

# The radiologist's handbook for future excellence 2020:

Four technologies to amplify success



**SECTRA**

Knowledge and passion

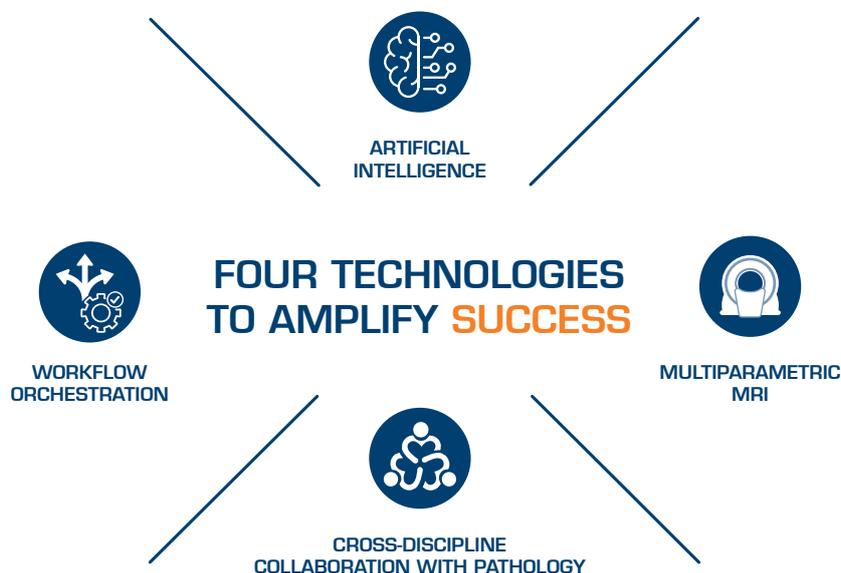
## Introduction

New technology and ways of thinking are reshaping the imaging landscape, enabling radiologists equipped with the right technology and skills to compete not only on price, but on the value and level of service they provide. Radiologists who leverage leading-edge technology to facilitate their diagnoses will have an advantage over those who do not—both when it comes to delivering higher-quality services faster and preventing themselves from becoming burned out. **Improving productivity is about much more than just retrieving image pixels faster.** A more holistic approach is needed as well as the use of smart tools on all levels of the workflow.

This handbook provides exclusive guidance on key technologies within four areas that, if handled well, will truly enhance radiologists' skills, scope and ability to cope with future demands and spend their time more wisely. The technology areas we will detail are:

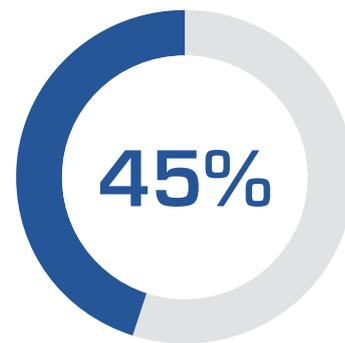
- » Workflow orchestration
- » Artificial intelligence
- » Multiparametric MRI
- » Cross-discipline collaboration with pathology

After each section, we provide a checklist with the most significant functionalities and prerequisites needed for you to stay ahead of the curve. Let's get started.



## An unmanageable situation for radiology —a need for tools to manage workloads

Radiologists today face increased pressure as a result of steadily growing volumes and increasingly complex image reviews. The impending shortage of radiologists and ongoing prevalence of burnout will further strain healthcare over the next few years and onward. A survey (15,000 respondents in October 2018) in the *Medscape National Physician Burnout, Depression & Suicide Report 2019*<sup>1</sup> found that **an incredible 45% of US radiologists have reported burnout symptoms during the last year**. Radiology came 12th place (out of 29) among all specialties<sup>1</sup>.



American radiologists reporting burnout symptoms during the last year.

It is projected that by 2025, a national shortage of radiologists in the US will leave tens of thousands of positions unfilled. *AuntMinnie.com* details the magnitude in an article from 2018<sup>2</sup>, looking overseas to the UK where this already is a hard reality:

*"... 99% of radiology departments reported that they were unable to meet their prescribed reading thresholds. For patients, more than 230,000 have had to wait a month or more for their imaging results."*

Laffeur, 2018

From another angle, radiology also faces increased financial pressure, with commoditization forcing radiology service providers to compete on price rather than the value they provide. This adds to the pressure on radiologists to cope with higher volumes. Studies report that, **in some cases, radiologists must interpret an average of one image every three to four seconds throughout an eight-hour workday** to meet their workload demands<sup>3</sup>. When the pressure on radiologists increases, we see alarming figures of the number of physicians experiencing burnout symptoms.

For the last four years, commoditization of radiology has been named *the* biggest threat to radiology in *AuntMinnie.com's* yearly "Minnies awards"<sup>4</sup>. However, physician burnout is likely to close in as the leading threat.

New technology can help radiologists to increase their productivity, improve their work/life balance, and move towards value-based imaging. Precedents and signs are beginning to emerge indicating that payers and referrers are looking for—and are prepared to pay more for—high-quality radiology services.

Adopting the *right* technology will not only enable radiologists to spend their time more wisely, but also shift focus to the additional clinical value that can be provided by modern technologies.

One example illustrating that competition in radiology services has moved from price to quality is the fact that the American retail corporation Walmart signed a contract with a health analytics company in 2019 to help their employees find facilities that provide the most accurate imaging services<sup>5</sup>.

### Make use of the *right* new technology

The commoditization of radiology has morphed over the years due to different technological advancements. From teleradiology, the genesis of commoditization, through to today's fears that artificial intelligence (AI) technology will make radiologists redundant, the practice of radiology as we know it is being challenged<sup>4</sup>. But time has proven that adopting the right technologies leads to an advantage over practices that do not and will successfully help overcome the current challenges. The task of filtering out new advantageous technologies to invest in and add to the diagnostic toolbox, however, is not an easy one. In addition, you must **ensure that those new technologies can be accessed through your enterprise imaging system**.

### Accelerated technology adoption—don't end up at a dead end

Access to new technology is often dependent on a new software release. A prerequisite that should not be overlooked is your vendor's capacity and willingness to upgrade your systems.

Some enterprise imaging vendors choose to keep all customers on the latest versions, while others only seem to deliver new functionality to *new* customers. This is often reflected in customer satisfaction. According to a 2018 report from KLAS Research<sup>6</sup>, there is a strong correlation between customer satisfaction and a vendor's capability to innovate *and* being able to deliver new technology. To evaluate both parameters, KLAS Research uses a metric called *technology score*, defined as "a combination of ratings for the following metrics: delivery of new technology, product has needed functionality, and supports integration goals".

To be equipped with new key technologies, **the first step is to make sure you have a platform that will be upgraded on a reasonably frequent basis.** In addition to scrutinizing the vendor's technology score in the KLAS report, here are a few questions to ask about their upgrade track record:

- » How long are their upgrade cycles?
- » How often do they release new versions?
- » Are upgrades included in the service agreement? (This is central, otherwise your own organization's financial priorities might become an obstacle.)
- » Do they have a successful track record of developing new technology?

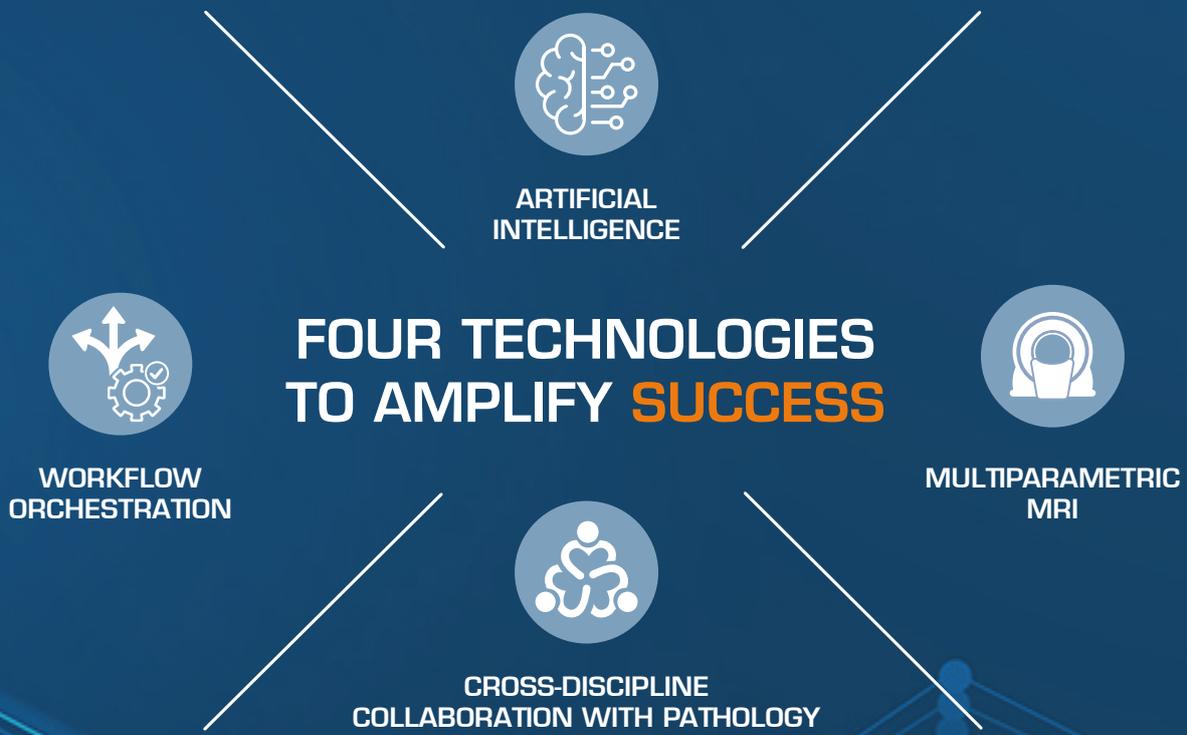
Once you have ensured the system you are on, or are considering, will be kept on a reasonably new release, **the next step will be to filter out the right new technologies to use.** In the following sections, we will outline the fundamentals in identifying, deploying and adopting key technologies. We want to help radiology to not only survive but thrive in 2020 and onwards.

If you want to see and experience some of the new technology mentioned in this handbook in action, we invite you to a live demonstration in Sectra's booth #6113 at RSNA 2019, December 1–5. Make your demo reservation at [medical.sectra.com/rsna](https://medical.sectra.com/rsna).



# Four technology areas for radiology longevity

The following sections address functionality within each of the four technology areas that are pivotal for future radiology success—both those already available and those to keep on your radar to ensure they are part of your imaging vendor's long-term plans.





## Workflow orchestration

As more and more healthcare providers consolidate, and radiology becomes more sub-specialized, the need for efficiently managed workflows has never been greater. To prevent physician overload and burnout, and to adhere to service-level agreements (SLAs), providers need to **ensure that the right radiologist reviews the right exam in the right order**. You need to be equipped with tools that can ensure an efficient workflow and maximize the probability that studies will be read within agreed upon SLAs, while evenly and fairly distributing the workload with respect to complexity.

The value of efficient workflow management is substantial. According to industry leaders interviewed in a 2018 article<sup>7</sup> published in *Diagnostic Imaging*, approximately \$15–20 billion of radiology's expenditures are unnecessary and avoidable, caused by shortages in the workflow. Either the right test is conducted at the wrong time, or patients receive an unnecessary repeat exam.

### Workflow management from an enterprise imaging perspective

It is fundamental that workflow orchestration tools are tightly integrated with, or preferably a part of, the enterprise imaging system. Patients are moved between departments where different data, images and requests are generated, and radiology is only one component in the optimization equation. Alongside proper integration, authentication and contextual synchronization with other systems such as the PACS, EMR and viewers, **a 'multi-ology' enterprise imaging system is a must for realizing proper workflow management**.

Information regarding future referrals and follow-ups is generated in various departments. Integrations with surrounding systems provide the enterprise imaging system with the necessary information to create a centrally controlled and unified workload distribution. In the future, access to information from various systems will become even more important as these systems become smarter at predicting and estimating workloads.

An enterprise imaging-centric approach towards workflow orchestration also contributes with a unified user interface. A single, easy-to-administer user interface will minimize interruptions to the already pressured workflow for radiologists and technologists. Launching a separate system should be avoided at all costs.

### Specific worklist tools

Many vendors offer good support for semi-automated workflow management. This is often based on adjustable worklists that can be configured to distribute the right exam to the right radiologist based on a set of criteria. These include worklists for acute cases and specific sub-specialties, as well as peer review and teaching and resident workflows. Adjustable worklists need to be tailored to suit the needs of each department.

## Communication tools

In addition, communication tools such as built-in chat functionality and automatic notifications are key to facilitating workflow orchestration. One example that highlights the importance of efficient communication tools was found in a study conducted at Massachusetts General Hospital, where they implemented an automatic alert-based intervention that reduced the number of delayed cases by 78 percent<sup>8</sup>.

Real-time and two-way communication was ranked as one of the most essential workflow-enhancing functionalities in an article<sup>7</sup> published in *Diagnostic Imaging* in 2018. Insights from several leading vendors of workflow orchestration solutions were summarized as follows:

*“Real-time communication is one of the most effective ways to transfer and manage data and side-step problems. It helps eliminate patient care delays and can prevent both clinical and medical record errors.”*

Palmer, 2018

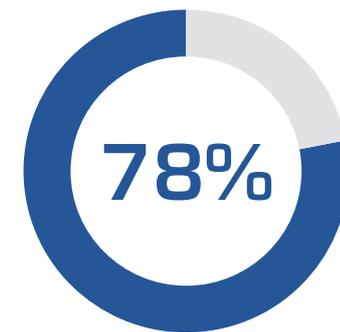
The interviews also reveal that instantaneous connection accelerates the workflow and can free up time for other responsibilities<sup>7</sup>.

## Workflow overview, alerts and analytics

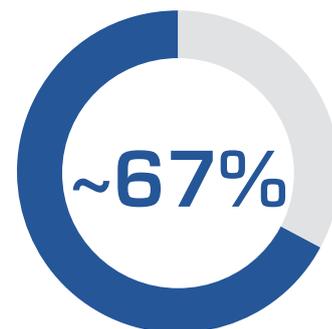
To make the right decisions, it is important to gain access to an overview of the current workload and performance for individual radiologists as well as for groups, departments and connected sites. The system needs to provide a real-time, customizable dashboard that gives an overview of work and allocations, identifies bottlenecks, and reallocates exams based on clinical status or SLAs.

The importance of having a system that can alert radiology managers to problems that need to be resolved was demonstrated in a study from 2017<sup>9</sup> that tracked exams from image acquisition to the PACS. Using a system that tracked and alerted managers in real time based on outliers, the study confirmed that **active alerts produced a threefold reduction in examination-to-PACS delays**. Their conclusion was:

*“By providing supervisors with information about exactly where delays emerge in their workflow and alerting the correct staff to take action, applications like ours create more robust radiology workflow with predictable, timely outcomes.”*



Reduction in delayed cases according to a study<sup>8</sup> due to efficient communication tools.



Reduction of examination-to-PACS delays due to efficient alert functionality was found in a study<sup>9</sup>.

Pianyk et al., 2017

Another functionality that should not be underestimated is the ability to extract analytical reports as a basis for decision-making to justify further recruitments or investments.

### The future: Automatic reallocation

Workflow orchestration that relies on AI-assisted workflow management is under development and some early pilots are under way. "Smart" automatic reallocation of exams should be based on the workload situation and different events, and be capable of managing the following tasks:

- » Automatically plan and organize exams, using pre-defined reading sessions designated by department, specialty, time of day, and other factors
- » Using dynamic exam assignment, automatically escalate and assign studies to the most appropriate and available reader based on radiologists' availability, subspecialties, location, time of day, etc.
- » Automatically balance workloads across your enterprise by matching exam workload with reading capacity
- » Prioritize reading queues and set configurable due-in-time thresholds for escalating and monitoring SLA exams
- » Send specific exams for AI-assisted pre-analysis based on the request and type of exam. For example, detection of lung noduli, lung embolisms or pneumothorax

AI-based automated workflow systems that will be available in the coming years will be able to intelligently use and apply data and assist with operations management. For instance, they will automatically recognize bottlenecks and use data to appropriately route exams to available radiologists to reduce waiting times and streamline care delivery. As an early adopter, implementing AI-based workflow orchestration capability can give you a jump start when it comes to increasing productivity in your overall reading workflow.

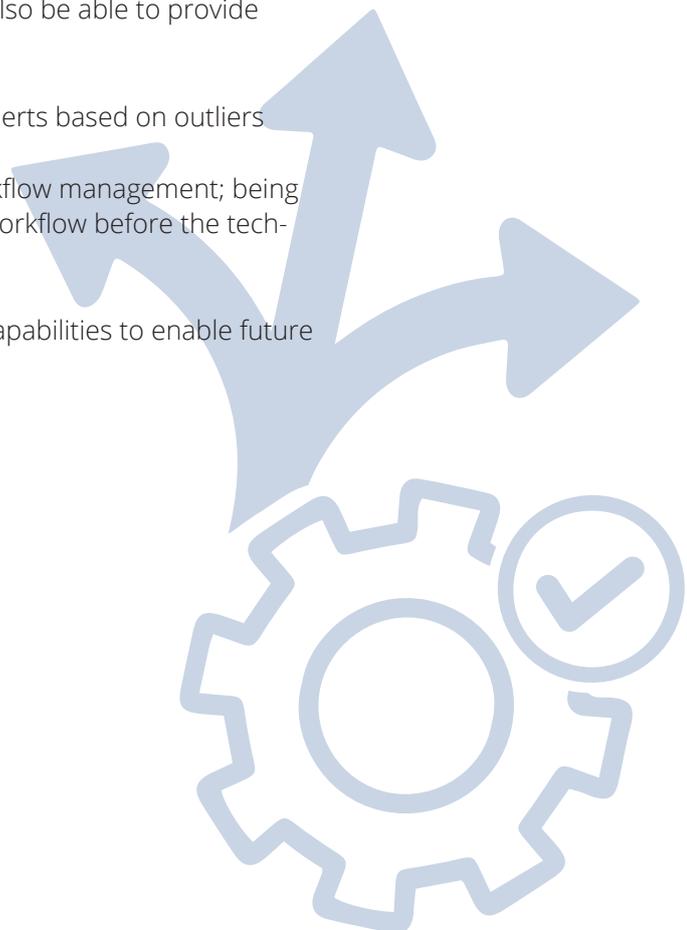
### The future: Forecasting capabilities and predictive analytics

In addition, forecasting capabilities based on patient visit data generated from the EMR and surrounding systems will be a key component of tomorrow's workflow orchestration engines. Efficiency gains will be realized through better planning for future recruitments and vacation periods, and by adjusting the exam reallocation.

**Now is a great time to scrutinize your enterprise imaging vendor's capability to integrate with various EMR vendors.**

## Workflow orchestration—The checklist

- ☑ Workflow orchestration tools should be tightly integrated with, or preferably a part of, the enterprise imaging system. Only then will the platform provide a single user interface that is efficient to administer, and the workflow can be optimized across specialties
- ☑ Workflow functionality should manage the integration, authentication and contextual synchronization with various IT systems, such as the enterprise imaging system, the EMR, and advanced visualization software
- ☑ Adjustable worklists should be configured to distribute the right exam to the right radiologist based on a set of criteria and tailored for each department's needs
- ☑ Real-time and two-way communication tools are a must-have
- ☑ A real-time and customizable overview dashboard is necessary for identifying bottlenecks and reallocating exams based on clinical status or SLAs. The functionality should also be able to provide analytical reports for decision-making
- ☑ The system should be able to generate alerts based on outliers
- ☑ Keep your eyes open for AI-assisted workflow management; being a pioneer in a pilot could improve your workflow before the technology is generally available
- ☑ Confirm your vendor's EMR integration capabilities to enable future forecasting opportunities





## Artificial intelligence

“PACS should be smarter than a 5th-grader” was a popular article<sup>10</sup> published on *AuntMinnie.com* in 2012. Based on Dr. Eliot Siegel’s presentation at the New York Medical Imaging Informatics Symposium, the article made reference to a popular American TV game show—“Are You Smarter than a 5th Grader?”—in describing the modern PACS of the time as a “dumb” system. Seigel’s mission was to highlight the need for adopting AI in radiology—an idea that today is close to becoming reality.

Much of the functionality that he asked for seven years ago is now available or on their way to become. Many of these developments—for example, PACS doing automatic measurements and tracking of tumor growth, auto-populating fields in a structured report, matching of prior exams, or integrating relevant data from the EMR that could be useful in a diagnostic review—are due to recent advancements in deep learning. Many of today’s radiologists are prepared to adopt the AI-based tools<sup>11</sup> that Dr. Siegel called for back in 2012 to increase productivity.

### Performance of current AI

At present, we are witnessing narrow, task-specific AI applications that can match and occasionally surpass the performance of radiologists in specific applications. Radiologists will potentially benefit from AI, as it will enable them to increase their efficiency and deliver higher-quality diagnoses<sup>3</sup>.

Today, most people agree that AI will not replace the radiologists, but that it has the potential to improve their capabilities, efficiency and accuracy. A good metaphor for the symbiosis between AI and radiologists was used in an article<sup>12</sup> on this topic, comparing the relationship between the radiologist and AI with pilots flying a plane with assistance from a highly advanced navigation system:

*“... the world’s best airplanes with automatic navigation systems still have at least two “human pilots” on board. Anything that deals with human lives, simply can’t be trusted on with machines or algorithms alone.”*

Mohan, 2018

As with the adoption of any new technology, it will take time before regulations, medical guidelines and healthcare—together with vendors—harmonize on how AI should be used. It will also take time to see which applications from different providers work well. Predicting the future is difficult but looking at the expectations of the radiology community as a whole provide at least general guidance on what we will see in clinical use the coming years.

## Expectations for AI

Probably the most extensive research into what radiologists expect from AI comes from a French study published in May 2019<sup>13</sup>, in which a large number of radiologists were surveyed. Based on the results, the authors concluded that most radiologists believe AI will:

- » Reduce medical errors,
- » Reduce the time spent per exam, and
- » Allow them to spend more time with patients.

Looking deeper into the study<sup>13</sup> on what specific tools radiologists expect from AI, three features were mentioned as the most expected (also summarized in Figure 1).

- » Automatic detection of lesions
- » Automatic measurements of lesions
- » Improvements in post-processing

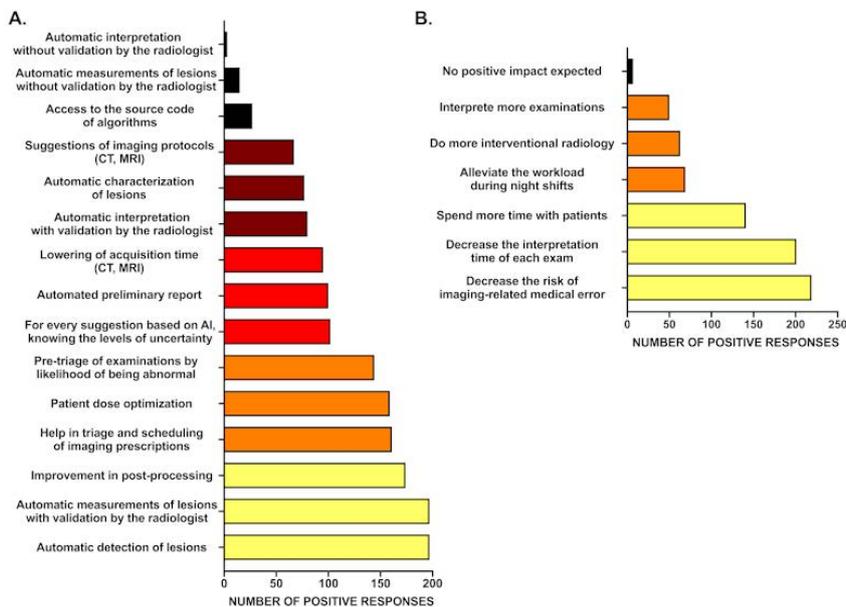


Figure 1. A: Ranking of expected technical features of AI-based tools, depending on the number of positive responses. B: Ranking of expected practical impact of AI-based tools on daily practice, depending on the number of positive responses. Chart courtesy of Dr. Thibaut Jacques, Dr. Q. Waymel, et al.

In summary, the study concluded that **there is great interest in and willingness to adopt AI, but there is also a need to accelerate the introduction of AI**. The bright side is that many of the applications mentioned by radiologists in the study are already available.

## Examples of useful AI available today

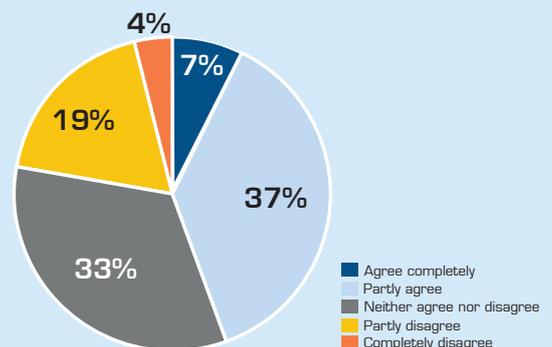
In contrast to the systems available in 2012 when Siegel expressed his frustration with “dumb” PACS<sup>10</sup>, AI is no longer just a thing of the future. AI is here, and some applications are ready to augment radiologists. Applications that radiologists soon will be able to benefit from include:

### » AI-assisted workflow and triage

- External AI apps can communicate with PACS to indicate the presence of potential findings and the nature of these findings. This information can be used to control the workflow, how exams are to be prioritized and the worklist they should be on.

In a survey from 2017<sup>11</sup> that asked radiologists whether they would trust an AI system to help them to prioritize cases, 44% either agreed completely or to some extent (see graph). This number is probably much higher today.

*Statement 2: I would trust an autonomous system to make the decisions for me in terms of what to read and when based upon findings from the automatic processing of the image data.*



### » AI-assisted diagnostic review and reporting

- External AI apps can communicate information about detected and characterized findings, which can act as an additional information source to support radiologists during review. One example is *automatic lesion tracking*, where the system finds and matches the same tumor on several sets of exams and measures its development.
- Information about detected and characterized findings can be linked to a reporting template to create *pre-filled structured reports*.
- *Matching series highlighting* has been proven to save a great amount of time. This is a typical feature where previous matching examinations are called attention to, that was previously prototyped and requested by many users and is now available.

## Future development of AI

In the coming years, we will witness a rapid development of AI, with better and quicker access to a large variety of best-of-breed AI applications. One example that Dr. Siegel mentioned<sup>10</sup>, and that many vendors are working on, is smart display protocols that provide suggestions on appropriate hanging protocols based upon previ-

ous preferences. Also, automatic identification of relevant priors is a feature that will save significant amount of time. Such applications will probably be accessed through platforms provided by the enterprise imaging vendors. At the same time, we will see a development towards workflows and tools for easier evaluation, monitoring and validation of third-party AI applications, which will further facilitate adoption.

### How to facilitate AI adoption

As it is still unclear which AI applications and vendors will add the most value, it is important to be equipped with a platform that offers a portfolio of AI applications from different vendors. These platforms—sometimes referred to as “AI application stores”—provided by enterprise imaging vendors, could be a way to spur adoption. Designed correctly, AI platforms could solve several of the main challenges related to adoption.

We have identified three fundamental aspects for successful AI platforms:

#### 1. Seamless integration into existing workflow

AI applications need to be part of, and be tightly integrated into, existing workflows to enable adoption in everyday radiology. There should be no external launch and the AI should be accessed as easily as any tool in the radiologist's diagnostic workspace. Most helpful would be a platform that provides tight, validated and tested integrations of AI applications into existing diagnostic workflows.

#### 2. AI made “unremarkable”

Every time the AI component catches the user's attention without contributing any value, it instead degrades the user's efficiency. Therefore, AI should only provide guidance when necessary and needs to be made “unremarkable” by being very carefully tailored to fit the clinical scenarios where it is to be used. Nuisance issues, such as having to log in to another application or being offered assistance when you don't need it, can and will prevent adoption. The design and integration offered by the enterprise imaging vendor should ensure that the AI tools accessed through the diagnostic review offer guidance only when it adds value.

#### 3. Rich portfolio access through neutrality

Most AI vendors have focused on a small area of interest. But a radiology department requires access to a rich portfolio of applications within many different areas, including breast, lung, liver and chest—preferably from one contracting party. Handling different contracts and business models with various vendors is most likely an arduous task for most radiology departments. The enterprise imaging vendors' AI platform should allow for a broad set of AI solutions for various tasks, through a single user interface and contract.

To summarize, the first step to facilitating AI adoption is investing in **a well-integrated AI platform that can provide a rich portfolio of “unremarkable” and reliable AI applications** in the long term.

## Artificial intelligence—The checklist

- ☑ AI application platforms provided by enterprise imaging vendors will speed up and facilitate the adoption of AI in radiology
  
- ☑ An AI application platform should be able to:
  - Offer a tight integration into the existing workflow
  - Offer “unremarkable” AI and only assist when needed
  - Offer a rich portfolio by being vendor neutral
  - Handle contracts with various AI vendors
  - Provide applications where the integration is tested and quality assured
  
- ☑ Examples of applications already available and ready to use:
  - AI-assisted workflow and triage
  - AI-assisted diagnostic review and reporting:
    - Automatic lesion tracking
    - Pre-filled structured reports
    - Matching series highlighting
  
- ☑ Make sure the vendor’s roadmap contains workflows and tools for easier evaluation and validation of AI applications





## Multiparametric MRI

There are a few modality-specific technologies on the rise, such as dual-energy CT, PET/CT and multiparametric MRI (mpMRI), all of which imposing new demands on PACS and advanced diagnostic applications for efficient image review. The need for high-performance applications is particularly significant for mpMRI review—the use of mpMRI has become a central part of cancer diagnostics and volumes are steadily growing<sup>14</sup>, especially for breast and prostate that, together with lung, are the most common cancer types<sup>15</sup>. This development has mainly been fueled by a range of recent studies showing significant positive clinical value by using mpMRI over other alternatives. **However, mpMRI review takes more time than many other exam types.** Radiologists who are equipped with tools to review these studies more efficiently will perform better than those who are not.

### Efficient mpMRI diagnostic tools—a must-have for managing workloads

Using MRI to derive the PI-RADS® score for prostate in order to predict cancerous lesions provides a very accurate diagnostic tool with high specificity for high-grade disease<sup>14</sup>. Radiologists who can separate “bad” lesions from those that do not require surgery will not only avoid unnecessary patient suffering, but also focus resources and speed up the time to surgery for those who need it.

*“Through the use of dynamic contrast-enhanced and diffusion weighted series [mpMRI, Ed.], prostate tumors that were previously not visible have become identifiable and quantifiable. The ability of MRI to improve staging and identification of clinically significant disease has resulted in increased utilization for different aspects of prostate cancer care.”*

Hutchinson and Lotan, 2017

The need for tools to increase productivity in prostate cancer care is significant, partly based on its massive increase in cost. The expenditures for the care of prostate cancer are expected to constitute the largest single portion of projected cancer care cost increases in the US in the coming years<sup>14</sup>.

Demand for MRI diagnostics is also growing within breast cancer, indicating a steady increase in volumes, mainly because of its high sensitivity and superior ability to detect cancers. A study from 2019<sup>16</sup> comparing different methods for breast cancer diagnostics concluded that mpMRI provides far more information than alternative imaging—namely high-resolution, cross-sectional lesion morphology—as well as

functional information on a variety of tissue perfusion, vessel permeability, tissue relaxation times, tissue cellularity/proliferation rate, and interstitial pressure. This is useful information for tissue characterization, and for distinguishing between benign and malignant lesions<sup>16</sup>.

Although the use of mpMRI has led to a paradigm shift in the form of improved diagnosis and monitoring of prostate and breast cancer, it has also led to longer examination reading times for radiologists<sup>16</sup> and changes in the practice of breast cancer review<sup>14</sup>. Hence, the benefits gained from mpMRI imaging must outweigh the increased costs of longer review times for practices and departments. **Highly efficient tools for mpMRI diagnostics for breast and prostate are a therefore a key priority**, and an area where enterprise imaging vendors differ in their offerings. Moreover, the use of mpMRI on other organs such as neuro and colon is growing, which will make such support important in the future.



*A picture from the Sectra booth at RSNA 2018, where prototypes of mpMRI functionality were shown to attendees. This functionality is now released and will be demonstrated at this year's RSNA.*

### Ease of use and performance are key

Experiences from early users of Sectra's mpMRI tools have shown that ease of use is more important than the actual number of features, and that advanced functionality for mpMRI must be seamlessly integrated into the diagnostic workflow. Ease of use also must be complemented by high performance since there will be no tolerance for switching windows or waiting for image processing. If your enterprise imaging vendor does not offer in-house developed functionality for mpMRI, you need to verify that it can smoothly integrate with third-party applications. Either way, it is essential that your vendor provides tools for mpMRI review that are well integrated into the existing diagnostic window and can meet your demands in terms of processing time.

It is worth mentioning that the same criteria are valid also for seamlessly integrated advanced visualization functionality for PET/CT images. A good diagnostic user interface would not require any separate logins or switching of windows to use such functionality.

## Don't take shortcuts on performance that compromise on image quality

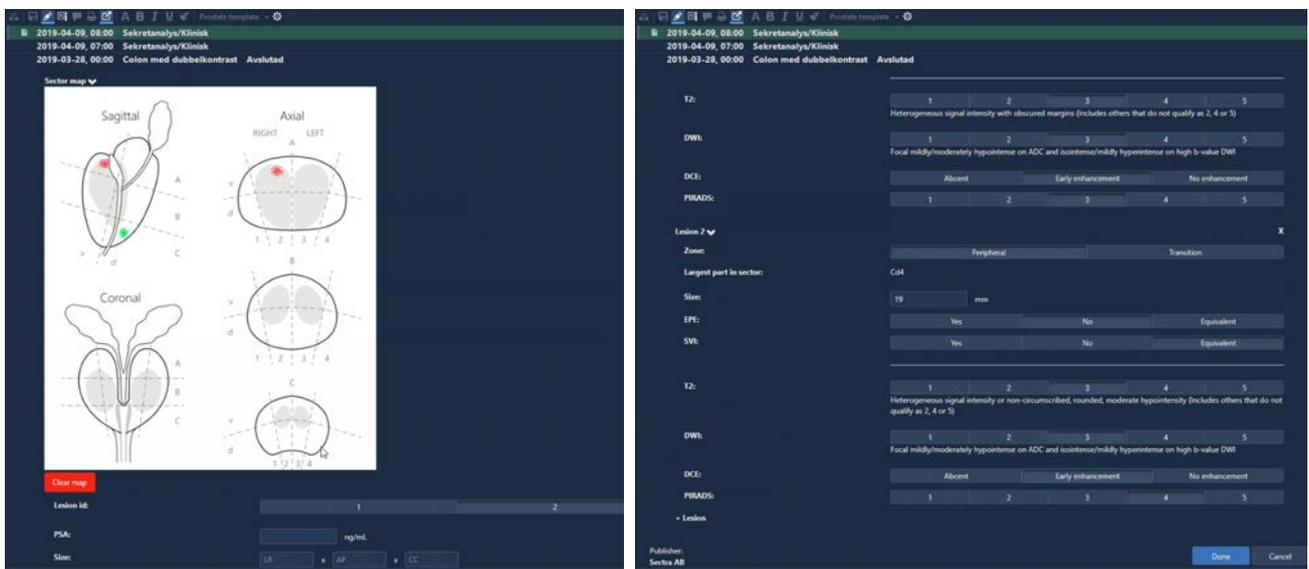
Another area related to the performance of mpMRI functionality is the frequently discussed topic of high-speed breast tomosynthesis review. Make sure you are equipped with an application for tomosynthesis images that provides high performance and doesn't compromise on image quality—you need both. According to an article from 2017<sup>17</sup>, for example, the use of lossy image streaming is disallowed by the Mammography Quality Standards Act (MQSA) for breast imaging and mammography in the US. Their review concluded that:

*"...compression in medical imaging have led several professional organizations to develop guidelines for the use of lossy compression in clinical practice. However, these guidelines are not always consistent among each other. [...] the use of lossy compression of mammography data is disallowed by the MQSA in the US."*

Liu et al., 2017

## Integrated structured reporting

Another application worth mentioning that supports the mpMRI review is structured reporting. The standardized methods for the acquisition, interpretation and reporting of breast and prostate cancer, BI-RADS® and PI-RADS®, could be streamlined by utilizing functionality for structured reporting. Ideally, it would automatically populate necessary information into the report, acting as both a time saver and decision support tool for users. It is a good idea to make sure you are equipped with mpMRI tools that can automatically populate measurements into structured reports.



Example of functionality for structured reporting where prostate measurements are automatically populated into the template.

## Multiparametric MRI—The checklist

- ☑ Make sure your enterprise imaging vendor provides tools for prostate and breast mpMRI, either developed in-house or tightly integrated third-party applications
- ☑ Make sure the mpMRI functionality is well integrated into the existing diagnostic window, is easy to use, and can meet your demands in terms of processing time. Functionality for advanced visualization of PET/CT is another area where these requirements are important
- ☑ mpMRI review will likely grow in other sub-specialties outside breast and prostate. Your vendor's ability to provide efficient tools for neuro and colon review will be valuable
- ☑ Make sure you are equipped with an application for tomosynthesis images that provide high performance and do not compromise on image quality. For example, lossy image streaming is not allowed by MQSA guidelines
- ☑ Functionality should be available to automatically populate structured reports to support BI-RADS and PI-RADS scoring





## Cross-discipline collaboration with pathology

Most radiologists would likely agree that better coordination among the medical specialties involved in cancer care would mean fewer errors and more efficient use of time. Radiology is becoming increasingly dependent on collaboration with other specialists and can thus take the lead in managing cross-disciplinary workflows. As one of the most IT-knowledgeable disciplines, **radiology can blaze the trail by utilizing new digital technology to apply so called integrated diagnostics**, especially with pathologists who are now moving towards digital image review.

Today, information exchange between specialties is often an analog-based and time-consuming task, mainly due to poor IT support. In a recent positive development, many healthcare providers are moving towards enterprise imaging systems that manage all patient-related multimedia, including images, documents and reports, in a single platform. Separate departmental PACS are becoming a thing of the past. A unified, central system provides radiologists with access to information, reports and images from all specialties, thus saving time and even increasing their confidence in decision-making.

We have identified three main areas in cross-disciplinary collaboration where the right functionality can provide substantial time savings:

- » Information and image access
- » Identification of discordance
- » Tumor board preparation, presentation and follow-up

### Information and image access

Make sure your enterprise imaging system supports a multimedia workflow for the most important collaborators with whom you exchange information. For most radiologists, this currently includes pathology, cardiology and breast imaging, and in the future will also include genomics.

Leading institutions around the world are taking action in this area and are in the process of implementing one enterprise imaging system that supports the workflows of all of these collaborators. Using one system for all -ologies is probably not a prerequisite for efficient image and report access, but it does minimize the number of integrations. **The result is a system more likely to run at lower costs, deliver higher stability, and provide a better user experience.**

When looking to *digital pathology support* for your enterprise imaging system, fast and intuitive image review is fundamental as this will determine if pathologists can and will leave the microscope behind in favor of digital review. Additionally, the system should offer functionality for driving the pathologists' workflow, with worklists similar to those

used by radiologists for years, tools for image analysis, and proper integrations with the laboratory information system (LIS). Few enterprise imaging vendors can live up to pathologists' requirements today.

The demands are similar for *breast imaging*, where the system should offer fast diagnostic review for both high-volume screening and advanced diagnostics, including support for tomosynthesis. Moreover, both pathology and breast imaging place high requirements on tight integration with third-party applications for image analysis and CAD.

Although the collaboration with *cardiology* is not as intense as with the other specialties mentioned, including cardiology as part of the enterprise imaging system would represent a strong win not least from an IT perspective. This places particularly high demands on good integrations with various best-of-breed cardiology applications. For cardiologists to use the enterprise imaging system, it is essential that it can provide a single diagnostic user interface without a need for multiple logins or to launch a new window for each specific application. Having one user interface also minimizes the need for training, which is often a struggle for cardiologists.

### Identify rad-path discordance

Errors and discrepancies in radiology practices are uncomfortably common, with an estimated day-to-day rate of 3–5% of studies reported. Much higher rates are mentioned in many targeted studies<sup>18</sup>. In some circumstances, diagnoses are proven by a pathologic examination, and this proof can be used to evaluate prior radiological diagnoses. The use of radiological-pathological correlation in decision-making, where possible, can avoid some erroneous assumptions, and can ingrain the practice of seeking histological proof of diagnoses before accepting them as incontrovertible<sup>18</sup>.

Implementing a rad-path correlation workflow poses both technical and organizational challenges. To support a discrepancy workflow technically, the enterprise imaging system should automatically be able to alert users to discrepancies between diagnostic findings. While not yet on the market, this functionality would reduce errors in diagnoses and potentially save time by avoiding unnecessary tumor board discussions and preparation time.

To be on the ready to adopt leading-edge technology such as discordance workflow functionality, radiology already needs to prepare and ensure it has the right prerequisites in place. Several studies point to readiness, illuminating the need for communication flows and linking of structured diagnostic results:

*“To this end, pathology-radiology integration workflows must ensure the flow of communications and specimens and link structured diagnostic results from pathologists with those of radiologists.”*

Liu et al., 2017

Another study<sup>19</sup> summarized some of the key elements of a system supporting integrated diagnostic workflows as follows:

- » Structured reporting capabilities: necessary to automate concept extraction from reports and perform comparisons
- » Supporting both radiology and pathology clinical workflows and the integration of textual, image and quantitative data generated by both disciplines
- » Being able to measure changes in the efficiency and accuracy of diagnosis, treatment timing and, ultimately, patient outcomes
- » The system should support interoperability in situations where radiology and pathology are housed in different institutions

### Tumor board preparation, presentation and follow-up

A single, joint platform for radiology, pathology and breast imaging will, together with the right set of tumor board tools, improve productivity in the preparation, presentation and follow-up of tumor boards. This was experienced in a pilot study conducted by University Hospitals in Cleveland, Ohio in 2018, where digital pathology images and reports were integrated into their enterprise imaging system and used in their breast tumor boards<sup>20</sup>:

The Rad-Path team agreed that integrated conferences like this could greatly enhance the clinical care and efficiency system-wide, especially for tumor boards.

Another benefit was found in image-guided biopsy procedures carried out by the radiologists:

*"This is why radiologic and pathologic correlation with every image-guided biopsy is so important [...] it helps us move toward a world where we really integrate radiologic, pathologic, genomic, and clinical data into kind of one unifying system. There is huge potential."*

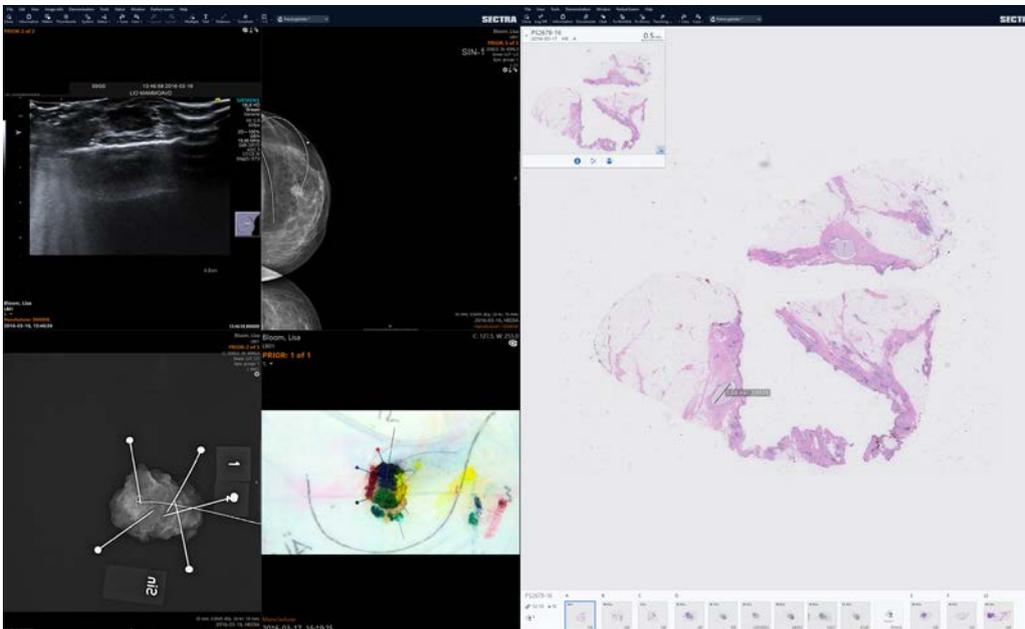
Hannah Gilmore, MD Chief of Anatomic Pathology and Director of the Breast Pathology Service at University Hospitals Cleveland Medical Center

Accessing the pathologists' reports *before the meeting* helps determine whether new exams are required and if so, avoids unnecessary preparations and meeting time. It is not unusual that radiologists prepare cases for the meeting that require an additional biopsy or examination.

Using one system *in the presentation* facilitates the discussion itself as images and reports can be accessed and reviewed on the fly to allow for a more efficient discussion.

*After the tumor board*, accessing the pathologists' reports will provide feedback on previous statements, including whether or not the suspected lesion was malignant.

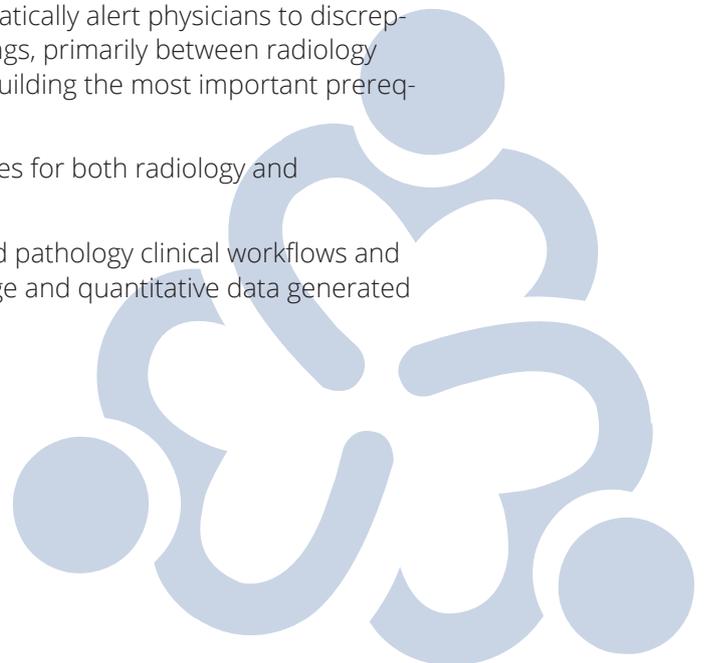
All in all, **the key to efficiency lies in tools that span from case preparation to presentation to follow-up requirements.**



Example of an enterprise imaging system giving access to all kinds of medical images and reports necessary in the tumor board discussion.

## Cross-disciplinary collaboration—The checklist

- ☑ Ensure that the enterprise imaging system supports various multi-media and a workflow for the most important collaborators with whom you exchange information
  - Digital pathology: Fast and intuitive image review. Functionality for driving the pathologist workflow, tools for image analysis, and proper integrations with the LIS
  - Breast imaging: Fast diagnostic workstation for both mammography screening and clinical breast diagnostics, including support for tomosynthesis
  - Both pathology and breast imaging should be able to tightly integrate with third-party applications for image analysis and CAD
  - Integrate best-of-breed cardiology applications without a need to launch a new window or perform multiple logins. One user interface also minimizes training needs
  - If possible, adopt an enterprise PACS that can handle both radiology and pathology in the same user interface to facilitate the tumor board scenario
- ☑ Ability to access the pathologists' reports before, during and after the tumor board
- ☑ In the future, when functionality is available, the enterprise imaging system should be able to automatically alert physicians to discrepancies between diagnostic findings, primarily between radiology and pathology. Begin today by building the most important prerequisites for this workflow, i.e.:
  - Structured reporting capabilities for both radiology and pathology
  - Support for both radiology and pathology clinical workflows and the integration of textual, image and quantitative data generated by both disciplines

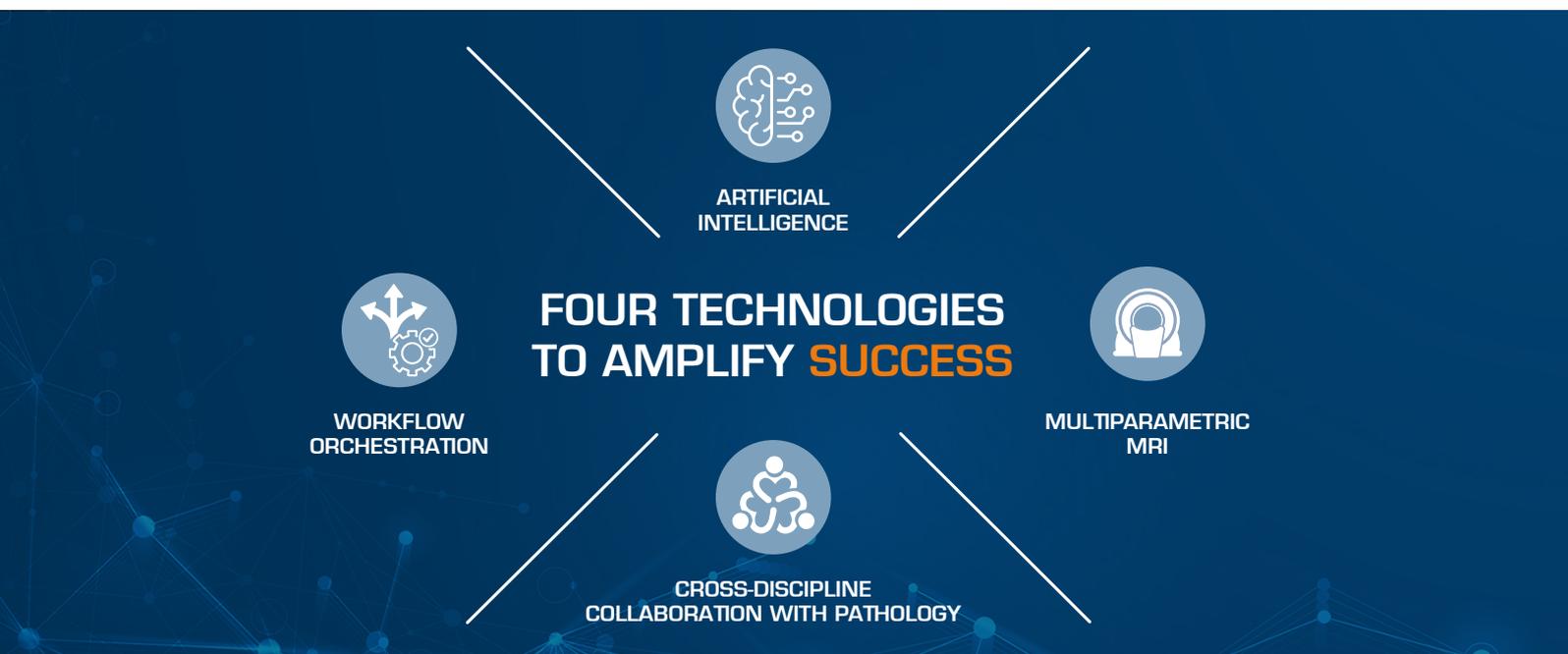


## Handbook summary

To thrive and prevent physician burnout, radiology must evolve. A paramount part of this change will be to embrace the right technologies to empower radiologists to do the same amount of work in less time. Improving productivity is about much more than just retrieving image pixels faster. A more holistic approach is needed as well as the use of smart tools on all levels of the workflow. The four areas of technology we have identified—*workflow orchestration*, *AI*, *mpMRI* and *cross-disciplinary collaboration*—will hopefully help and guide the radiology specialty to cope with growing volumes, increase productivity and manage workloads. The checklists under each area offer specific, short- and long-term advice on which functionality to adopt as part of your enterprise imaging platform.

A prerequisite to benefit from new technology is to make sure you have a platform that will be upgraded on a reasonably frequent basis. Scrutinizing the vendor's "technology score" in the KLAS Research Performance Report and asking questions about upgrade cycles will minimize the risk of ending up at a dead end.

When it comes to which key technologies to adopt, the following summary looks at the ingredients for a system that will amplify your future success.



### **Workflow orchestration**

- » Tools should be tightly integrated with, or preferably a part of, the enterprise imaging system
- » Adjustable worklists should be configured to distribute the right exam to the right radiologist based on a set of criteria and tailored for each department's needs
- » Real-time and two-way communication tools are a must-have

### **Artificial intelligence**

- » AI application platforms provided by enterprise imaging vendors will speed up and facilitate the adoption of AI in radiology. These platforms should be able to:
  - Offer a tight integration into the existing workflow
  - Offer “unremarkable” AI and only assist when needed
  - Offer a rich portfolio by being vendor neutral
  - Handle contracts with various AI vendors
  - Provide applications where the integration is tested and quality assured

### **Multiparametric MRI**

- » Make sure your enterprise imaging vendor provides tools for prostate and breast mpMRI
- » Make sure the mpMRI functionality is well integrated into the existing diagnostic window, is easy to use, and can meet your demands in terms of processing time
- » Make sure you are equipped with an application for tomosynthesis images that provide high performance and do not compromise on image quality. For example, lossy image streaming is not allowed by MQSA guidelines
- » Functionality should be available to automatically populate structured reports to support BI-RADS and PI-RADS scoring

### Cross-discipline collaboration with pathology

- » Ensure that the enterprise imaging system supports various multimedia and a workflow for the most important collaborators with whom you exchange information
  - Digital pathology: Fast and intuitive image review. Functionality for driving the pathologist workflow, tools for image analysis, and proper integrations with the LIS
  - Breast imaging: Fast diagnostic workstation for both high-volume screening and advanced diagnostics, including support for tomosynthesis
  - Integrate best-of-breed cardiology applications without a need to launch a new window or perform multiple logins. Having one user interface also minimizes training needs
  - If possible, adopt an enterprise PACS that can handle both radiology and pathology in the same user interface to facilitate the tumor board scenario

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As technology is ever evolving, this handbook will soon be out of date. But no worries, we will update it as shifts and changes occur with respect to technology, regulations or medicine. To stay up to date, please subscribe to our knowledge-sharing updates at [medical.sectra.com/subscribe](https://medical.sectra.com/subscribe).

### Join us at RSNA

If you want to see and experience some of the new technology mentioned in this handbook in action, we invite you to a live demonstration in Sectra's booth #6113 at RSNA 2019, December 1–5. Make your demo reservation at [medical.sectra.com/rsna](https://medical.sectra.com/rsna).



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