obsolete and parts availability diminishes there could be compatibility and service support issues later on. That will eventually render the continued updating of equipment uneconomical, if not impossible. Every hospital's decision is unique and requires you to take a hard look at your current equipment, your efficiency goals and patient outcome markers, along with your future goals for radiography.

Here are some options when considering new equipment:

**Existing Analog or CR system upgraded with a DR Retrofit** — Average Price Range: \$40,000 to \$85,000

This step up from CR is 40% less than purchasing a new fully integrated system. Many DR flat panel retrofit kits can extend the life of a CR system. They also eliminate time-consuming cassettes and come in different options:

**Fixed detectors:** install a detector in the wall stand of your existing system. This may be a good solution for rooms dedicated to chest exams, where technologists don't need to move the detector out of the wall stand.

**Tethered detectors:** a detector that is moveable between the wall stand and the table, tethered by a cable. This option is a good fit for smaller volume hospitals or clinics where there isn't much need to move the detector.

**Wireless detectors:** these communicate with the workstation without cables. If you need maximum flexibility in the room, wireless detectors are a good choice.

However, CR systems that have undergone digital upgrades were not built for DR's higher throughput capability, providing additional stress on subsystems, which leads to downtime and cost. In the short-term, such solutions will maximize the speed of previously analog rooms but may lack many of the workflow and ergonomic features enjoyed with fully integrated systems.

**New Analog and Refurbished System with Retrofit DR** — Though similar to the above in features and configurations, this is a new, never-before-used system (or a refurbished one) with a digital upgrade kit. Each vendor rebuilds and certifies its machines to certain quality standards, but make sure an older model will fit your current and future clinical needs.

**Digital X-Ray System** — Average Price Range: \$95,000 to \$150,000 used and \$140,000 to \$300,000 new

When you purchase a system built for DR, you reap the benefits of an integrated system, drive greater efficiencies and enable high patient throughput while allowing for the best possible patient experience. The latest X-ray systems integrate features not available in retrofit kits, such as Artificial Intelligence designed to deliver outcomes in workflow, critical care areas and image quality. Many of the considerations mentioned above are available through this purchase option.

# Setting Key Performance Indicators and Outcomes Goals

Measuring the success of your investment, both from a financial and non-financial standpoint, is critical. Your hospital will have its own measures of success and determining your own parameters up front will help you select a partner and an X-ray system aligned to your vision and long-term goals. A few post-installation Key Performance Indicators (KPIs) to consider are:

**Clinical Excellence:** Consider diagnostic confidence, image interpretation, pathological findings rate, rate of compliance with protocols and report compliance. Also ensure that the technology you're considering has outcomes tied directly to your needs. This is especially important when evaluating artificial intelligence solutions for radiography.

**Resource Utilization:** Percentage of time that equipment is unavailable due to unscheduled downtime, how efficiently the system can be used with limited resources, number of exams performed by technologists and number of reports generated to radiologist to measure staff productivity.

**Patient Experience:** Including number of incidents involving patient injury, measurement of wait time, patient experience scores relative to their exam or their overall experience throughout diagnosis and treatment.

**ROI:** How does this system help you with new efficiency gains that translate to revenue? Are your reject rates going down? Are decreased workflow times leading to higher throughput? How have your patient experience ratings changed, and how will that impact referrals?



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