

# The Past, Present, and Future of Radiology

Jana C. Arellano RT.T

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## The Past State of Radiology



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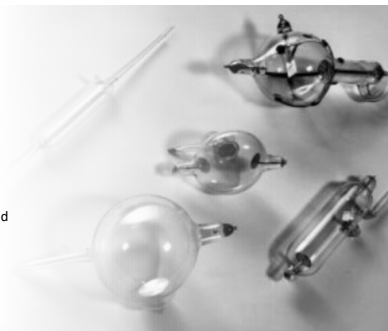
## The Image

William Roentgen's discovery of x-rays in 1895 was the new photography.

It was the blending of two technologies: photography and the Crookes Tube.

The quality was poor, and the radiation exposure was high.

Early x-ray pioneers became martyrs to the x-ray field.



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X-ray Martyrs



Fig. 23-9. The statue honoring the pioneers who died victims of their exposure to radiocesium (135S).

A monument to the radiation martyrs in St. George's Hospital in Hamburg, Germany. One hundred and fifty-nine names were inscribed at the time it was built in 1936 and hundreds more have been added since.

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The x-ray tubes were improved from the early ones used by Roentgen.

Safety has improved, but the tube's core has not drastically changed.



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The Equipment—Plates and Film

- Plates – The early photographers were using silver compounds, but it wasn't until the liquids were flattened out that it was discovered that light emissions create a lasting image.
- Over the years, the film and plates were improved from glass, photo-synthesizing materials, intensifying screens and screen-film combinations.



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### The Equipment— Plates and Film

- Early exposures were long and resulted in large radiation doses due to the technology of the imaging plates.
- On July 8, 1896, William Levy underwent a two-hour exposure to his head to locate a bullet in his brain. "Electrical Review: A Weekly Journal of Electric Light, Telephone .... Volume 29—Made Bald By Xray"




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### The Equipment— Plates and Film



Roentgen emphasized early in the discovery of the first x-ray images the importance of the photographic plate as a means of recording the radiographic image.



In 1886, the price list of one plate and film manufacturer listed sizes as: 14 x 17 inches, 11 x 14 inches, 10 x 12 inches, 8 x 10 inches, 6.5 x 8.5 inches, and 5 x 7 inches.



Glass plates were initially used despite the availability of multiple testing methods of different components and combinations for x-ray imaging.



Edison alone tested 8,500 different materials, and in 1896, the first-time fluorescent screen-film combination was used.

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### Storage and Capacity

Glass plates were the early choice for an optimal x-ray.

Glass had some drawbacks (e.g., heavy and costly).

A 14 x 17-inch glass plate weighed approximately 2 pounds.

A 14 x 17-inch glass plate cost \$1 in 1906, which equates to approximately \$100 today.

In 1913, an improved x-ray film was introduced, which was perfect timing due to WWI and the shortage of the photographic glass plates.

X-ray film went through various transitions, each improving the amount of time required to obtain an image. The film was a lot lighter than glass plates (from pounds to ounces) and the cost was decreased.

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The Past State of Radiology



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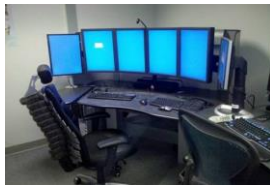
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The Present State of Radiology

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The Present State of Radiology



DIGITAL IMAGING



DIRECT CAPTURE



FASTER TECHNOLOGY  
LOW-DOSE EXAMS

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
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## Computer Radiology

 Imaging plates that when exposed to x-rays retain the radiation in a phosphor layer.

 Plates are scanned and a blue light emits with intensity proportional to the amount of the radiation exposure.

 The light is then detected by an analog device known as a photomultiplier (PMT) and converted to a digital image using an analog-to-digital converter.

 The digital image is viewable on the computer screen.

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The X-Ray Room

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## DR Imaging

 Direct capture into a digital image.

 Use of solid-state detectors with computer processing and image display.

 Detector technology is improving; there are two types (indirect and direct).

 Indirect technology takes the x-ray photons, converts to light, and then converts to a digital image.

 Direct technology takes the x-ray and converts directly to a digital image.

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## The Present State of Radiology

- MV's 2019 X-Ray/DR/CR Market Outlook Report observes that over 80% of the fixed general x-ray installed base in U.S. hospitals uses DR technology, up from half of the installed base in 2015.
- The government has influenced the transition to CR and DR by lowering Medicare reimbursements annually for radiology departments that utilize older technology. [Consolidated Appropriations Act of 2016](#).

X-ray Technology	Year Implemented	Reimbursement Reduction
Analog	2017	20%
Computed Radiography	2018	7%
Computed Radiography	2023	10%
Digital Radiography	None	None

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The Portable X-Ray Tube

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## The Future of Radiology

 **Block Chain**

 **Artificial Intelligence**

 **Interoperability**

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### Blockchain

- Popularized by the Bitcoin explosion
- Digital ledger where the records are kept by many
- Decentralized – meaning one entity doesn't govern the data
- Each block of data is connected to the prior block of data, which is the chain that is difficult to break



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The technology and mindset of patients and healthcare professionals are not ready for blockchain technology.

“Who owns the data” is a commonly used phrase...but it's who owns the data breach for systems that share patient data.

In my opinion, Health Information Exchanges are paving the way for blockchain.

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### Artificial Intelligence

- Study by Lunit and Korean Academic Hospital published in Lancet Digital Health
- The study shows a significant improvement in the performance of radiologists before and after using AI. According to the study, the AI alone showed 88.8% sensitivity in breast cancer detection, whereas radiologists alone showed 75.3%. When radiologists were aided by AI, the accuracy increased by 9.5% to 84.8%.

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### Artificial Intelligence

- AI works by having massive data sets and creating algorithms.
- It's a comparison of thousands and thousands of bits of information. That radiologist will be aided to have a better diagnosis.
- Think of the number of cases that radiologists read; the AI technology aids them in reading with a high level of accuracy.
- AI will take some time for full implementation.
- Some of the AI software will also merge data from patients' historical medical records.

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### Interoperability

- This is the linking of all data from multiple organizations in one uniformed record.
- The Health Information Exchange is a repository of all patient data. Manifest MedEx, a California statewide HIE, has data from hospitals, ambulatory clinics, labs, radiology, and health plan claims data.
- Interoperability reduces healthcare costs by decreasing repeated testing—for radiology, that means fewer radiation doses for patients.
- Interoperability enables patients to receive care more quickly and enables doctors to make efficient medical decisions.

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