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THE CHALLENGE OF IMAGING IN THE ICU AND HOW SPECTRALDR TECHNOLOGY CAN HELP

MONITORING THE CONDITION OF ICU PATIENTS: A CHALLENGE FOR IMAGING

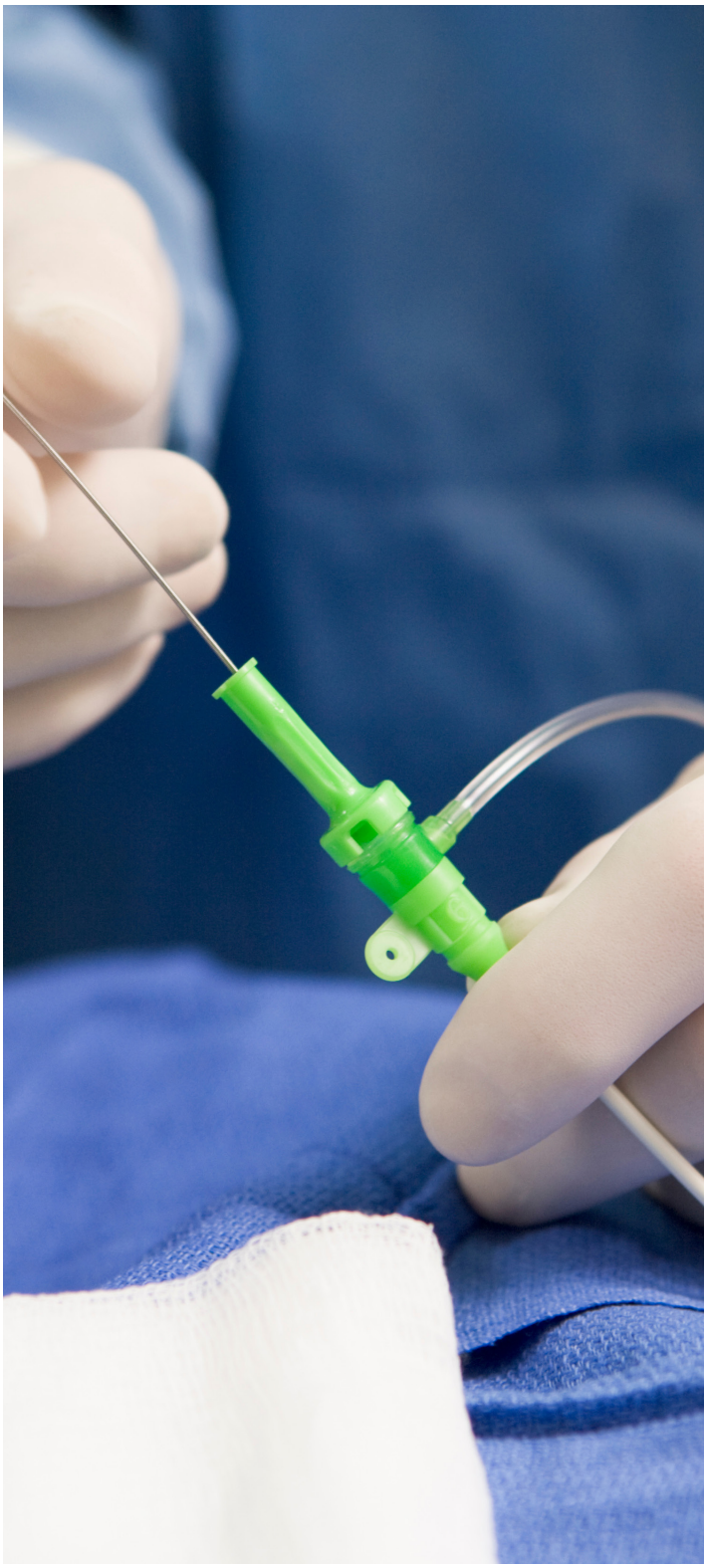
Radiography plays a critical role in monitoring the condition of intensive care unit (ICU) patient[4]. In fact, many hospitals in North America do daily chest radiographs on their ICU patients to support treatment, making it the most frequent radiological procedure in the ICU[5]. Radiography is commonly done to check for pneumonia or pneumothorax and is often used to monitor the location of devices such as catheters or endotracheal tubes[5]. Despite this, there are many problems associated with the use of radiography in the ICU:

Difficulties delineating lines/tubes

A recent study found that 27% of recently placed catheters/tubes are malpositioned, however, only 6% were detected with traditional radiography[6]. Producing high-quality radiographic images in patients with central venous catheters is difficult due to several factors. Patient rotation and movement caused by breathing can degrade the quality and diagnostic capability of chest radiographs in ICU patients[7] . Additionally, patient anatomy or disease may impede the visualization of other catheters or tubes. Improving the ability to properly image patients in the ICU is critical to manage complications and ensure that their condition does not deteriorate[5]. Last, aside from being a malpractice concern, incorrect positioning affects patient care and quality, all of which are of utmost priority for healthcare organizations.

Radiation risk for ICU patients

As described, daily chest radiographs are routine for many patients within the ICU. Cumulative radiation exposure in ICU patients is a known concern for all patients but especially for those with extended stays in the ICU due to chronic illnesses[10] and for pediatric and neonatal patients[11].

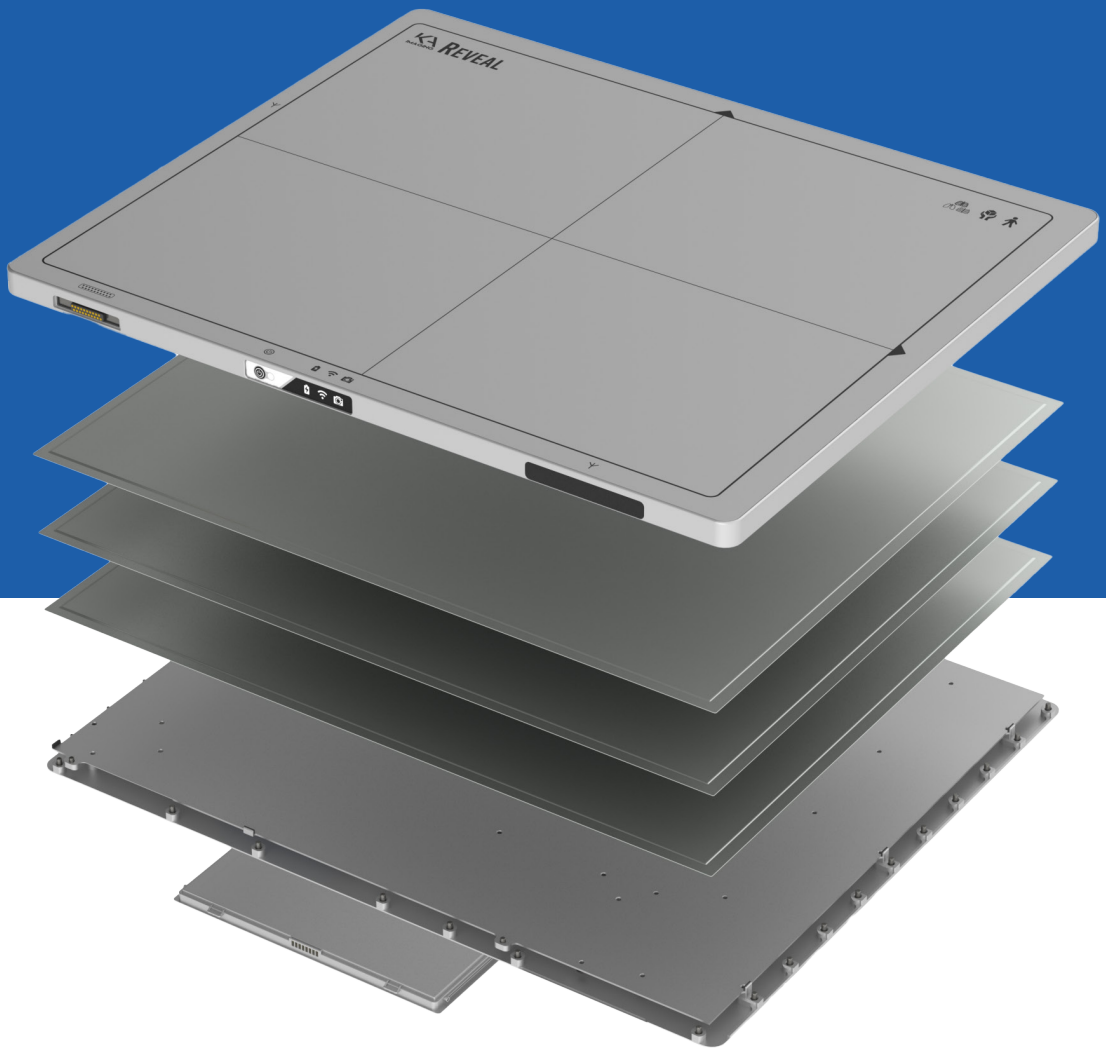


Risk of intra-hospital transportation for imaging

Furthermore, it remains difficult for patients in the ICU to physically be moved to other imaging modalities. X-rays are by comparison more accessible within a hospital; however, traditional radiography has well known clinical limitations. Bedside high-quality images are especially critical for ICU patients as moving critically ill patients within a hospital or clinic is associated with pulmonary complications (especially for patients with ventilators), where atelectasis and pneumothorax risks are significantly elevated potentially 3-fold and 2-fold respectively[8]. Further, rates of infection, hemodynamic complications, metabolic dysregulation and a variety of other factors make intrahospital transportation for ICU patients especially risky[9]. As well, the movement of ICU patients requires significant coordination between clinicians and hospital workers and can be extremely difficult for patients reliant on large machinery (e.g. dialysis unit, ventilator etc)[9]. Other risks include disruption of lines and tubes and patient injuries.

A SOLUTION - *SPECTRAL*DR™ TECHNOLOGY AND REVEAL 35C™ SPECTRAL RADIOGRAPHY

The Reveal 35C™ detector incorporates SpectralDR™ technology which improves diagnostic detail by providing a DR image in addition to a bone and a soft tissue image. This helps remove overlapping stuructures and provides the best visualization of all diagnostic features using one exposure.



*Spectral*DR™ Technology

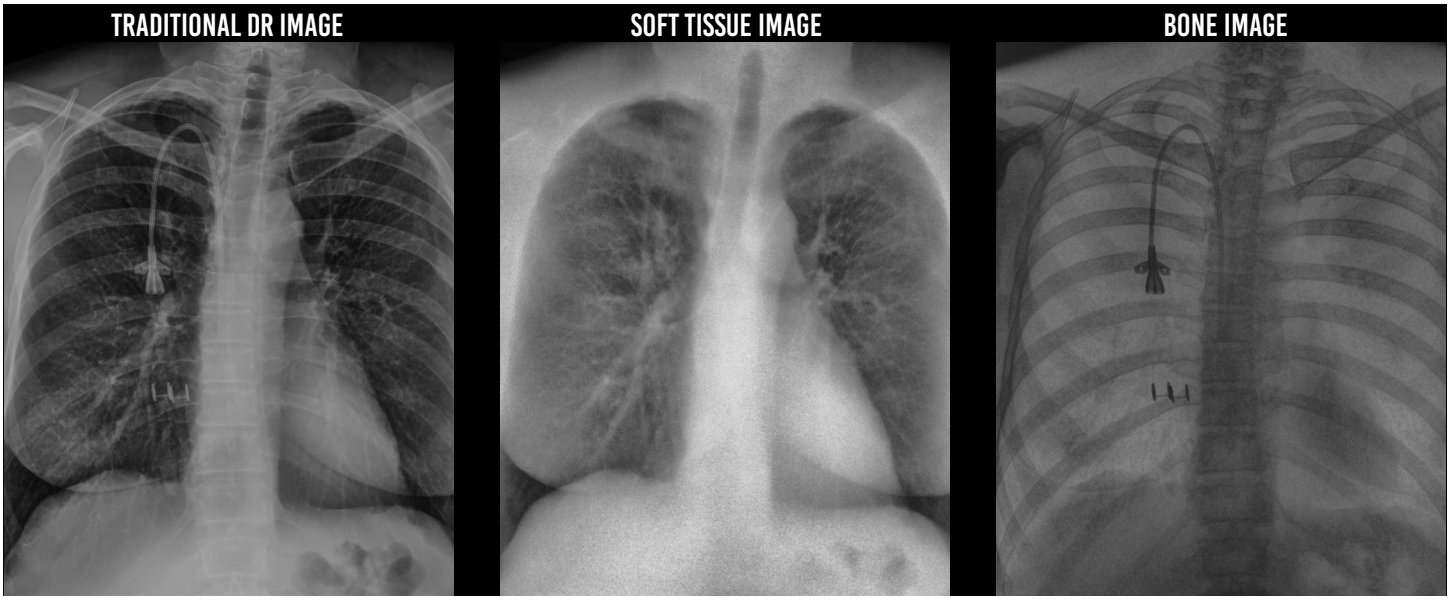
The Reveal 35C™ detector acquires the full X-ray spectrum with just one radiographic exposure using a combination of multiple scintillation layers. The result is three images, a traditional Digital Radiographic image, a soft tissue (low atomic number) image and a bone (high atomic number) image. All of this is done at the same radiation dose as a conventional chest radiograph and without the motion artifacts common to other dual-energy technologies.

Better visualization of lines/tubes, lesions and foreign bodies

In the following examples, in the bone image, lines, tubes and calcified nodules are clear, while in the soft tissue image, pneumothorax and pneumonia are also seen. In conventional Digital Radiography (DR), this is not always the case.

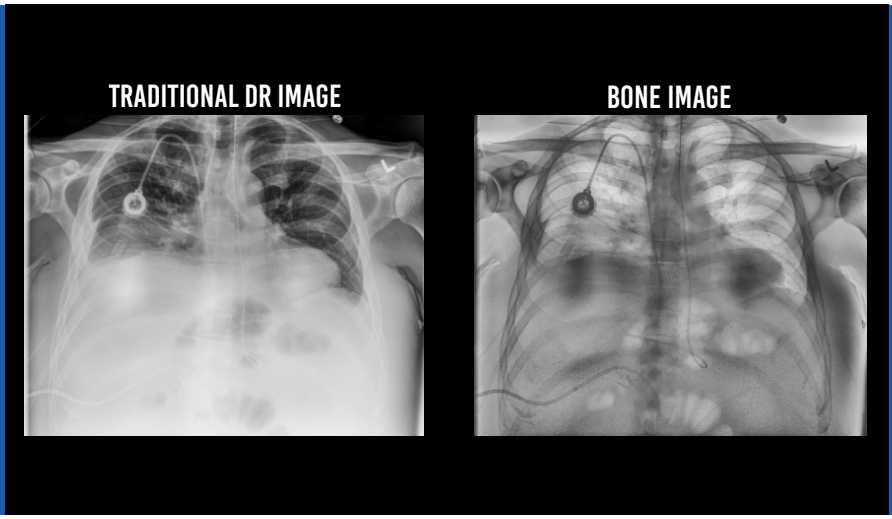
Case Analysis: Pneumonia

In the study case involving a 51-year-old female leukemia patient, the Conventional DR X-Ray was read as normal. Upon viewing the Dual-Energy Soft Tissue image, the radiologist noticed a highlighted focal opacity indicative of pneumonia (confirmed on CT).



Case Analysis: Lines/Tubes Delineation

In this example, take note of the high level of detail exhibited in the vascular wire mesh. Whereas conventional typical DR images have a difficult area resolving this anatomical area, the Reveal 35C Dual energy detector excels.



3 images with the same radiation dose

The Reveal 35C™ detector only requires a single exposure and provides the additional material subtracted dual energy images with no increase in dose when compared to standard radiographic imaging. The Reveal 35C detector also has an advantage over conventional kVp switch dual-energy solutions that require two sequential exposures resulting in additional radiation dose and unsightly streaking artifacts due to heart motion. The Reveal 35C™ allows for improved resolution and tissue differentiation all in a single exposure (dose) of radiation.

More quality at the bedside

Reveal 35C™ is the world's first truly mobile dual-energy solution. Thanks to SpectralDR™ technology, Reveal 35C is able to produce high quality, dual energy radiographic images with significantly improved soft tissue differentiation while still at the patient's bedside. This can avoid the significant risk associated with the movement of patients from ICU to the radiography department if bedside imaging fails.

PROVEN RESULTS

A recent study was presented by KA Imaging at the Radiological Society of North America on the added diagnostic value of portable dual-energy chest radiography. 28 traditional DR and 28 Dual Energy images (bone and soft tissue each) were reviewed and scored, by 9 international reviewers. The study yielded three positive outcomes: The l**ines and tubes were better visualized**; the dual-energy images markedly **increased confidence** for the majority of readers and the change in median reading time for single DR versus three images was statistically insignificant. These results clarify the benefits of the Reveal 35C in the ICU - an easier-to-read image that can not only differentiate tissues, but also lines, tubes and devices common to ICU patients without sacrificing efficiency of a healthcare environment.

Additionally, in a recent study conducted at a mid-size hospital in Canada, the majority of intensivists surveyed reported a **reduction in the time to intervention** following imaging, an **increased confidence in diagnosis** when using the Reveal 35C, and an overall **reduction in follow-on procedures** (additional imaging). Overall these findings showcase the clinical application of the Reveal 35C, how it fills a niche in ICU imaging and helps reduce unnecessary patient movement around the hospital.

Another study presented at the European Congress of Radiology in 2021, the Reveal 35C technology was shown to detect **33% more pneumonia cases** (including COVID-19) than traditional X-Ray[12]. The paper presents the initial results of an ongoing clinical trial that is being carried out in Toronto (Canada).

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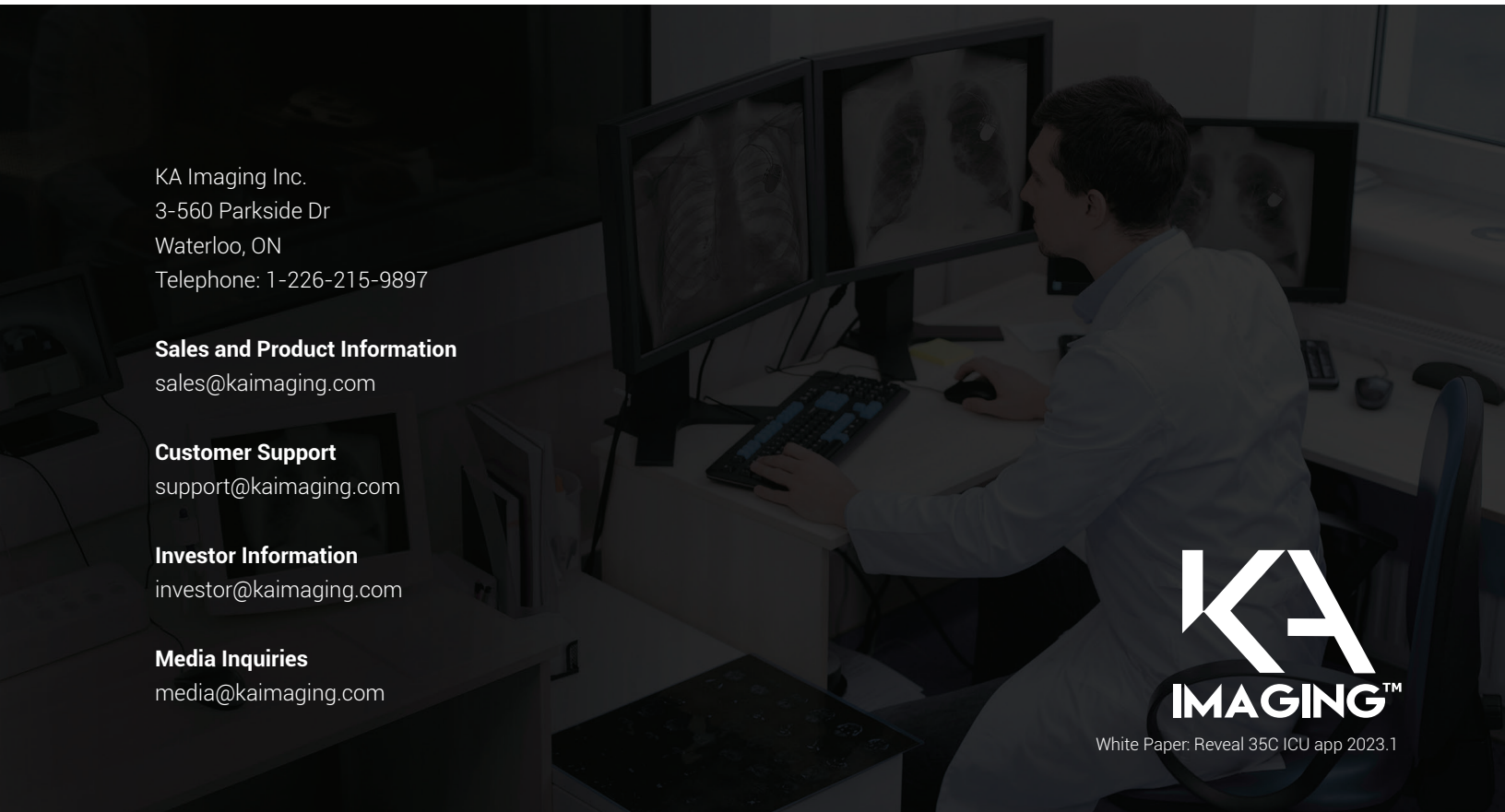

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