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Valuation of Diagnostic Imaging: Introduction

Diagnostic imaging is "the process of making a visual representation of the interior of the body for medical intervention."[1] This process utilizes medical imaging techniques to "create pictures of a patient's internal anatomy and convert them to film" in order to detect, diagnose, and treat diseases and injuries.[2] Diagnostic imaging can be performed in a number of sites, including hospitals, physician offices, and freestanding independent diagnostic testing facilities (IDTFs), defined by the Centers for Medicare & Medicaid Services (CMS) as "a facility that is independent both of an attending or consulting physician's office and of a hospital."[3] Over 70% of imaging volume is performed in a hospital setting, while the remaining portion occurs in the outpatient setting.[4]

The various modalities that comprise diagnostic imaging may be utilized in a wide variety of medical applications, and include, but are not limited to:

(1) X-Ray;
(2) Magnetic resonance imaging (MRI);
(3) Computed tomography (CT);
(4) Mammography;
(5) Ultrasound; and
(6) Positron emission tomography (PET)

Each modality is discussed in turn below.

X-Ray

X-ray, or radiography, utilizes small doses of ionizing radiation to produce images of the body's internal structures.[5] In some x-ray exams, barium or iodine-based contrast may be used to improve the visibility of specific tissues, bones, blood vessels, or organs.[6] Soft tissues in the body, such as muscle or fat, allow the x-ray to pass through and appear gray on digital media or film.[7] Tumors and bones, which have a higher density compared to soft tissue, do not allow all of the x-rays to pass through, and thus appear white on the image.[8] When a break in the bone is present, the x-ray beam passes through the broken area, rendering the image as a dark line on the white bone.[9] To create a radiograph, patients are positioned so the body part being imaged is located between an x-ray detector and an x-ray source.[10] Technology used in x-rays is also utilized in other types of diagnostic procedures, including fluoroscopy, arteriograms, and CT scans.[11]

MRI

MRIs allow providers to noninvasively diagnose or monitor injuries or disorders of the brain, spinal cord, heart, abdominal organs, or joints.[12] Common MRI exams include functional MRIs (fMRIs), when a patient is asked to perform certain activities to map functional areas of the brain before surgery; breast scans; magnetic resonance angiographies (MRAs), which help visualize blood vessels; magnetic resonance venographies (MRVs), which help visualize organ blood vessels using a contrast dye; and cardiac MRIs.[13]

Unlike x-rays and CT scans, which use ionizing radiation technology in order to take images of the body, MRIs use a large magnet, radio waves, and a computer to create a cross-sectional image of the internal organ(s) and/or structure(s) in question.[14] An MRI may be more appropriate than a CT scan when organs or soft tissues are being studied, as an MRI scan is more capable of displaying the contrast between normal and abnormal soft tissues and can differentiate between fat, water, and muscle with more accuracy.[15] In order to highlight certain tissues and improve accuracy, a contrast dye, taken orally or intravenously, may be utilized in some patients, which may extend the length of treatment.[16]

CT

CT scans, also known as computerized axial tomography (CAT) scans, are often used to examine bones, muscles, fat, organs, or blood vessels, although they are capable of providing detailed images of any part of the body.[17] Unlike MRIs, CT scans use x-ray and computer technology to produce cross-sectional images, which are more appropriate for diagnosing cancer, pneumonia, abnormal chest x-rays, and brain bleeds.[18] CT scans go beyond the standard x-ray by providing additional detail related to internal organs and structures by emitting a series of narrow beams through the body in an arc-like formation.[19] These scans produce two-dimensional (2D) images of sections of the body, but can be combined to create a three-dimensional (3D) image.[20] Scans may take mere seconds to several minutes; however, if oral contrast is needed, it requires an additional 45 to 60 minutes to reach the digestive tract.[21]

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Mammography

Mammograms are specifically utilized to conduct an x-ray examination of the breast in order to detect breast diseases.[22] In addition to conventional mammography, there are three additional advances, including digital mammography (rather than utilizing x-ray film), computer-aided detection (CAD), and digital breast tomosynthesis (DBT).[23] DBT, also known as 3D mammography, is an advanced form of imaging that creates a 3D image of the breast(s), combining multiple images from different angles.[24] Mammograms are often used as a screening tool to detect breast cancer, which can show changes in a breast up to two years before a patient or physician can feel them.[25] The U.S. Preventative Services Task Force recommends women between the ages of 50 and 74 receive mammograms biannually and states that the decision to undergo a mammogram is an individual one between the ages of 40 and 49.[26] Another common mammography use is for diagnostic purposes, to evaluate a patient with certain symptoms in or on the breast, e.g., lump, pain, skin dimpling, or nipple discharge, which takes longer to perform and utilizes a higher dose of radiation to obtain more views of the breast(s).[27]

Ultrasound

Ultrasounds utilize sound waves to produce pictures of the inside of the body.[28] Unlike other medical imaging tests, such as CT scans and x-rays, radiation is not utilized in ultrasounds.[29] Ultrasound imaging is used to examine unborn children in pregnant women, as well as to diagnose infection, swelling, and pain in internal organs.[30] No special preparation is required before an ultrasound scan is administered.[31] An image is produced by traveling through the blood in the chamber of the heart, for example, and if it hits a valve in the heart, it will bounce back or echo.[32] The denser objects will result in more of the ultrasound bouncing back, giving the ultrasound its features.[33] The three main types of ultrasound imaging utilized by providers are diagnostic ultrasounds, pregnancy ultrasounds, and ultrasounds used as guidance for procedures.

Ultrasounds that are performed during pregnancies are traditional ultrasounds, where a 2D image of the fetus is produced.[34] The 2D ultrasound produces flat-looking images and outlines, which allows providers to examine the structure and internal organs of the fetus.[35] 3D ultrasounds allow for the examination of certain facial features of the fetus, and other body parts such as the toes and fingers.[36] 4D ultrasounds are 3D ultrasounds taken in motion.[37]

PET

PET scans are imaging tests that help reveal the biochemical or metabolic function of the organs and tissues of the body.[38] PET scans utilize the injection of radioactive drugs called "tracers" to show both atypical and typical metabolic activity.[39] The most commonly utilized tracer is FDG (fluorodeoxyglucose), a simple sugar (glucose) that has been radiolabeled; FDG gives off energy in the body, which can be observed by the scanner.[40] PET scans will measure functions such as blood sugar metabolism, blood flow, and oxygen use.[41] Providers typically use PET scans to help diagnose cancer and assess cancer treatment; they can also use it to assess certain brain and heart issues.[42] PET scans will usually take about 15 to 20 minutes, but patients can expect to be in the PET imaging department approximately two to three hours.[43] PET scans are safe, and no side effects are associated with radioactive tracers, which only remain in the body for a short time.[44] The dose of radiation is very small, and approximate to a few years of natural radiation from the environment.[45]

Conclusion

In light of the current conditions of the diagnostic imaging industry, demand may be driven by: (1) the increased demand for services due to the aging Baby Boomer population, who will require more diagnostic imaging services; and (2) a patient and payor preference for diagnostic imaging conducted in freestanding centers (in contrast to the hospital or hospital outpatient department setting). The next installment of this five-part series will review the competitive environment of the diagnostic imaging industry.

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1 "Global Diagnostic Imaging Market" Mordor Intelligence, Sample Report, 2017.
2 *Ibid.*
3 "Independent Diagnostic Testing Facility (IDTF) Fact Sheet" Centers for Medicare & Medicaid Services, Medicare Learning Network, ICN909060, October 2022, available at: https://www.cms.gov/Outreach-and-Education/Medicare-Learning-Network-MLN/MLNProducts/Downloads/ICN909060-IDTF-Fact-Sheet.pdf (Accessed 11/1/23), p. 1.
4 "Healthcare Utilisation: Diagnostic Exams" Organisation for Economic Co-Operation and Development, https://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT# (Accessed 11/3/23).
5 "X-ray (Radiography)" RadiologyInfo.org, https://www.radiologyinfo.org/en/x-ray (Accessed 11/1/23).
6 *Ibid.*
7 "X-Rays" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/xrays (Accessed 11/1/23).
8 *Ibid.*
9 *Ibid.*
10 "X-rays" National Institute of Biomedical Imaging and Bioengineering, June 2022, https://www.nibib.nih.gov/science-education/science-topics/x-rays (Accessed 11/1/23).
11 "X-Rays" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/xrays (Accessed 11/1/23).
12 "MRI (Magnetic Resonance Imaging): Uses" U.S. Food and Drug Administration, December 9, 2017, https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/MRI/ucm482763.htm (Accessed 11/1/23); "Magnetic Resonance Imaging (MRI)" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/healthlibrary/conditions/adult/radiology/Magnetic_Resonance_Imaging_22,MagneticResonanceImaging (Accessed 11/1/23).
13 "What Are the Different Types of MRI Examinations" Stanford Health Care, https://stanfordhealthcare.org/medical-tests/m/mri/types.html (Accessed 11/1/23).

(Continued on next page)

14 "What is an MRI?" WebMD, https://www.webmd.com/a-to-z-guides/what-is-a-mri#1 (Accessed 11/1/23).
15 "Benefits and Risks" in "MRI (Magnetic Resonance Imaging)" U.S. Food & Drug Administration, December 9, 2017, https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/MRI/ucm482765.htm (Accessed 11/1/23).
16 "Magnetic Resonance Imaging (MRI)" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/healthlibrary/conditions/adult/radiology/Magnetic_Resonance_Imaging_22,MagneticResonanceImaging (Accessed 11/1/23).
17 "Computed Tomography (CT) Scan" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/healthlibrary/conditions/adult/radiology/computed_tomography_ct_scan_22,computedtomographyscan (Accessed 11/1/23).
18 "What is a CT Scan?" WebMD, https://www.webmd.com/cancer/what-is-a-ct-scan#1 (Accessed 11/1/23); "CT scan or CAT scan: How does it work?" By Christian Nordqvist, Medical News Today, July 24, 2018, https://www.medicalnewstoday.com/articles/153201.php (Accessed 11/1/23).
19 "Computed Tomography (CT) Scan" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/healthlibrary/conditions/adult/radiology/computed_tomography_ct_scan_22,computedtomographyscan (Accessed 11/1/23); "CT scan or CAT scan: How does it work?" By Christian Nordqvist, Medical News Today, July 24, 2018, https://www.medicalnewstoday.com/articles/153201.php (Accessed 11/1/23).
20 "CT scan or CAT scan: How does it work?" By Christian Nordqvist, Medical News Today, July 24, 2018, https://www.medicalnewstoday.com/articles/153201.php (Accessed 11/1/23).
21 "CT (CAT) Scan" St. Michael's, http://www.stmichaelshospital.com/programs/imaging/ctscan/faq.php (Accessed 11/1/23).
22 "Mammogram Procedure" Johns Hopkins Medicine, https://www.hopkinsmedicine.org/healthlibrary/test_procedures/gynecology/mammogram_92,P07781 (Accessed 11/1/23).
23 "Mammography" RadiologyInfo.org, https://www.radiologyinfo.org/en/info.cfm?pg=mammo (Accessed 11/1/23).
24 *Ibid.*
25 *Ibid.*
26 "Breast Cancer: Screening" U.S. Preventative Services Task Force, Final Recommendation Statement, January 11, 2016, https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/breast-cancer-screening (Accessed 11/3/23).
27 "Mammography" RadiologyInfo.org, https://www.radiologyinfo.org/en/info.cfm?pg=mammo (Accessed 11/1/23); "Mammograms" National Cancer Institute, https://www.cancer.gov/types/breast/mammograms-fact-sheet#q2 (Accessed 11/1/23).
28 "General Ultrasound" RadiologyInfo.org, https://www.radiologyinfo.org/en/info/genus (Accessed 11/1/23).
29 "Ultrasound" Cleveland Clinic, https://my.clevelandclinic.org/health/diagnostics/4995-ultrasound (Accessed 11/1/23).
30 RadiologyInfo.org, https://www.radiologyinfo.org/en/info/genus (Accessed 11/1/23).
31 "How do ultrasound scans work?" By Yvette Brazier, Medical News Today, June 23, 2017, https://www.medicalnewstoday.com/articles/245491 (Accessed 11/1/23).
32 *Ibid.*
33 *Ibid.*
34 Cleveland Clinic, https://my.clevelandclinic.org/health/diagnostics/4995-ultrasound (Accessed 11/1/23).
35 *Ibid.*
36 *Ibid.*
37 *Ibid.*
38 "Positron Emission Tomography Scan" Mayo Clinic, April 18, 2023, https://www.mayoclinic.org/tests-procedures/pet-scan/about/pac-20385078#:~:text=A%20positron%20emission%20tomography%20(PET)%20scan%20is%20an%20imaging%20test,typical%20and%20atypical%20metabolic%20activity. (Accessed 2/22/24).
39 *Ibid.*
40 "PET Scan" HealthDirect, February 2022, https://www.healthdirect.gov.au/pet-scan (Accessed 2/22/24).
41 "PET Scan" Cleveland Clinic, October 19, 2022, https://my.clevelandclinic.org/health/diagnostics/10123-pet-scan (Accessed 2/22/24).
42 *Ibid.*
43 HealthDirect, February 2022.
44 *Ibid.*
45 *Ibid.*

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