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RADIATION DOSE ASSOCIATED WITH FLUOROSCOPY X-RAY EXAMINATIONS FORPEDIATRICS

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Abstract:

Introduction: *Diagnostic reference levels (DRL) of procedures involving ionizing radiation are important tools for optimizing radiation doses deliveredto patients and to identify cases where the levels of dose are unusually high. This is very important for pediatric patients undergoing fluoroscopic examinations, as these examinations can be associated with a high radiation dose.*

Material and Methods: *Pediatrics fluoroscopic studies performed at Maternity and Children Hospitals in Makah city was conducted on 140 patient Childrenranging in age from (1 to 14 years) analyzed to determine range, mean, 75th percentiles of Dose–Area Product (DAP) undergoing X-ray Fluoroscopy examination to evaluate the diagnostic and measure Total Effective dose (msv), and Total Entrance Dose (mGy.cm2). This data is automatically collected from DF by the structured sent by the imaging network's to the software (DICOM, RIS, HIS, and Dose watch.*

Results*: were obtained Result Comparing the dose (DAP, and ESR) with the (NPDD-IAEA-ICRP) depend on range or median, all radiation doses for pediatric are within the limit.*

Conclusion*: Diagnostic reference levels are recommended as an optimizationtool for radiation dose assessment in medical imaging procedures involving the utilization of radiation. So can be divided the optimization for reducing dosesto exposure setting and exposure protocol.*

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1-1 INTRODUCTION:

Clinical x-rays were utilized for medical testing for hundreds of years, dating back to Roentgen's 1896 finding. The varied absorption of x-rays while interaction with the patient's psyche also was, as it is now, the fundamental premise for therapeutic uses of x-rays. [1]

When a regular x-ray laser strikes the human, it mixes with the body cells, resulting in a varied transmitted x-ray flux that is determined by the attenuation all along beam pathways. This creates a "shadow" of the interior anatomy that is overlaid. To offer anatomic information to a medical practitioner, an x T ray– sensitive detector catches the transmission proportion and turns the x-rays into a visual projected picture. Scientists and researchers developed the capacity to create a complete three-dimensional depiction of the architecture in the 1970s and 1980s by acquiring several, directional projected and synthesizing them into computed tomography images using computerized techniques. CT pioneered the use of computerized image capture in diagnostic radiography for medical diagnosis, revolutionizing the use of x-rays in diagnostic medical imaging. The regulated x-ray beam of known energy and amount is the common entity across all x-ray photography. X-rays are high-energy electromagnetic emission. [2]

Wilhelm Conrad Rontgen, a German scientist who won the Nobel Prize in Chemistry in 1901, identified X-rays in 1895. Godfrey Newbolt Effect is a type constructed the first X-ray positron emission tomography equipment in 1972, ignoring the fact that their potential benefits in diagnostic imaging diagnostics were clear from the very beginning. [3]

The most often used instrument in the detection of illnesses is X-ray, which accounts for a significant portion of man's exposure to artificial resources. In medicine, X-ray imaging is an effective diagnostic tool for which there is no acceptable substitute. X-ray exams should deliver pictures containing significant diagnostic information with the lowest possible radiation dosage, according to the idea of "as low as reasonably feasible" (ALARA). Some legislative bodies have Created quality assurance procedures in hospital medical imaging departments to attain this purpose.

In many domains, such as physics, medicine, biology, cultural heritage, and material science, monochromatic X-ray sources have proven to be an essential tool for study and diagnostics. The special properties of monochromatic X-rays, in particular, are of significant interest in medical research and are critical for the application of various revolutionary treatments, namely in the disciplines of radiology and radiotherapy.[4]

For purposes needing slightly elevated homogeneous X-ray beams, type ofelectromagnetic is by far the most appropriate source to date. The investment decision necessary to establish, establish, and run a femtosecond plant, and from the other side, is so far beyond the capacity of any modest major research university or clinic, restricting the use of these sophisticated methods on a wide scale (or in clinical settings). Although the professional industry's best efforts, an X-ray source equivalent to a femtosecond in terms of found that the perceived, process ability, and brightness, while also being portable and economical, are yet to be developed. [5]

The dispersion of laser pulses by accelerated particles, known as inverted Rayleigh interactions, is one of the most promising ways to create powerful adjustable monochromatic radiation from a small source. Many research organizations and labs across the globe are running or planning scientific activities aiming at constructing and launching inverse Compton scattering-based equipment (ICS). Various methods have been developed and executed in order to create radiation beams with different energyranges, spectra, and properties that can meet the requirements of diverse application. Over the last decade, the technology necessary to generate high-performance inverse Compton sources has advanced fast, with a successful continuous transition from research-oriented and demonstration machines to practical user facilities. Various research organizations have carried out preliminary tests for a proof of principle as well as radiographic imaging. Multiple user facilities in European are now being built: STAR (University of Calabria,Cosenza, Italy) [5] and Thom (University of Calabria,Cosenza, Italy) (LAL, Rosary, France) [6].

1-2. X-ray interactions

For x rays in the diagnostic energy range the most important interactions processes are absorptions or scatterings (figure 1). These processes are responsible for the varying transmission of photons through the patient’s body, which subsequently forms the image. A photon that is absorbed is lost from the beam of primary photons emerging from the X-ray tube on its way towards the image

receptor. A photon that is scattered changes its direction of motion and may lose some of its energy. Information about the patient is conveyed by the primary photons; scattered photons, arising from interactions in the patient, reduce the image information content. Photon absorption and scattering in the patient result in the absorptions of energy. The energyabsorbed per unit mass is called the absorbed dose and is measured in J/kg or Gray, Gy.

1.2.1Absorption

In a photoelectric absorption event, a photon is wholly absorbed by one of the inner atomic electrons, which is subsequently ejected from the atom (a photoelectron). Thevacancy in the electron shell is filled by an electron from an outer shell and a new photon a so-called "characteristic photon" may in some cases be created. The energy of this photon is characteristic of the atom and equals the difference in the binding energies of the two atomic electrons. The probability for absorption varies rapidly with the atomic number of the atom, Z; increasing as Z3.5. It decreases with increasing photon energy until the energy exceeds the binding energy of the electrons in a shell. Then more electrons can participate in the process and the probability increases considerably. In iodine, the binding energy of the inner K-shell electrons is 33.2 Kev, a value called the K-edge. The probability of X-ray absorption in iodine increases by a factor of five at this value (see figure1). Iodine absorbs many more photons Than soft tissue.

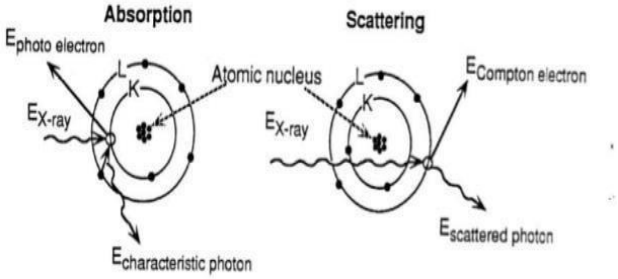


Figure1 Schematic representation of X-ray photon absorption (a) and scattering (b) with atomic electrons.

An X-ray photon with energy EX-ray interacts with an inner K-shell electron. A photoelectron escapes the atom and creates a vacancy in the K-shell, which is filled by an L-shell electron. The difference in binding energy between the K- and L-shells may be emitted as a characteristic photon. When a photon is (Compton) scattered, the Compton electron and the scattered photon share the energy of the incoming X-ray. At the photon energies used in diagnostic radiology, only a small part of the energy is transferred to the electron.

1.2.2Scattering

When X-ray photons interact with atoms and scatters, the process is called Compton scattering. An incoming photon interacts with one of the outer electrons, ejecting it from the atom. Some of the energy is transferred to the (Compton) electron, the rest remaining with the scattered photon. If a 100 Kev

Photon is scattered 45°; its energy loss is only 5 Kev. Even if a photon is scattered backwards, it cannot lose all its energy in one scattering event. This means that photons can scatter many times before their energies are so low that they are finally absorbedor escape the patient. The probability of Compton scattering is approximately independent of the atomic number and decreases only slowly with increasing photonenergy.

1.2.3Attenuation

The number of photons of a given energy lost from a primary beam due to interaction with a thin material-layer is proportional to the thickness of the material and to the number of incident photons. The constant of proportionality is called the linear attenuation coefficient, m. It expresses the probability per unit length that a photon of a given energy will interact somewhere during its passage through the material and it is the sum of the two interaction processes absorption and scattering. The value of m depends on the energy of the photon and on the material (figure 2) and generally decreases with increasing energy. It is the difference in the attenuation properties of various types of tissue in the body, which causes an image. When the difference is large, the tissue of interest will be distinguished more easily in the image (larger contrast). The difference in m-values between soft tissue and bone (or iodine) is much larger than that between soft tissue and adipose tissue. Bone and iodine are thus easier to distinguish from soft tissue in the image than adipose tissue.

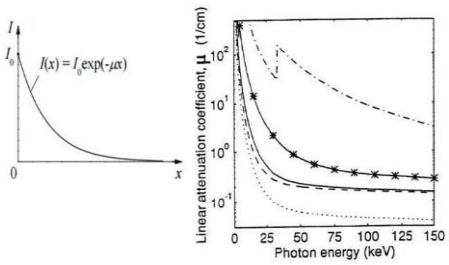


Figure photonenergy (Kev

1.3. History of X-RAY

- 1895 - Wilhelm Roentgen, a German scientist, discovers X-rays while experimenting on cathode light in a glass tube. [3].
- Thomas Edison invents 1896 - inspired by Roentgen x-ray monitor.
- 1906 - Charles Barkla, British physicist demonstrates that light beams can skew X-rays too. This gives valuable proof that X-rays are actually light waves with various wavelengths and frequencies [3].
- 1912 - Max von Laue discovered that he can calculate the strength of x-rays withcrystallites and primarily embraces x-rays in atomic radioactivity and wavelength [1].
- 1913 -14 - Lorenz Bragg and William Henry Bragg discovered that wavelength of x-rays could be used to examine atomic divergence in crystals as well as the x- ray field [4].
- 1913 - William David Coolidge is developing the practical X-ray machine. This is a large glass container with a beam of electron and metal in a tube named the Coolidge. As the beam fires at the mark, the X-rays are released. Increased voltage produces higher frequency and shorter range, stronger and more intense X-rays. His invention of Coolidge patents in 1916[4].
- 1922 - Arthur H. Compton tests the absorption of highly polished glass X-rays, and very precisely measures the duration. He describes a mechanism known, as the Compton Effect; the dispersed X-rays are less strong than particulate matter in the initial beam.
- 1953 - James D. Watson and Francis Crick developed the DNA structure using the X-ray diffraction images from Rosalind Franklin [5].
- 1972 - Godfrey Hounsfield, the British electronics scientist, invents a CTscanner, utilizing thin X-ray beams to create 3D images of a person's body.
- 1999 - The Chandra X-ray Telescope has been designed by Space Shuttle as themost powerful x-ray telescope ever.
- 2000 - In order to enhance airport baggage screening safety, CT X-ray scannersare used.
- 2009 - The strongest source of radiation in the nation is developed byCalifornia's SLAC National Accelerator Laboratory [5].
- 2018 - New Zealand researchers create a diagnostic scanner that can display the human body's 3D color X-rays.
- 2019 - Singapore scientists demonstrate that perovskite particles can produce enhanced X-ray sensors [6].

1.3.1 Fluoroscopy

Fluoroscopy is a sort of psychological imaging that uses a television to display a continuous X-ray picture, similar to an X-ray movie. An X-ray laser is sent through the body throughout a fluoroscopy examination. The picture is sent to a computer, which allows the movement of a bodily component, equipment, or contrast agent ("X- ray dye") through to the biological to be observed in considerable detail.

Figure 3

Figure 2 shows a schematic of an image-intensified fluoroscopy system. An X- ray tube, spectrum shaping filters, a field restriction device (also known as a collimator), an anti-scatter grid, an Image receiver, an image-processing computer, and a display device are the main components. A high- voltage generator, a patient-support device (table or couch), and hardware to allow moving of the X- ray source and image receptor assemblies relative to the patient areall optional but required components. [8]

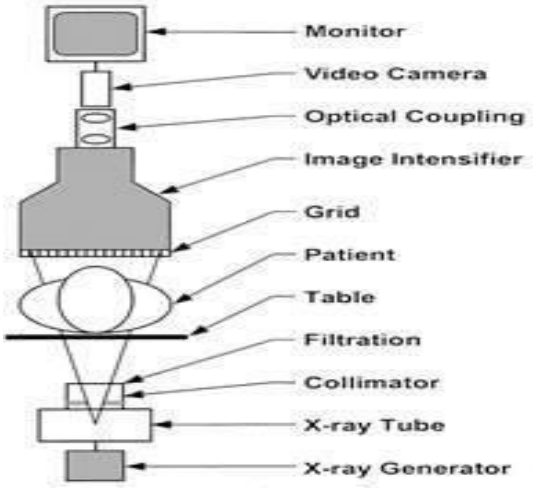


Figure4 Schematic Diagram of a fluoroscopic system using an X-rayimage intensifier (XRII) and video camera

1.3.2 X-ray Source

In terms of construction and operation, the slightly elevated generator and X-ray tube used in most fluoroscopy systems are comparable to those used in general radiography applications. Heat generated capacity is required for angiographic "runs," which are sequences of higher-dose radiography pictures collected in fast succession to visualize unpacified arteries, in specially modified facilities such as those used for cardiovascular imaging. In a diagnostic or interventional process, these runs are frequently interleaved with fluoroscopic imaging, resulting in a significant demand on the X-ray tube. In most cases, special X-ray tubes are used in such systems.

When great spatial response is required but reduced radiation intensity is acceptable, focal spot diameters in fluoroscopic tubes can be as tiny as 0.3 mm and as large as 1.0 or 1.2 mm when higher power is required. Continuous or pulsed radiation can be used, with recommendations concerning being more frequent in current systems. Automatic temperature rate control keeps the radiation dose per frame at a predefined level during **the examination, responding to the** absorption characteristic of the participant's physiology and ensuring a continuous degree of picture quality. [9]

1.3.3 Beam Filtration

Between the X-ray tube exit port and the collimator, beam-hardening filters are commonly used in fluoroscopic imaging systems. A low kVp produces a spectral shape that is well-matched to the barium or iodine k-edge for high contrast in the anatomy of interest, while added aluminum and/or copper filtration can reduce skin dose at the patient's entrance surface, while a low kVp produces a spectral shape that is well- matched to the barium or iodine k-edge for high contrast in the anatomy of interest.

This additional filtration in the beam path might be user-selectable, giving the operator the freedom to choose between low and high dosage modes as needed during a fluoroscopic treatment. Other methods use automated filtration to obtain a specified degree of picture quality and dosage reductions dependent on beam attenuation circumstances.

Many fluoroscopy systems also include "wedge" filters that are partially transparent to the X-ray beam in addition to beam shaping filters. To limit entry dosage and excessive image brightness, these adjustable filters dampen the beam in areas specified by the operator. [10]

1.3.4 Collimation

All X-ray equipment has shutters that limit the geometric extent of the X-ray field. The collimation in fluoroscopy might be circular or rectangular, depending on the geometry of the image receptor. When the operator picks a field of view, the collimator blade locations are automatically adjusted to be somewhat bigger than the viewable field. The collimator blades adjust to preserve the field of vision and limit "spillover" radiation outside of the viewable region as the source-to-image distance (SID) varies. Both circular and rectangular field of view systems include automated collimation. See figure 5

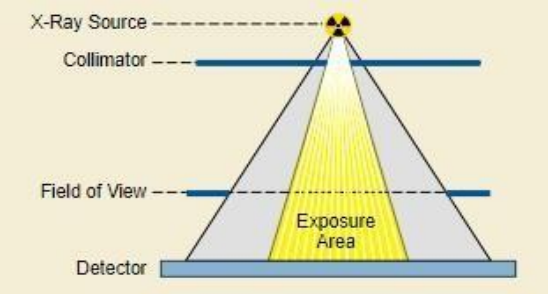


Figure 5

1.3.5 Patient Table and Pad

Patient tables would have to be strong enough to support individuals and are designated for a certain maximum weight by the manufacture. To minimize reflections, signal interference, and picture contrast reduction, it is critical that the table does not absorb a lot of light.

Advanced composite technology combines great strength with reduced radiation absorbing, making it an excellent table component. For maximum padding, foam cushions are frequently put here between customer and the table, with reduced radiation penetration. [11]

1.3.6 Anti-Scatter Grid

Because a major percentage of interventional procedures exams are done in high- scatter environments, such as the abdominal area, anti-scatter grids are common components of fluoroscopic systems. Grid ratios typically vary from 6:1 to 10:1. Grids can be circular (XRII systems) or rectangles (FPD systems), and the administrator can typically remove them.

1.3.7 Image Receptor — X-ray Image Intensifier (XRII)

The X-ray uses characterization (Figure 2) is a machine that converts the X-ray beam intensity

pattern (also known as the "remnant beam") into a visual picture that can be captured by a recording device and presented on a video display monitor. An incoming phosphor layer, a photocathode, electron optics, and an output phosphorous are the main components of an XRII.

Like the original fluoroscope, the cesium iodide (CsI) input phosphor coverts the X-ray picture into a visible light image. The photocathode is located near to the Input phosphor and releases electrons in direct proportion to the visible light shone on its surface from the input phosphor. The electrons are guided, accelerated, and multiplied in quantity by the electron optic components before colliding with a phosphor-coated surface, which lights visually when impacted by high-energy electrons. This is the XRII's output phosphor. [11]
In theory, the enhanced picture on the tiny (1" diameter) output phosphor may beobserved.

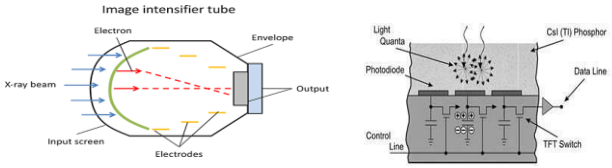


Figure 6 Components of an X-ray image intensifier

He XRII achieves orders of magnitude more light per X-ray photon than a simple fluorescent screen. This occurs through electronic gain (amplification by the electron optics) and magnification gain (concentrating the information from a large input surface area to a small output phosphor area) as shown in Figure 2. This allows relatively high image quality (signal-to-noise ratio) at modest dose levels compared with non-intensified fluoroscopy. [13]
The introduction of video technology provided a significant convenience factor: it allows several individuals to look at the picture at the same time and allows for therecording and post-processing of fluoroscopic image sequences.

Image intensifiers come in a range of input sizes, from 10–15 cm to 40 cm. The input surface is always round and curved, which is a design feature of the vacuum tube technology that it is made of.
The video or plumb icon analogue video cameras used in XRII systems were initially acquired from the broadcast television sector. Digital cameras with charge- Coupled device (CCD) image sensors or complementary metal oxide semiconductor (CMOS) technology became commonplace in subsequent systems.

1.3.8 Image Receptor — Flat Panel Detector (FPD)

Fluoroscopic systems with a "flat panel detector" (FPD) assembly have been introduced in recent years, replacing the XRII and video camera components. When flat panel X-ray detectors were originally introduced into radiography, they providedthe advantages of a "digital camera" over current technology.

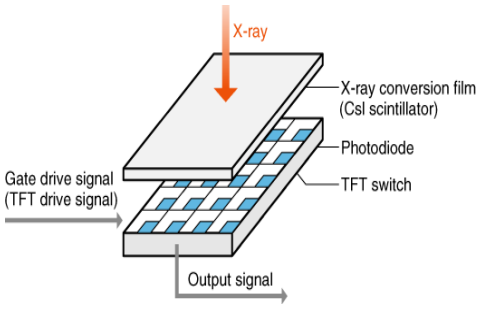


Figure 7 Flat Panel Detector (FPD)

The demand for minimal dosage per picture frame in fluoroscopic applications has been a problem for FPDs, implying that the detector's intrinsic electrical noise must be **extremely low** and the necessary dynamic range is considerable. Although it has been challenging to develop FPDs with low enough electrical noise characteristics to obtain a decent signal-to-noise ratio (SNR) under low exposure settings, such devicesalready exist. [14]

Flat panel detectors are physically smaller than XRII/video detectors, providing for more mobility and patient placement freedom. The most significant advantage of the FPD is that it is free of the XRII's numerous intrinsic flaws, such as geometric "pin- cushion" distortion, "S" distortion, veiling glare (glare that extends from particularly bright spots), and vegetating (loss of brightness at periphery). In FPDs, these phenomena simply do not exist. Some XRII/video systems have a lower dynamic range than FPDs. [15]

Another benefit of FPDs is that, unlike XRII/video, the spatial resolution of the image receptor is largely determined by the detector element size and is independent Of the field of view. In XRII systems, the magnification gain necessitates an inverse relationship between the entry dosage and the field-of-view in order to maintain a constant brightness **at the output** phosphor. For FPDs, there is no such limitation; the entrance detector dosage is independent of the field of view. [16]

Individual detector elements are arranged in a grid on flat panel detectors. The square components have a thickness of 140–200 microns per side and are produced on glass substrates using amorphous silicon thin-film technique.

Fluoroscopy detector arrays range in size from 20 x 20 cm to 40 × 30 cm. A single detector can have up to 5 million separate detection elements. The modified electrode is covered with a calcium iodide (CsI) interferometry

Layer, with thin-film photo detectors and semiconductors catching the visual electrical beam from the scintillator to generate the digital picture, which is then sent to a processor at a frames per second chosen by the user (Figure 3). Frame rates of up to 30 frames per second are possible. [9]

1.3.9 Image Display

High-quality video displays are required for fluoroscopy, allowing viewers to notice minute details and small contrast variations in the anatomy of interest. Over the last few years, medical image display technology has been able to "ride on the coattails" of the television business.

High-resolution flat-panel LCDs with high maximum brightness and high contrast ratios are standard in modern systems. To guarantee that the largest range of grey levels is displayed, these displays should be calibrated to a standard luminance response function (such as the DICOM part 14 Grayscale Standard Display Function.)

The latest interventional/angiographic systems include 60-inch diagonal high- definition screens that can accommodate up to 24 separate video input sources that may be organized in a variety of ways on a single huge display monitor. Individual physician preferences can be kept and customized display layouts. [15]

1.3.10 System Configurations

Fluoroscopic devices come in a range of setups to maximize usefulness for the therapeutic task(s) they are designed for. "Traditional" radiography/fluoroscopy systems include a patient table that tilts all the way to the vertical position, allowing fluoroscopy to be performed while the patient stands upright. The X-ray tube is located beneath the tabletop, while the image receptor is located above the table. These systems are most commonly employed for gastrointestinal imaging (upper and lower GI barium enhanced studies). [16]

The patient table's tilting capacity lets the operator to use gravity to help the barium contrast material pass through the esophagus, stomach, and intestine. Older systems may have a "spot film" mechanism that permits a radiographic cassette to be placed in front of the fluoroscopic image receptor, allowing radiographs to be taken with the fluoroscopic X-ray source. **Static** pictures are frequently collected in current systems using the same digital image receptor that is used for fluoroscopy, therefore spot film is becoming obsolete.

The remote operated system is a variant on the traditional R/F design, in which the X-ray tube and image receptor are inverted, with the tube above the patient table and the image receptor below. These systems may be completely controlled, including table motions, from a shielded control booth operator's console using a joystick-type controller. This safeguards employees against secondary radiation exposure.
Angiographic systems use a "C-arm" shape to allow for convenient patient access while fluoroscopy directs the placement of specific arterial and venous catheters. Advanced functions such as digital subtraction and road mapping are included in these systems. The latest systems may do 3D imaging by spinning the C-arm around the patient and performing a tomographic reconstruction to get a volumetric image data set. In angiographic mode, this is known as 3D rotational angiography, whereas in CT mode it is known as cone beam CT (CBCT).

Advanced fluoroscopic capabilities, including, as variable frame rate, automated beam filtering, and advanced image post-processing, are available in systems Developed for vascular/interventional radiology and cardiology/electrophysiology. Finally, in musculoskeletal radiology, orthopedics, urology, gastroenterology, and pain management, among other fields, the movable C-arm arrangement is popular in the operating room and for office-based operations. Mobile C-arms are typically tiny,low-cost devices, although some are equipped with higher-power X-ray sources capable of producing significant radiation output levels.

1.4Previous studies

According to Brenner (2014) [17], there is a widespread concern about the radiation dosage levels given to pediatric kids during X-ray

treatments, as well as the potential consequences. This is because children are more radiosensitive than adults are, and their predicted life expectancy means they are more likely to develop cancer during their youth. Regardless, X-rays have continued to serve a vital role in the identification of diseases and injuries in pediatric patients when necessary. The availability of the cost of alternative imaging modalities is significantly impacted by such suitability in countries with low resources. Because of these factors, the application of appropriateness criteria for certain diagnosis methods varies by nation. Regardless of these differences, protecting children from radiation during X-ray exams is an essential feature that all countries share.

Livingstone teal. (2004) examine that radiation doses to children having fluoroscopy tests should be considered since they have a greater risk of acquiring radiation-induced cancers than adults. This study offers radiation dose data for 205 children aged 0 to 15 years who had fluoroscopic exams utilizing a digital imaging system. The dose area product (DAP) data were used to calculate the entry surface doses (ESD) and effective doses. The findings revealed that, Infants received 0.4, 0.81, 0.83, and 0.4 most of barium during barium swallow, barium enema, distal colon gram, and maturating cystourethrography (MCU), respectively. The mean effective doses during barium swallow, barium enema, distal colon gram, and MCU for children aged1 to 5 were 0.27, 1.98, 0.77, and 0.4 mSv, respectively. The mean effective dosages during barium swallow, barium enema, and MCU for children overthe age of 5 yearswere 0.34, 1.06, and 0.34 mSv, respectively [18].

Because of its capacity to aid in diagnosis, radiation-based imaging technologies have been of enormous use to humanity. However, the hazards of radiation exposure from diagnostic X-ray scans have been a major worry among the public, as well as the scientific and medical professions. (Faulkner and Osier, 1999)
[19] It is well known that youngsters have a two to three time's higher chance of acquiring radiation-induced cancer than adults. (President and colleagues, 2004) [20] Because radiological tests assist patients, the radiation risk has long been seen as tolerable. Improved imaging techniques, such as digital radiography, have the potential to reduce radiation dosage to patients while maintaining acceptable image quality. Crawley and Booth. [21]

Greetings, Huda (2004) High radiation doses from radiological tests can have predictable consequences such skin erythema and epilation, which are particularly severe in youngsters owing to their quickly proliferating cells. Because of the huge number of individuals studied and the lack of a threshold dosage, stochastic effects are also a cause for worry. Radiation dose measurement in radiosensitive organs such as the uterus, ovaries, and testes is therefore of particular importance. The best possible definition of probabilistic risk is functional dose, which seeks to account for the power delivered in all bombarded regions and their relative different from the competitors. [22]
2014, Coaly et al. Their research intends to prove that attendants who manually hold newborns during fluoroscopic procedures get modest radiation exposures. Thermo luminescent dosimeters were used to measure doses to the hands and necks of three radiologists and three nurses who performed or assisted at all fluoroscopic operations in a children's hospital for one month. This facility does all fluoroscopy on children without using an ant scatter grid. The total dosages for the neck and hands were 20 to 50 micro Sv per week for the neck and 40 to 210 micro Sv per week for the hands. The three radiologists and three nurses took turns receiving these dosages. When compared to the doses received by interventional radiology employees, individual doses received per staff member are quite low. The doses given to the researchers were around 5% of the NHMRC's recommended limit

For radiation workers. Nurses were given higher dosages than radiologists were, and measures will be done to further minimize this amount. [23]

The quantity of ionizing radiation used in radiological exams requires measurement, according to Suleiman OH (2004), to guarantee that the right amount of radiation is utilized to form a picture. A dose area product (DAP) meter is used to measure the radiation doses given to patients, which is a reasonably simple method of measurement when a large number of patients are involved. For calculating radiation danger during radiological exams, Monte Carlo modelling approaches that employ DAP values have been widely accepted for estimating effective dose and organ doses. [24]

Fluoroscopic operations (especially longer interventional procedures) might expose patients to significant radiation doses, according to Maynard (2001). The amount of radiation given

varies on the type of examination, the size of the patient, the equipment used, the technique used, and a variety of other parameters. The receptor entrance exposure and skin entrance exposure rates, which should be measured at regular intervals, are the best indicators of the fluoroscopy system's radiation dosage performance. Not only is it necessary to assess these rates, but it is also necessary to monitor patient dosages clinically. Although direct monitoring of patient skin dosages during operations is ideal, existing approaches have significant drawbacks. Intermittent exposures, grid removal, last image hold, dose spreading, beam filtering, pulsed fluoroscopy, and other dose reduction techniques can help lower skin doses. Fluoroscopic operators, who are properly trained, understand the factors that determine radiation dosage, and employ different dose reduction strategies may be able to effectively regulate patient exposure [25].
Effective dose control of patients may be possible with proper fluoroscopic operator training, an awareness of the variables that determine radiation exposure, and the application of various dose reduction

1.5 THE ROLE OF FLUOROSCOPY IN MODERNRADIOLOGY

The amount of fluoroscopic exams (especially barium tests), as documented in a 2009 review by Levine et al [27], has been dropping for decades. The increased availability of sophisticated cross-sectional imaging and interventional modalities such as CT, MRI, and endoscopy has contributed to this development. In that study, there was particular worry **expressed about the** future of barium fluoroscopy, with two probable outcomes presented: The first possibility was the GI fluoroscopic examination's inevitable obsolescence; the second scenario was the probable stabilization and/or rise in the use of fluoroscopy as a cost-effective diagnostic examination [27].

The apparent reduction of fluoroscopy can be explained in a number of ways. The firstis a variety of alternative imaging options: CT, MRI, and ultrasound are increasingly utilized in conjunction with manometer, endoscopy, and even direct therapeutic intervention (such as empiric medicine) for GI problems including epigastria discomfort and dyspepsia. Pathologies formerly seen only with a fluoroscopic small bowel series can now be visualized using abdominal CT, focused ultrasound, and MRI heterography. Even medical screening has shifted to more advanced cross-sectional imaging, with CT being a classic example (although public knowledge of this treatment is still a topic of debate, and use is still regarded "poor" at around 1%)[28].

More than just the availability of additional modalities challenge fluoroscopy. Prior studies have shown that economic factors1 have a significant role, since fluoroscopic exams are reimbursed at a lower rate than CT or MRI [27], especially when using the relative value unit (RVU) system [29]. Furthermore, when compared to MRI or CT, many new professionals may consider fluoroscopy to be a "lower tech" method of imaging. As a result, finding younger radiologists who are interested in completing these exams has become increasingly challenging. Furthermore, the necessity of fluoroscopic techniques has not been adequately addressed in radiology schools. Finally, fluoroscopy is an operator-dependent modality; unlike other imaging modalities (such as CT and MRI), where a technician is largely responsible For image capture, radiologists are frequently responsible for both performing and interpreting fluoroscopic examinations.

The above was shown to have detrimental effects on radiology resident training in the "art" of fluoroscopy in a 2009 evaluation. GI fluoroscopy has a smaller number of professors and fellows assigned to it than body CT, ultrasonography, or MRI. Residency training might be limited to a few weeks in the first year, and then only during pediatric and night call resident rotations after that. As previously, stated, poor training frequently leads in "the blind guiding the blind" among senior and younger residents, compounding mistakes. This is especially difficult when trainees conduct a large number of fluoroscopic exams. Trainees were exposed to considerably higher radiation than professors in a retrospective review were of 17966 tests over 5.5 years[30].

The researchers also believed that a greater understanding of the disparity might help training programmers build standards, procedures, and targeted education in the safe use of fluoroscopy for patients and operators.

Fluoroscopy, by its very nature, is a hands-on experience that necessitates direct instruction in the fluoroscopy suite. A well-rounded programmer requires faculty that have a good grasp of "relevant medical physics, patient placement, and strategies for best visualization of anomalies on single and double contrast examinations"[31]. A basic

understanding of fluoroscopic technique is required for patient safety. Leaders and professors within departments must believe in the modality's inherent worth, while learners must remain passionate, with a clear and detailed curriculum.

1.6 BENEFITS OF FLUOROSCOPY

The ability to receive a real-time examination with true temporal resolution, including the capacity to move a patient during an exam, is a benefit of fluoroscopy that is sometimes not accessible with typical CT or MRI. Second, compared to CT, fluoroscopy exposes patients to potentially lower levels of ionizing radiation, with anaverage dosage of 10-50 mGy/min for routine fluoroscopy in a standard fluoroscopy suite setup [32] and overall exam lengths of under 1 minute. This compares to a sample CT abdomen/pelvis effective dose of about 12 most and up to 24 most for a multiphase CT scan of the same region [33]. Finally, fluoroscopy allows for a concentrated and functional evaluation of a specific area of interest. Finally, real- time evaluation of contrast delivery with agents such as barium and non-ionic chemicals ispossible.

On the technological side, fresh strategies have been proposed to simplify evaluation on consecutive studies and for various RIS/PACS systems, such as real- time labelling of successive fluoroscopic swallowing studies [34], which would eliminate ambiguities and misinterpretations.

1.7 Fluoroscopy in the pediatric setting examination

CT is not a favored modality in pediatrics settings since dose quantities are a major issue. Pediatric examinations may include fluoroscopic small bowel series, diagnostic and/or therapeutic barium enemas (for example, to evaluateHirschsprung's Disease), voiding cystourethrograms, and more "interventional" therapeutic applications, such as the acute reduction of an ileocolic intussusception or enlargement of the ileocolic intussusception. [35] These operations should be performed by residents and accompanying personnel who are qualified. Several examples are given:

1.7.1 Barium meal

Barium Meal is an x-ray examination of the upper gastrointestinal tract. It involves swallowing a liquid contrast called barium, which coats the lining of the esophagus (gullet), stomach and small intestine so that it can be seen on x-rays.]An x-ray of the route from the mouth to the stomach is called a Barium Swallow (pharynx and the esophagus).

- You must not eat or drink anything from 8 p.m. the night before the examination until it is over.
- No medicines should be taken on the day of the exam.
- If you are going to an appointment.
- Children are not permitted to be left alone in the waiting room.
- Please inform the Technologist if you have any allergies or if you think you might be pregnant.

Children Under 12

- May eat and drink in the evening.
- Not to eat or drink in the morning.

Newborn - 2 Years

- Nothing to eat or drink three hrs. Prior to exam, time.
- Children with diabetes should fast two hrs. Prior to the exam. [37]

1.7.2 Maturating Cystourethrogram (MCUG)

This is a unique x-ray that shows the bladder, the urethra (the tube that connects the bladder to the kidneys), and thetubes that connect the kidneys to the bladder (ureters).

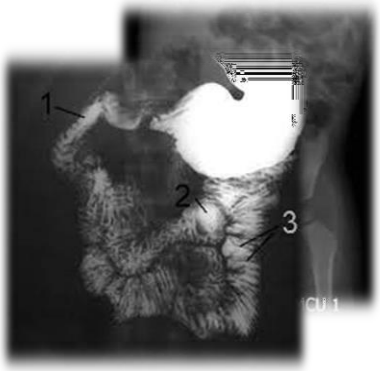


Figure 8 Cystourethrogram (MCUG)

The kidneys produce urine. Urine goes through the ureters and into the bladder, where it accumulates. When the bladder is full, it contracts, causing urine to flow down the urethra and out of the body. As the bladder fills and empties, the MCUG test will reveal any anomalies. It will reveal if urine flows normally or whether it flows in the wrong direction, upwards from the bladder to the kidneys. The condition of urine running upwards is known as vision-ureteric reflux (VUR or reflux of the kidneys).

1.7.3 Barium Enema

An X-ray exam called a barium enema is used to detect changes or abnormalities in the large intestine (colon). A colon X-ray is another name for thetechnique. [38]

An enema is a procedure in which a liquid is injected into your rectum using a tiny tube. The liquid in this scenario contains a metallic ingredient (barium) that covers the colon lining. Normally, an X-ray picture of soft tissues is weak, but the barium coating results in a distinct silhouette of the colon.

During a barium enema exam, air may be pumped into the colon. The air expands the colon and improves the quality of images. This is called an air-contrast (double- contrast)

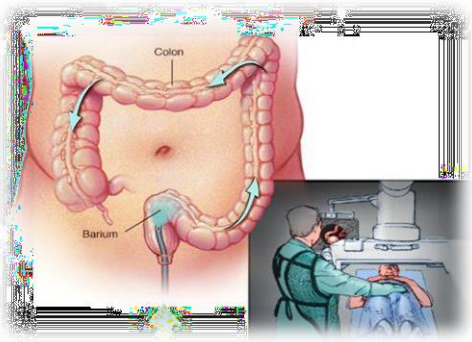


Figure 9. Barium Enema

1.7.4 Video fluoroscopy

In addition to clinical history and bedside evaluation, video fluoroscopy (VFS) or modified barium swallow has been deemed the instrumental test of choice in the study of swallowing over the last 10 years. Donner and Siegel proposed the use of cineradiography to examine swallowing in 1965, recognizing its utility in the study of dysphagia induced by neuromata diseases. Since then, this approach has been re- elaborated and enhanced, most notably by Loge Mann, who has made significant contributions to our understanding of the physiopathology of swallowing, with significant implications for the diagnosis and treatment of dysphagia. The examination, which consists of recording fluoroscopic images that appear on the monitor during the patient's intake of a radio-opaque bolus, allows for a precise assessment of not only the morphological features but also, and most importantly, the Dynamics of the swallowing act, including its three phases: oral, pharyngeal, and esophageal. [40]

1.8. Risks

There is a chance that some material will travel down the incorrect way during video fluoroscopy (aspiration). All precautions will be made to reduce the likelihood of this happening and the amount of material that may end up in the incorrect place. We will also try to keep the quantity of x-ray radiation you are exposed to to a minimum. The use of 'contrast' (a specific liquid that shows up on x-ray) during the process is normally without complications, but please let us know if you feel poorly during or after the procedure.

1.9 Radiation dose and biological effects

The dose-area product (DAP) or the entry skin dose can be used to describe a patient's radiation exposure (ESD). DAP is a measure of the overall quantity of radiation released from the equipment towards to the patient and is calculated by multiplying the amount of drug in air by the area of the beam. The effective dose, which characterizes stochastic risk such as radiation-induced cancer, might be calculated using DAP. Cardiac catheterization operations, for example, have been reported to provide DAP of around 60 Gy/cm2, resulting in an effective dose of approximately 12 most [40]. ESD is used to assess the likelihood of deterministic consequences like skin lesions. For coronary procedures, an ESD of 1 - 2.5 Gy has been recorded [41].

DAP of around 60 Gy/cm2 has been observed during cardiac catheterization operations, resulting in an effective dose of roughly 12 mSv [39]. ESD is used to Assess the possibility of deterministic consequences like skin lesions. In coronaryprocedures, an ESD of 1-2.5 Gy has been documented [41].

1.10 EQUIPMENT FACTORS

Modern fluoroscopy technology allows the operator to alter the picture quality and radiation dose to meet the specific demands of the examination. Automatic brightness control (ABC) ensures that the visual brightness on the display remains consistent. This is performed by automatically adjusting tube voltage and current to account for the patient's variable attenuation. There are at least two dosage levels available, and in most cases, the low-dose mode provides sufficient picture quality [44, 45].

Cine-runs can also benefit from the low-dose strategy. It is best to begin fluoroscopy with a low-dose mode and then transition to a higher radiation level if needed. The ABC may not function properly during exams of the patient's peripheral regions, resulting in "image flare." Manual exposure parameter adjustment or technique locking of the ABC to a desired setting is advised in these instances. If radiation-opaque items must

be added into the imaging field, technique-lock must be used. It is occasionally possible to select the ABC's operating mode. The tube power is increased more than the stream as the patient thickness grows if low dosage is a priority. The increased tube voltage will result in a modest loss of picture contrast, particularly in soft tissue. The tube current might be raised higher than the tube voltage in instances when picture contrast is critical (Figure 1). Because a low dosage is preferred for pediatrics usage, pediatrics mode (if available) will offer a slightly greater tube voltage for thin individuals.

Theoretical studies [46] have indicated that utilizing a combination of reduced tube voltage and enhanced filtration in pediatrics tests can reduce dosage (0.2 mm Cu). With today's generators, however, this is tough to do. Proper ABC algorithms and the employment of the appropriate mode are thus critical for both patient dosage (factor 2) and picture quality [47]. Because it is not assured that these elements can be readily altered on the equipment, it is critical to consider them at the equipment's commissioning.

Pulsed fluoroscopy [48, 49], which releases radiation in brief pulses rather than continuous mode, is an effective means of reducing patient exposure while retaining picture quality. It is possible to select pulse rates as low as one per second. Lower pulse rates result in greater dosage reduction. To provide a constant flicker-free video display on the monitor, a digital picture memory and gap filling are utilized. The lack of temporal resolution is a downside of pulsed fluoroscopy. This is not, however, a huge issue with some training. Frame averaging is another technique for lowering patient dosage. In this scenario, the detector produces a sequence of frames that are averaged before being shown on the monitor. As a result, the noise in the given image will be reduced, allowing the dosage rate to be reduced without sacrificing image quality. The significant visual lag is a downside of adopting extensive frame averaging. For fluoroscopy, flat panel detectors have also been introduced. The great sensitivity to X- rays, extensive dynamic range, and strong contrast resolution of these detectors allow for the optimization of the examination procedure in terms of absorbed dosage and picture quality. When implementing these systems, it is critical to look for ways to reduce patient dosage while retaining adequate picture quality, rather than improving image quality when it is not needed [49]. Flat panel detectors have been found to minimize the patient dosage by 30%. The function of the equipment and the approach must be extensively evaluated in order to capitalize on these opportunities [50].

Modern image intensifier-based fluoroscopy systems are incredibly versatile devices that may be used in a variety of dynamic and static imaging modes. This versatility is accompanied by the fact that different imaging modes have varied dosage profiles, making dosimeter problematic. Fluoroscopy can be used in a variety of dynamic imaging modalities, including standard fluoroscopy, high-dosefluoroscopy, and traditional and digital cine fluoroscopy. These devices can also record static pictures, which can be analogue or digital (e.g., conventional photo spot images, digital photo spot images). The operator should be familiar with the relative dosage characteristics of the various imaging modes, and it is critical that these modes be correctly configured and maintained during the system's lifetime.

Although other parameters are significant, the receptor entry exposure rates and skin entrance exposure rates are the greatest indicators of a fluoroscopy system's radiation dose performance. Furthermore, exposure rates are affected by body thickness and operational parameters; as a result, some form of dynamic patient dose monitoring is becoming increasingly desirable during lengthy fluoroscopicprocedures. [51]

1.10.1 Receptor Entrance Exposure Rates

Possibly the most critical dosage performance characteristic is the receptor entrance exposure rate. The effective "speed" of the imaging system, or the quantity of radiation employed in picture production, is measured by receptor entry exposure. Because skin dose is reliant on and rises with increasing receptor entry exposure, and because image noise, and thus the perceptibility of low-contrast detail, is likewise dependent on it, the receptor entrance exposure is crucial.

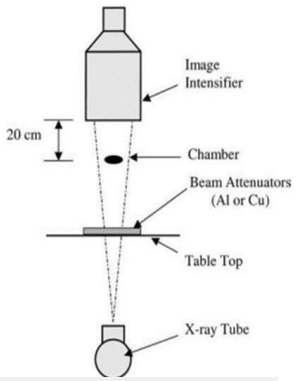


Figure 10. Setup for measuring receptor entranceexposure rates.

Despite the vital necessity of this parameter, no laws exist that limit receptor entry exposure rates, even though x-ray system manufacturers commonly set receptor entrance exposure values to comparable levels for related imaging modes [52]. The entry exposure at the surface of the image receptor (with the grid removed) necessary to create a single image for a certain x-ray spectrum is typically stated. To limit the backscatter contribution, the ionization chamber is located 20–30 cm from the image intensifier surface (with a fixed source–image intensifier distance of 100 cm) in the measurement geometry [53]. (Fig). The inverse square law is used to rectify the exposure rates to the image intensifier's entry surface. With the grid removed, the rates of receptor entry exposure are assessed [54]. However, it is often impractical to remove the grid from some systems, in which case the manufacturer-specified grid transmission factor can be used to correct for the presence of the grid [55].

In video fluoroscopy and other dynamic recording modes, a sequence of static pictures are acquired at a rate of 25–30 images per second. The ability to compare dynamic and static imaging modalities by expressing receptor entry exposure on a Per-image basis. [56] Of view for different fluoroscopic imaging modes at a peak kilo voltage of 80. For a bigger image intensifier (e.g., 30- or 40-cm field of view) operating in the 23-cm field of view mode, these numbers will be different. To put these figures in context, the equivalent number of radiographs and digital photo spot images [57] that can be produced due to the required receptor entrance exposure rates under the same exposure geometry and kilovolt peak are compared with the equivalent number of radiographs and digital photo spot images that can be produced due to the required receptor entrance exposure rates under the same exposure geometry and kilovolt peak.

1.10.2 Patient Doses for Typical Fluoroscopic Procedures

Patient dosages are determined by a variety of criteria, including machine characteristics, the patient's age, size, and body composition, and user settings, such as collimation, source-to-skin distance, and so on. The dosage rate to the patient is highest when the x-ray beam penetrates the body via the skin. For a medium-sized adult, the normal fluoroscopic entry exposure rate is around 30 mGy/min (3 rad/min) (since 10 mGy 1 rad); however, it is often greater in image-recording modes. Patient dosages during diagnostic and interventional procedures have been reported in a variety of studies [58].

When opposed to interventional treatments, diagnostic techniques under fluoroscopic control have much shorter fluoroscopic periods and lower entry skin doses. For interventional procedures, mean fluoroscopic durations are much greater [59]. This fact is clearly shown by [60], who used the PEMNET system to quantify radiation exposure in real time to patients undergoing diagnostic and interventional procedures. The average fluoroscopic exposure periods for diagnostic and interventional procedures were found to be significantly different: 4.7 minutes versus

21.0 minutes. The median doses for diagnostic and interventional procedures, respectively, were 1,350 mGy (135 rad) and 3,760 mGy (376 rad). Multiple views are employed during coronary angiography compared to fewer views during percutaneous Trans luminal coronary angioplasty procedures, hence the dosage appears to be larger than previously reported (29, 30). In addition, because of real- time exposure assessments and modifications for varying angulations and projections, the results are better. [61] Reported skin dose data from more than 500 Interventional neurologic radiology procedures collected using the PEMNET system. They looked at the data to see if certain treatments were likely to provide skin doses higher than those suggested for monitoring (1 Gy) or that were linked to radiation-induced skin damage (2 Gy) (3). The possibility for major erythema was predicted to be present in 6% of embolization operations and 1% of cerebral angiographic tests (entrance skin dose 6 Gy).

Rosenthal et al [62] used recorded fluoroscopic time and radiation output data to estimate radiation exposure during radiofrequency catheter ablation operations. More than 750 participants from nine different institutions took part in this trial. The average fluoroscopic time was 53 minutes, with a wide range (standard deviation 50 minutes). The dosage threshold for radiation skin damage (2 Gy) was surpassed in 22% of treatments, with estimated skin doses of 1,300 mGy 1,300 (130 rad 130)

MATERIAL AND METHODS:

2.1 Fluoroscopy

Is an imaging technique commonly used by physicians to obtain real-time images of the internal structures of a patient with a fluoroscope? It is used to visualize: organ motion ingested or injected contrast agent catheterized interventions (inserting stents, RF ablation,)

Fluoroscopy is a type of medical imaging that

shows a continuous X-ray image on a monitor, much like an X-ray movie. During a fluoroscopy procedure, an X-ray beam is passed through the body. The image is transmitted to a monitor so the movement of a body part or of an instrument or contrast agent ("X-ray dye") through the body can be seen in detail.
Fluoroscopes are most often used for:

- Intra-operative navigation
- Intra-operative referencing
- Target location Problems
- Very low contrast Image noise

2.2 Measurement Radiation dosimeter of fluoroscopy:

2.2.1 Dose-area product (DAP):

DAP-meters measure the product of radiation dose to air and the area of the X- ray field. DAP is expressed in Gy.cm2 or mGy.cm2.An ionization chamber larger than the area of the X-ray beam is placed just under the X-ray collimators. The DAP ionization chamber must intercept the entire X-ray field for an accurate reading; this quantity is proportional to EAP. The reading from a DAP-meter can be changed by either altering the X-ray technique factors (kVp, mAs or time), or varying the area of the field or both, various dosimeter quantities are used for patient dosimeter. Patient dose may be determined in different ways; however, regardless of the method used, DAP or alternatively EAP, or air karma must be available to the researcher. The diametric quantities can be computed by employing the radiographic parameters and The measured radiation output of the X-ray machine, or by using surface dose or dose-area product measurements of actual patient examinations.
Drinking a chalky-tasting liquid that contains barium. Barium is a substance that makes parts of your body show up more clearly on an x-ray.

2.2.2 Entrance Surface Dose (ESD):

The entrance surface dose or entrance skin dose (ESD) is the measure of the radiation dose [mGy] that is absorbed by the skin of a patient. Entrance skin dose includes backscatter, should include (or estimate) the attenuation and is either directly measurable using dosimeters or can be calculated using the modality related dose parameters
However, ESD is a poor indicator of radiation risk, as it does not account for tissue sensitivity, penetration and exposed field size. Since ESD does not include the exposed field size, ESD is a better surrogate parameter for estimating the risk of deterministicskin reactions, provided the position of the radiation field on the skin does not change.

2.3 Examination radiation dose of fluoroscopy:

2.3.1 Barium enema:

A barium enema is an X-ray exam that can detect changes or abnormalities in the large intestine (colon). The procedure is also called a colon X-ray.
An enema is the injection of a liquid into your rectum through a small tube. In this case, the liquid contains a metallic substance (barium) that coats the lining of the colon. Normally, an X-ray produces a poor image of soft tissues, but the barium coating results in a relatively clear silhouette of the colon.
During a barium enema exam, air may be pumped into the colon. The air expands the colon and improves the quality of images. This is called an air-contrast (double- contrast) barium enema.

2.3.2 Barium meal:

A barium meal is a diagnostic test used to detect abnormalities of the esophagus, stomach and small bowel using X-ray imaging. X-rays can only highlight bone and other radio-opaque tissues and would not usually enable visualization of soft tissue. However, infusion of the contrast medium barium sulfate, a radiopaque salt, coats thelining of the digestive tract, allowing accurate X-ray imaging of this part of the abdomen.

- Contrast Media
- Double -contrast esophageal: This is a carbonated drink, which includes swallowing dry effervescent crystals followed by a sip of water. Alternatively, the water and crystals may be mixed and swallowed together; however, mixing prior to drinking may allow a significant amount of the carbon dioxide to escape before ingestion. Instruct the patient not to burp despite the sensation todo so.
- A single contrast barium enema is the density of the barium or water-soluble contrast. If it is too dense, then not only will the fluoroscopic tube "burn out" the background image and obscure overlapping loops, it will also obscure smaller (and sometimes large!) colonic lesions
- Oral Contrast Materials
  Barium-sulfate contrast materials that are swallowed or administered by mouth (orally) are used to enhance standard x-ray, fluoroscopy, and CT images of the gastrointestinal (GI) tract, including:
- pharynx
- esophagus
- stomach
- the small intestine
- the large intestine (colon)

In some situations, iodine-based contrast materials are substituted for barium-sulfatecontrast materials for oral administration.

- Rectal Contrast Materials
  Barium-sulfate contrast materials that are administered by enema (rectally) are used to enhance standard x-ray, fluoroscopy, and CT images of the lower gastrointestinal (GI) tract (colon and rectum). In some situations, iodine-based contrast materials are substituted for barium-sulfate contrast materials for rectal administration.
- Intravenous Contrast Materials Iodine-based and Gadolinium-based
  Iodine-based contrast materials injected into a vein (intravenously) are used to enhance x-ray (including fluoroscopic images) and CT images. Gadolinium injected into a vein (intravenously) is used to enhance MR images. Typically, these are used to enhance:
- internal organs, including the heart, lungs, liver, adrenal glands, kidneys,pancreas, gallbladder, spleen, uterus, and bladder
- gastrointestinal tract, including the stomach, small intestine and largeintestine
- arteries and veins of the body, including vessels in the brain, neck, chest,abdomen, pelvis and legs
- soft tissues of the body, including the muscles, fat and skin
- features in the brain
- features in the breast
- Micro bubble Contrast Materials

Micro bubble contrast materials are tiny bubbles of an injectable gas held in a supporting shell. They are extremely small—smaller than a red blood cell—and have a high degree of "echogenicity", or ability to reflect ultrasound waves. Structures with higher echogenicity will appear brighter on ultrasound. Once the micro bubbles are in the bloodstream, ultrasound technology is able capture differences in echogenicity between the gas in the micro bubbles and the surrounding tissues of the body, producing an ultrasound image with increased contrast. The micro bubbles dissolve, usually within 10 to 15 minutes, and the gas within them is removed from the body through exhalation. Contrast-enhanced ultrasound with micro bubbles is a convenient, relatively inexpensive way to improve visualization of blood flow, and it does not use radiation. It is a useful option for patients with kidney failure or those with allergies to contrast agents used for MR and/or CT imaging.
Micro bubble contrast materials can be targeted or untargeted. Untargeted contrast- enhanced ultrasound —the more common method— helps diagnose certain diseases by providing evaluation of blood flow in the heart and other organs. In targeted contrast-enhanced ultrasound, specific molecules are bound to the surface of the micro bubbles. After injection, the micro bubbles attach to specific targeted tissue sites, causing an increase in the ultrasound signal at the sites.
Contrast-enhanced ultrasound with micro bubbles is used in the assessment of:

- blood perfusion in organs
- thrombosis, such as in myocardial infarction
- abnormalities in the heart
- liver and kidney masses
- inflammatory activity in inflammatory bowel disease

2.3.3 Cystourethrogram (MCUG)

In some children, an abnormality in the valve or the ureters allows urine to flow backwards, a condition called VU reflux. In mild cases, urine backs up into the lower ureter. In severe cases, it can back up into the kidney. Usually, children with this condition are born with it. Other causes include:

- bladder obstruction
- abnormal urination with very high pressure within the bladder
- incomplete emptying of the bladder
- therapy treatment response

2.4. Study objectives/ Amis:

In dose and risk estimation in abdominal DF scan for pediatric patients. Aims/ Assessment radiation dose by (DAP, effective dose). Risk estimation of radiation dose in DF scan. Compare radiation dose with national and international ICRP.

2.5. Study Area:

The study was conducted in the DF unit in radiology department in Maternity and Children Hospital Makah. The study will be done at Maternity Children Hospital in Mecca City on children stratified by ages 1-6, and 12 years old for children. Will be measurement of the (DAP - KAP-MAS - effective dose) performed by. (Dose Management System collected by Dose Watch automatically collects and analyzes radiation and contrast dosage data across facilities, modalities, and manufacturers within your imaging network to enable compliance. These automatic tracking capabilities make it easy to access a wide range of

data to ensure low dosage strategies data for patients.

2.6. Study Subjects:

This study represents a method for Data will be collected via fluoroscopyexamination unit team on X-ray scanners that represent pediatrics at radiosensitive organs. An effective dose will be measured from organ doses by dose watch and then presented in tables classified according to stratified age groups. Other detailed filtering methods will be analyzed and comparison with other data will be performed, and other different comparison methods will be used.

2.7. Study Design:

The methodology used was a retrospective study by utilizing the software (Dose Watch) and phantoms. Screening Dose Watch) and phantoms are recorded as numerical reading making it straightforward to collect large amounts of information for statistical analysis without any requirement to quantify outcomes. The quantitative method was deemed more suitable in this instance as the process can be easily reproduced in the future. It is also useful as there is a measurable objective for this service evaluation. The trust audit panel reviewed the proposal and study design In addition, along with the trusts research department, gave consent to proceed with the service review. As this was a service evaluation in nature, it did not require full ethical consideration, as there would be no retrospective change to patient management.

2.8. Sample Size:

120 pediatric patients enrolled in the Maternity and Children Hospital in Makah for children aged 1-6, and 12 years for children who were randomly selected from different pediatrics age groups and mixed gender.) In the study from January 2022 to February 2022.

2.9. Data Management and Analysis Plan:

The collected data will be exported from Dose Watch software to Microsoft Excel and then will be imported to the SPSS software for continuous variables will be presented, and dose distributed. Figures and tables will be used to represent the result.

2.10. Institutional Review Board (IRB)/Ethical Board Approval The study protocol submitted to the Ethical Review Committee of Maternity and Children Hospital Makah. - Ministry of Health. In addition, each subject will give written informed consent.

2.11. Statistical analyses:

Continuous variables were presented as mean and standard deviation if are normally distributed or median and interquartile range if their distribution is skewed. Student'st-test will be implemented to test for differences between the various characteristics among cases and control, where applicable, or Mann–Whitney test will be used if theassumptions of the t-test will not be met. A chi-square test will be used for comparisons between categorical variables. Simple and multiple logistic regression analyses will be used for the estimation of the crude and adjusted odds ratios. All statistical calculations will be performed using SPSS (version 21.0.)

RESULTS AND DISCUSSION:

3.1 Quality Control:

Before the results are studied and analyzed, we must work quality control in order toensure that all readings, results and radiation doses are correct before giving the doseto the patient.

Quality control (QC) is an integral part of quality assurance it involves specific actions designed to keep measurable aspects of the process involved in manufacturing a product (image) or providing a service within specified limits. QC issummarized in four principal steps.

- Acceptance testing to detect defects in equipment that is newly installed or has undergone major repair.
- 2- Establishment of baseline performance of the equipment-commissioningcommissioning test). 3
- - Detection and diagnosis of changes in equipment performance before they become apparent in images.
- 4- Verification that the causes of deterioration in equipment performancehave been.

Table1: Typical patient entrance skin exposure rates (ESER) 10 cm:

Radiation Protection Assessment

	1st x-ray Control Panel	
1	There is visible light on 'prepare' and 'expose'	Yes
2	If more than one tube is used from the panel, the tube selector switches should be labeled	Yes
3	Panel indicators are functioning correctly	Yes
4	Control buttons are functioning correctly	Yes
5	The radiographer has a clear view of the table and chest stand from the panel	Yes
6	Tube overload protection circuit is working properly	Yes
	2nd Protective Equipment	
1	Protective clothes and devices are in good condition	Yes
2	Protective clothes are at least 0.25 mm Pb equivalent	Yes
3	Protective clothes are checked annually	Yes
4	Inspection records are kept .	Yes
5	Protective dosimetry reports are satisfactory	Yes
6	Record of the tube maintenance and faults book are available	Yes
7	'Local Rules for Radiographers' sheet is available	Yes
	3th Physical Inspection	
1	Focal spot indicator is present	Yes
2	Source to image Distance Indicator Present	Yes
3	Source to image Distance Indicator Accurate	Yes
4	If filters can be removed there should be a visible indicator of filter absence	Yes
5	Tube perpendicularity indicator is present	Yes
6	Tube angulation indicator is present	Yes
7	Locking devices are effective.	Yes
8	The light beam is switched off automatically	Yes
9	The diaphragm can be closed completely.	Yes
10	Tubeheads and supports are smooth and easy to use	Yes
11	Cable coverings are intact	Yes

Table2: Typical patient entrance skin exposure rates (ESER) 17.5 cm

Detector to Image Receptor Distance = 100 cm

Magnification	Operation Mode	mA	Kv set	kV read	Accuracy %	Dose /s µGy/s
Normal	Low Fluoro	0.9	63	62.9	-0.001	0.025
	medium	1.2	63	63.2	0.003	0.033
	High Fluoro	2.7	63	64.9	0.030	0.077
	Acquisition		81	80.3	0.012	1.22
Magnification 1	Low Fluoro	1.3	66	66.7	0.010	0.043
	medium	1.7	68	68.6	0.008	0.582
	High Fluoro	3.2	73	72.5	-0.006	0.125
	Acquisition		81	80.2	-0.009	1.68
Magnification 2	Low Fluoro	3.2	73	72.8	-0.002	0.069
	medium	2.1	73	72.9	-0.001	0.088
	High Fluoro	3.2	81	81.9	0.011	0.192
	Acquisition		81	80.3	-0.008	3.04
Magnification 3	Low Fluoro	1.3	76	77.1	0.014	0.086
	medium	2.3	76	77.6	0.021	0.121
	High Fluoro	3.8	86	88.2	0.025	0.278
	Acquisition		81	80.4	-0.007	4.52

Table 3: radiographic half value layer

SID = 100 cm For 17.5cm PMMA no Anti scatter Grid

Detector to Image Receptor Distance = 100 cm

Magnification	Operation Mode	mA	Kv set	kV read	Accuracy %	Dose /s µGy/s
Normal	Low Fluoro	1.8	77	79.1	0.027	0.100
	medium	2.4	77	77.1	0.001	0.120
	High Fluoro	1.7	86	87.8	0.020	0.270
	Acquisition		81	80.2	-0.009	155.5
Magnification 1	Low Fluoro	2.4	84	85.2	0.014	0.155
	medium	2.4	84	86.3	0.027	0.211
	High Fluoro	3.2	85	87.6	0.030	0.410
	Acquisition		81	80.3	-0.008	7.52
Magnification 2	Low Fluoro	3.3	90	94.1	0.045	0.256
	medium	3.4	95	98.9	0.041	0.320
	High Fluoro	3.4	110	112.7	0.024	0.545
	Acquisition		81	80.4	-0.007	8.64
Magnification 3	Low Fluoro	4.2	110	101.3	-0.007	0.330
	medium	3.7	105	107.6	0.024	0.436
	High Fluoro	4.1	105	113.2	0.078	0.542
	Acquisition		81	80.4	-0.007	11.34

Radiographic Half Value Layer (HVLs)

Focal spot chamber distance :100cm	kV :96	mAs :0.3

Exposure (mGy)E_0	0.514	Filtration (mm)	0
$E_0/2$	0.257		
Exposure reading (Ea)that is greater than $E_0/2$ (mGy)	0.408	Corresponding Thickness T_a	1
Exposure reading (E_b)that is less than $E_0/2$ (mGy)	0.221	Corresponding Thickness T_b	4

HVL (mmAl)	3.25
Result	PASS

Results : HVL = 3.25 .mm Al .
Criteria : HVL $\geq$ 2.8 mm Al .

Image Quality

Focal spot chamber distance :100cm	kV :	mAs :

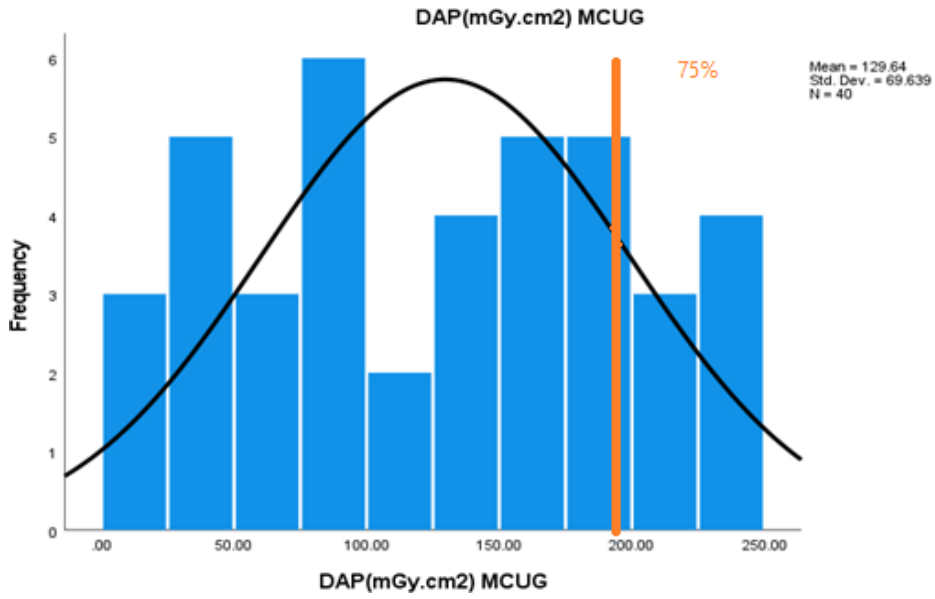
Low contrast	12
Dynamic range	6
Resolution	2.2

3.2 Analysis data:

Using SPSS software for data analysis depends on the Frequency of doses. After that, using descriptive statistics, calculate the mean, median, and 75th percentile.

Data Collection: The examinations were chosen based on an estimate of the number of studies carried out in the radiology, so collected data from 1 Sep. 2021 to 1 May 2022 by Dose watch software. This data is received from a DF scan machine, and then exported to an Excel sheet. The basis for number at 40 patients.

- the relationship between DAP and Frequency for MCUG exam; the medianwas 134.4 mGy.cm The 25%, 50th, and 75th percentiles, respectively (72.4 – 134.4 -194.6) mGy .cm and Std deviation was 69.6 See a graph1
  In a chart 1 the linear of DAP with No. of patients, the equation is (y=3.652x + 0.1263) and (R-squared value = 0.989)



Graph 1

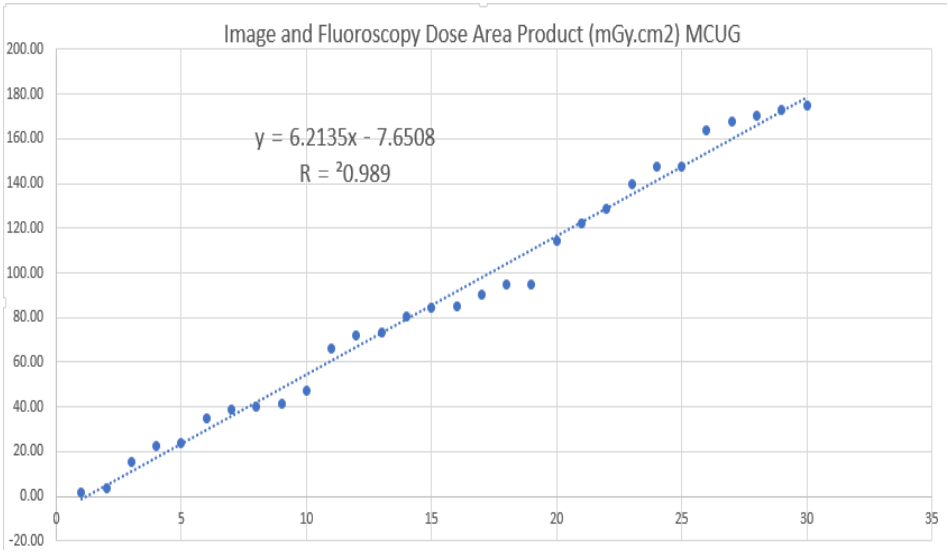
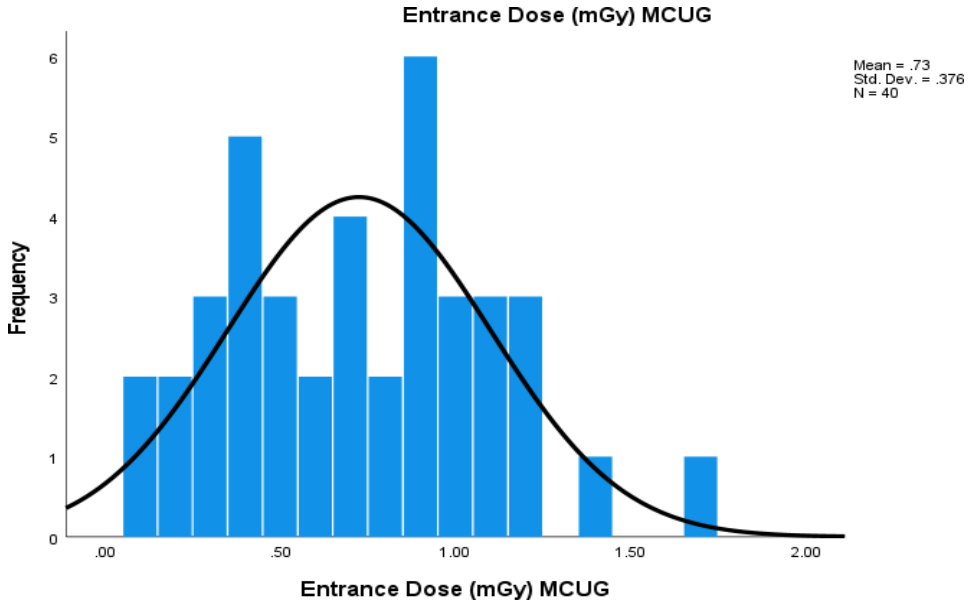


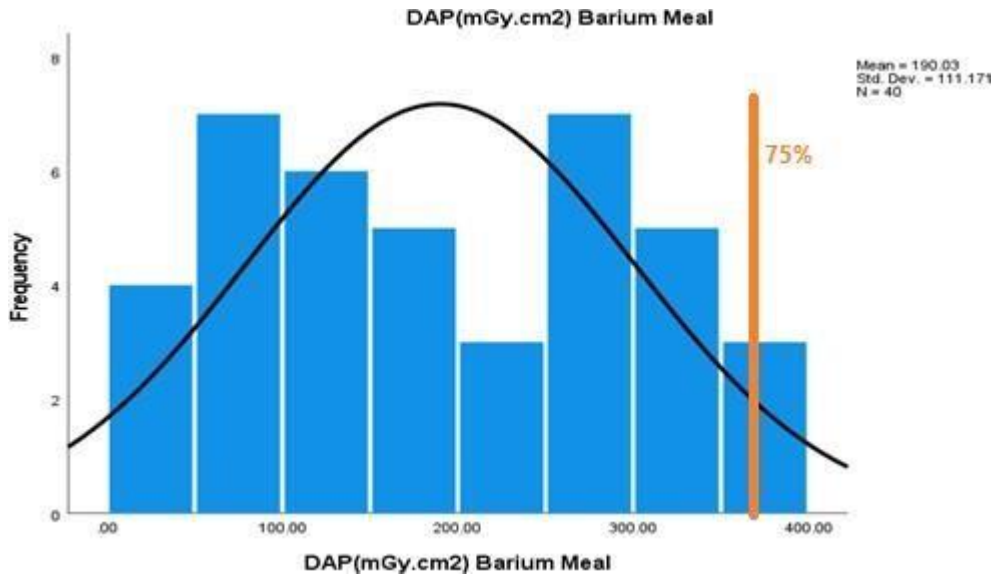
Chart 1

The relationship between (Entrance dose (ESR) and Frequency of MCUG; the median was 0.70 mGy.cm the 25%, 50th, and 75th percentiles, respectively (0.40 – 0.70- 1.00) mGy .cm and STD deviation was 0.376 See a graph 2



Gaph.2

- the relationship between DAP and Frequency for Barium meal exam; themedian was 182.40mGy.cm The 25%, 50th, and 75th percentiles, respectively (78.42-182.4-277) mGy .cm and Std deviation was 111.17 See a graph 3 In a chart 2 the linear of DAP with No. of patients, the equation is (y=9.474 x + 4.1931) and (R-squared value = 0.9926)



Graph 3

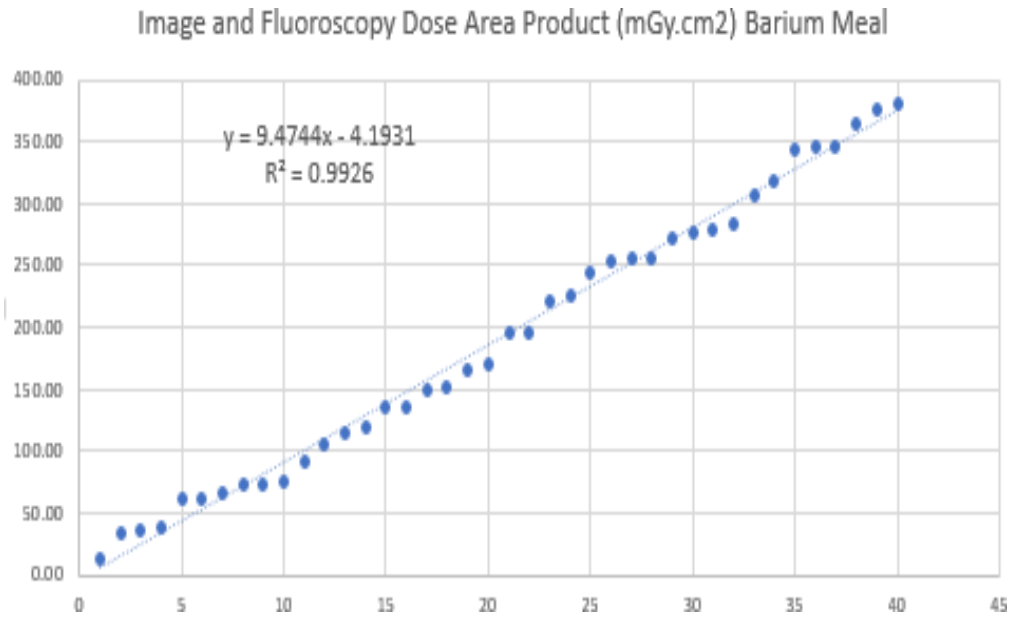
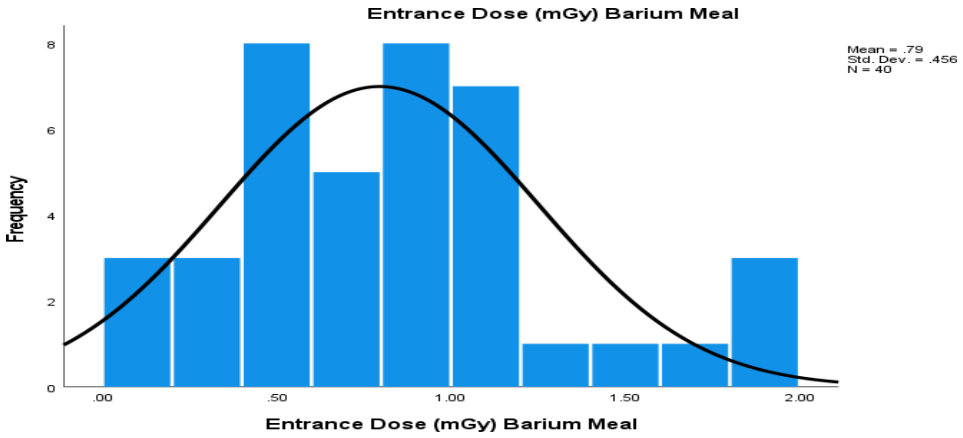


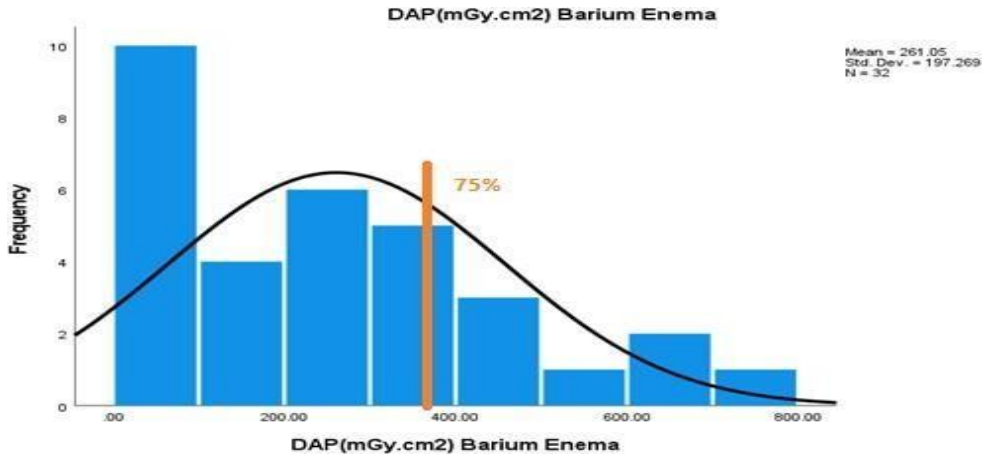
Chart 2



Graph 4

The relationship between (Entrance dose (ESR) and Frequency of barium meal exam; themedian was 0.80 mGy.cm the 25%, 50th, and 75th percentiles, respectively (0.42 – 0.80-1.00) mGy .cm and Std deviation was 0.45 See a graph 4

- the relationship between (DAP) and Frequency of barium enema exam ; the median was 218 mGy.cm The 25%, 50th, and 75th percentiles, respectively (94– 218 -362) mGy .cm and Std deviation was 197.2 See a graph 51 In a chart 3.8 the linear of DAP with No. of patients, the equation is (y=3.652 x + 0.1263) and (R-squared value = 0.989)



Graph5

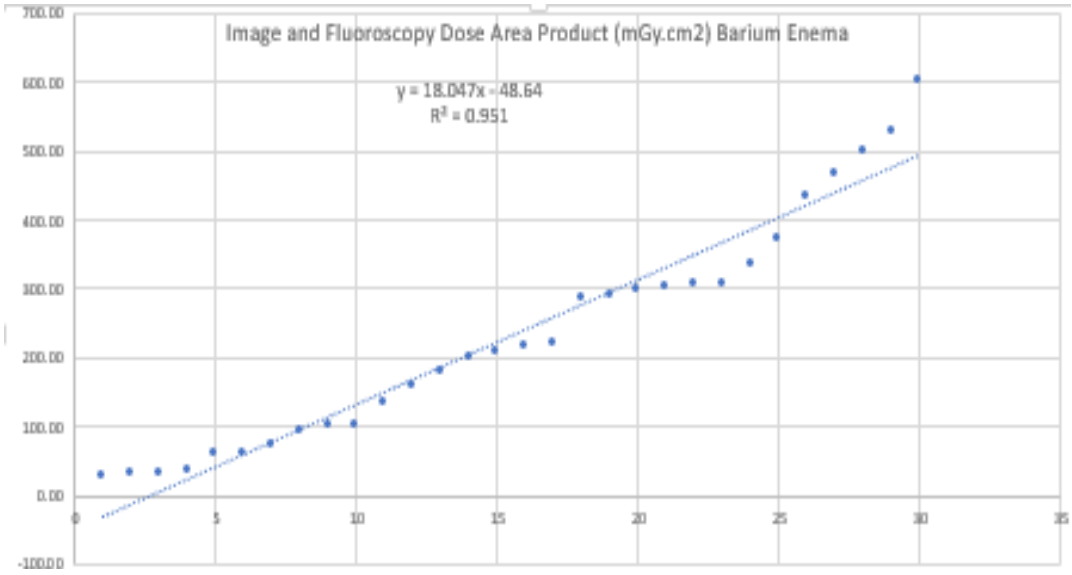
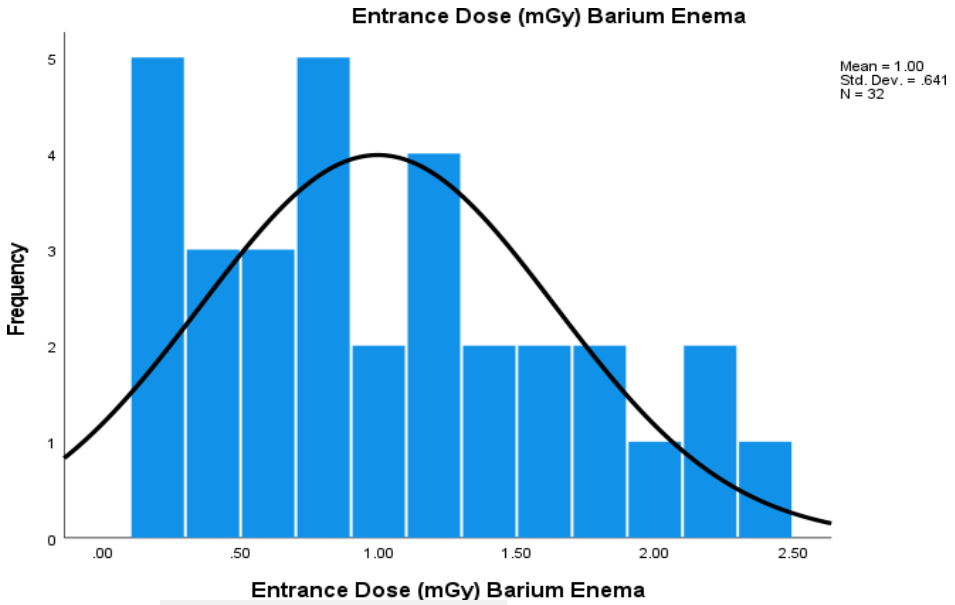


Chart 3

- the relationship between the (ESR)(entrance dose) and Frequency for Barium enema exam; the median was 0.85mGy.cm The 25%, 50th, and 75th percentiles, respectively (0.42-0.85.4-1.47) mGy .cm and Std deviation was 0.64 See a graph 6 In a chart 3 the linear of DAP with No. of patients, the equation is (y=3.652 x + 0.1263) and (R-squared value= 0.989)



Graph 6

3.3Assess radiation doses with international diagnostic referencelevels (NPDD -ICRP – IAEA)

All Results of patient dose assessment for the most commonly performed radiological examination of children are presented in this study. There are considerable variations in the assessed dose levels, depending on the examination type The National Patient Dose Database (NPDD) is maintained the NPDD, national reference doses for common X-ray examinations are based on third quartile values ofthe mean patient doses observed in a nationally representative sample of X-ray rooms (NPDD, IAEA, and ICRP respectively (Table 4- Table 5- Table 6)

Comparison of KAP values in the present study and results obtained in other similarstudies for three types of fluoroscopy examinations and four age groups

Table 4. National reference doses for diagnostic examinations on pediatric patients National Patient Dose Database (NPDD) UK.—2005 review

Examination	Standardage (year)	DAP per examination (Gy cm2	No. of rooms
	0	0.3	53
	1	0.7(0.8)	59
	5	0.8(0.8)	58
	10	1.5	44
	15	2.5	30
Barium meal	0	0.4	16
	0	0.4	25
	1	1.1(1.2)	20
	5	1.3(1.2)	22
	15	6.4	25
Barium swallow	0	0.4	26
	1	1.2(1.3)	40
	5	1.3(1.3)	36
	10	2.9	41
	15	3.5	40

Table 5:Table 6 national reference doses for fluoroscopy examinations on pediatrics patients –2005 review from the (book ICRP PUBLICATION 121)

Examination type	Standard age (years)	Dose area product perexamination (Gy cm^2)
Maturating cystourethrogram	0	0.3
	1	0.7 (0.8)
	5	0.8 (0.8)
	10	1.5
	15	2.5
Barium meal	0	0.4
	1	1.1 (1.2)
	5	1.3 (1.2)
	10	2.4
	15	6.4
Barium swallow	0	0.4
	1	1.2 (1.3)
	5	1.3 (1.3)
	10	2.9
	15	3.5

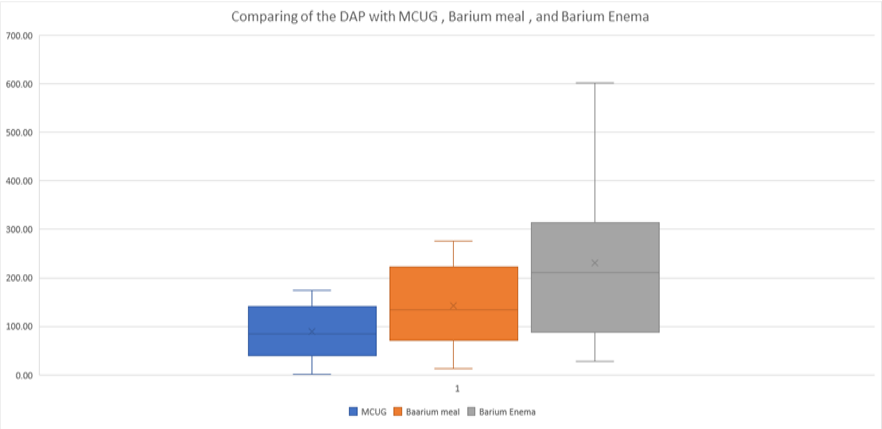
TABLE 6: COMPARISON OF THE UNITED KINGDOM'S REFERENCE DOSES

(2005 AND 2000) FOR PAEDIATRICS AND DIAGNOSTIC REFERENCE LEVELS AT GREAT ORMOND STREET HOSPITAL[37, 89, 106] by IAEA

Examination	Age (a)	2005 national reference doses (cGy □ cm^2)	2000 review kerma area product per exam (cGy□ cm^2)	Great Ormond Street Hospital diagnostic reference level (cGy □ cm^2)
Maturating cyst urethrogram	0	30	40	5
	1	70	100	5
	5	80	100	10
	10	150	210	42
	15	250	470	42
Barium meal	0	40	70	8
	1	110	200	8
	5	130	200	12
	10	240	450	32
	15	640	720	32
Barium swallow	0	40	80	8
	1	120	150	8
	5	130	150	12
	10	290	270	32
	15	350	460	32

3.4 Discussion:

It is noted that in cases the DAP of the barium enema exam higher than Comparedto the MCUG and Barium usually lasts about 20 to 30 minutes but you may be at the hospital longer, Because of the presence of the intestines and digestive systemmeal .see this graph 7



3.5 CONCLUSIONS:

It is important that protocols in digital radiography be specific to the imaging required, and use no more radiation than what is needed to achieve a satisfactory diagnosis.8 In comparison with studies previously reported in the literature, the current study presents reduced radiation dose to children during fluoroscopic examinations with the use of a digital radiography machine. It is necessary, however, to periodically monitor radiation doses in order to reduce the radiation burden on these patients Diagnostic reference levels are recommended as an optimization tool for radiation dose assessment in medical imaging procedures involving the utilization of radiation. The justification of current local practice and dose optimization in pediatric DF is achieved by reviewing the scanning parameters, which can be divided into exposure setting and protocol exam, it is important that protocols in digital radiography be specific for pediatric patients. In digital imaging systems, selection of optimal exposure factors and the use of adequate copper filters results in the reduction of radiation doses to patients without sacrificing diagnostic value.

3.6 Study limitations:

The limitations are the sample size is not large as well as the generalize ability of the study area not represent the whole of the Saudi population. Another study is needed with a large sample size from a different region in Saudi Arabia to examine the same factors in this study. Analysis data Collected data from DF scan and software.

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Appendix

Analysis data for patient age 0 to 14 years for (Barium Swallow and Meal, mcug)

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2022-04-25	XR Barium Enema	0.20060999999999998	2021-07-03 00:00:00.0	[0-5]	MALE	371.50	371.50	225.00	15.00	1.50	1.50
2022-04-22	XR Gastrografin Enema	1.053208	2018-11-15 00:00:00.0	[0-5]	FEMALE	2568.80	2568.80	360.00	11.00	3.80	3.80
2022-04-19	XR Barium Enema	0.085752000000000001	2022-04-18 00:00:00.0	[0-5]	MALE	158.80	158.80	178.00	8.00	1.20	1.20
2022-04-11	XR Barium Enema	0.03834	2022-04-05 00:00:00.0	[0-5]	MALE	71.00	71.00	54.00	6.00	0.50	0.50

2022-03-24	XR Barium Enema	0.268812	2021-04-07 00:00:00.0	[0-5]	MALE	497.80	497.80	171.00	8.00	1.80	1.80
2022-03-21	XR Barium Enema	0.031211999999999997	2022-03-01 00:00:00.0	[0-5]	FEMALE	57.80	57.80	53.00	11.00	0.40	0.40
2022-03-20	XR Barium Enema	0.322036	2016-02-17 00:00:00.0	[6-10]	MALE	1238.60	1238.60	276.00	14.00	3.40	3.40

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2022-03-16	XR Barium Enema	0.324864	2021-08-04 00:00:00.0	[0-5]	MALE	601.60	601.60	105.00	10.00	1.90	1.90
2022-03-08	XR Barium Enema	0.178021999999999	2020-12-01 00:00:00.0	[0-5]	FEMALE	434.20	434.20	62.00	11.00	1.40	1.40
2022-03-07	XR Barium Enema	1.066624	2012-05-10 00:00:00.0	[6-10]	FEMALE	4102.40	4102.40	227.00	18.00	6.10	6.10
2022-03-06	XR Barium Enema	0.216767000000000002	2017-09-02 00:00:00.0	[0-5]	MALE	528.70	528.70	85.00	11.00	1.60	1.60
2022-02-27	XR Barium	0.949273	2017-04-29 00:00:00.0	[0-5]	FEMALE	2315.30	2315.30	399.00	17.00	5.00	5.00

	Enema										
2022-02-20	XR Barium Enema	0.165564	2022-02-18 00:00:00.0	[0-5]	MALE	306.60	306.60	208.00	23.00	2.10	2.10
2022-02-13	XR Barium Enema	0.157032	2021-05-27 00:00:00.0	[0-5]	FEMALE	290.80	290.80	123.00	6.00	0.80	0.80
2022-02-08	XR Barium Enema	0.880639	2017-03-11 00:00:00.0	[0-5]	FEMALE	2147.90	2147.90	203.00	8.00	5.80	5.80
2022-02-06	XR Barium Enema	0.0158759999999999998	2022-01-21 00:00:00.0	[0-5]	FEMALE	29.40	29.40	47.00	12.00	0.20	0.20
2022-01-23	XR Barium	0.1116050000000001	2011-12-15	[6-10]	MALE	656.50	656.50	207.00	11.00	1.70	1.70

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2022-01-23	XR Barium Enema	0.220792000000000002	2015-03-16 00:00:00.0	[6-10]	FEMALE	849.20	849.20	220.00	12.00	2.90	2.90
2022-01-12	XR Barium Enema	0.117588	2018-03-08 00:00:00.0	[0-5]	FEMALE	286.80	286.80	50.00	7.00	1.00	1.00
2022-01-09	XR Barium Enema	0.111564	2021-05-27 00:00:00.0	[0-5]	FEMALE	206.60	206.60	110.00	6.00	0.70	0.70
2022-01-04	XR Barium Enema	0.159624	2022-01-02 00:00:00.0	[0-5]	MALE	295.60	295.60	257.00	11.00	1.20	1.20

2022-01-04	XR Gastrografin Enema	0.107136	2021-08-04 00:00:00.0	[0-5]	MALE	198.40	198.40	96.00	8.00	0.60	0.60
2021-12-20	XR Barium Enema	0.18063	2021-02-28 00:00:00.0	[0-5]	FEMALE	334.50	334.50	80.00	7.00	1.10	1.10
2021-12-19	XR Barium Enema	0.09061	2020-06-02 00:00:00.0	[0-5]	FEMALE	221.00	221.00	103.00	8.00	0.80	0.80
2021-12-12	XR Barium Enema	0.250938	2021-08-01 00:00:00.0	[0-5]	FEMALE	464.70	464.70	281.00	13.00	2.30	2.30
2021-12-01	XR Barium	0.072036	2021-08-01	[0-5]	FEMALE	133.40	133.40	25.00	6.00	0.60	0.60

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2021-11-23	XR Barium Enema	0.015120000000000001	2021-10-10 00:00:00.0	[0-5]	FEMALE	28.00	28.00	57.00	9.00	0.20	0.20
2021-11-21	XR Barium Enema	0.04995	2021-10-28 00:00:00.0	[0-5]	MALE	92.50	92.50	37.00	11.00	0.30	0.30
2021-11-09	XR Barium Enema	0.018576	2021-10-09 00:00:00.0	[0-5]	MALE	34.40	34.40	27.00	10.00	0.20	0.20
2021-11-04	XR Barium Enema	1.163744000000001	2019-03-23 00:00:00.0	[0-5]	MALE	2838.40	2838.40	302.00	12.00	8.30	8.30

2021-11-03	XR Gastrografin Enema	0.016416	2021-11-02 00:00:00.0	[0-5]	MALE	30.40	30.40	31.00	7.00	0.20	0.20
2021-11-03	XR Barium Enema	0.024272	2019-03-23 00:00:00.0	[0-5]	MALE	59.20	59.20	13.00	1.00	0.20	0.20
2021-11-03	XR Gastrografin Enema	0.053406	2021-05-09 00:00:00.0	[0-5]	FEMALE	98.90	98.90	32.00	8.00	0.30	0.30
2021-10-27	XR Gastrografin Enema	0.123533	2016-12-26 00:00:00.0	[0-5]	MALE	301.30	301.30	53.00	6.00	1.10	1.10

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-10-24	XR Barium Enema	0.862966	2016-01-10 00:00:00.0	[0-5]	MALE	3319.10	3319.10	259.00	11.00	6.80	6.80
2021-10-24	XR Barium Enema	0.073431	2020-06-02 00:00:00.0	[0-5]	FEMALE	179.10	179.10	61.00	10.00	0.70	0.70
2021-10-11	XR Barium Enema	0.313404	2019-07-28 00:00:00.0	[0-5]	MALE	764.40	764.40	70.00	19.00	2.20	2.20
2021-10-06	XR Barium Enema	0.0536219999999999996	2021-09-30 00:00:00.0	[0-5]	FEMALE	99.30	99.30	134.00	6.00	0.80	0.80
2021-09-29	XR Barium	0.755835	2017-04-29 00:00:00.0	[0-5]	FEMALE	1843.50	1843.50	388.00	21.00	6.30	6.30

	Enema										
2021-09-28	XR Barium Enema	0.591835	2019-02-24 00:00:00.0	[0-5]	MALE	1443.50	1443.50	486.00	36.00	6.00	6.00
2021-09-14	XR Barium Enema	0.16443	2021-06-11 00:00:00.0	[0-5]	MALE	304.50	304.50	95.00	10.00	1.40	1.40
2021-09-07	XR Barium Enema	0.116532	2021-07-04 00:00:00.0	[0-5]	MALE	215.80	215.80	132.00	9.00	0.90	0.90
2021-09-06	XR Barium Enema	0.392329000000000004	2018-02-03 00:00:00.0	[0-5]	MALE	956.90	956.90	99.00	8.00	2.30	2.30
2021-08-29	XR Barium	1.2995579999999998	2012-04-07	[6-10]	MALE	4998.30	4998.30	133.00	1.00	7.40	7.40

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2021-08-29	XR Barium Enema	0.609466	2016-02-20 00:00:00.0	[0-5]	MALE	2344.10	2344.10	270.00	14.00	5.10	5.10
2021-08-17	XR Barium Enema	0	2018-05-18 00:00:00.0	[0-5]	MALE	0.00	0.00	102.00	11.00		
2021-08-15	XR Barium Enema	0	2021-05-04 00:00:00.0	[0-5]	MALE	0.00	0.00	42.00	15.00		
2021-08-10	XR Barium Enema	0	2020-10-08 00:00:00.0	[0-5]	MALE	0.00	0.00	83.00	5.00		

2021-08-09	XR Barium Enema	0	2021-02-28 00:00:00.0	[0-5]	FEMALE	0.00	0.00	71.00	7.00
2021-08-04	XR Gastrografin Enema	0	2021-06-19 00:00:00.0	[0-5]	MALE	0.00	0.00	244.00	10.00
2021-08-01	XR Barium Enema	0	2021-04-19 00:00:00.0	[0-5]	MALE	0.00	0.00	127.00	12.00
2021-07-11	XR Barium Enema	0	2017-02-12 00:00:00.0	[0-5]	MALE	0.00	0.00	106.00	11.00
2021-07-08	XR Barium	0	2017-06-30	[0-5]	MALE	0.00	0.00	204.00	15.00

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2021-07-06	XR Barium Enema	0	2020-10-27 00:00:00.0	[0-5]	MALE	0.00	0.00	37.00	5.00		
2021-06-27	XR Barium Enema	0	2009-10-16 00:00:00.0	[11-15]	MALE	0.00	0.00	331.00	14.00		
2022-04-25	XR Barium Enema	0.20060999999999998	2021-07-03 00:00:00.0	[0-5]	MALE	371.50	371.50	225.00	15.00	1.50	1.50
2022-04-22	XR Gastrografin Enema	1.053208	2018-11-15 00:00:00.0	[0-5]	FEMALE	2568.80	2568.80	360.00	11.00	3.80	3.80

2022-04-19	XR Barium Enema	0.0857520000000001	2022-04-18 00:00:00.0	[0-5]	MALE	158.80	158.80	178.00	8.00	1.20	1.20
2022-04-11	XR Barium Enema	0.03834	2022-04-05 00:00:00.0	[0-5]	MALE	71.00	71.00	54.00	6.00	0.50	0.50
2022-03-24	XR Barium Enema	0.268812	2021-04-07 00:00:00.0	[0-5]	MALE	497.80	497.80	171.00	8.00	1.80	1.80
2022-03-21	XR Barium Enema	0.0312119999999999997	2022-03-01 00:00:00.0	[0-5]	FEMALE	57.80	57.80	53.00	11.00	0.40	0.40
2022-03-20	XR Barium	0.322036	2016-02-17	[6-10]	MALE	1238.60	1238.60	276.00	14.00	3.40	3.40

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2022-03-16	XR Barium Enema	0.324864	2021-08-04 00:00:00.0	[0-5]	MALE	601.60	601.60	105.00	10.00	1.90	1.90
2022-03-08	XR Barium Enema	0.178021999999999999	2020-12-01 00:00:00.0	[0-5]	FEMALE	434.20	434.20	62.00	11.00	1.40	1.40
2022-03-07	XR Barium Enema	1.066624	2012-05-10 00:00:00.0	[6-10]	FEMALE	4102.40	4102.40	227.00	18.00	6.10	6.10
2022-03-06	XR Barium Enema	0.216767000000000002	2017-09-02 00:00:00.0	[0-5]	MALE	528.70	528.70	85.00	11.00	1.60	1.60

2022-02-27	XR Barium Enema	0.949273	2017-04-29 00:00:00.0	[0-5]	FEMALE	2315.30	2315.30	399.00	17.00	5.00	5.00
2022-02-20	XR Barium Enema	0.165564	2022-02-18 00:00:00.0	[0-5]	MALE	306.60	306.60	208.00	23.00	2.10	2.10
2022-02-13	XR Barium Enema	0.157032	2021-05-27 00:00:00.0	[0-5]	FEMALE	290.80	290.80	123.00	6.00	0.80	0.80
2022-02-08	XR Barium Enema	0.880639	2017-03-11 00:00:00.0	[0-5]	FEMALE	2147.90	2147.90	203.00	8.00	5.80	5.80
2022-02-06	XR Barium Enema	0.0158759999999 99998	2022-01-21 00:00:00.0	[0-5]	FEMALE	29.40	29.40	47.00	12.00	0.20	0.20

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2022-01-23	XR Barium Enema	0.11160500000000001	2011-12-15 00:00:00.0	[6-10]	MALE	656.50	656.50	207.00	11.00	1.70	1.70
2022-01-23	XR Barium Enema	0.22079200000000002	2015-03-16 00:00:00.0	[6-10]	FEMALE	849.20	849.20	220.00	12.00	2.90	2.90
2022-01-12	XR Barium Enema	0.117588	2018-03-08 00:00:00.0	[0-5]	FEMALE	286.80	286.80	50.00	7.00	1.00	1.00
2022-01-09	XR Barium Enema	0.111564	2021-05-27 00:00:00.0	[0-5]	FEMALE	206.60	206.60	110.00	6.00	0.70	0.70

2022-01-04	XR Barium Enema	0.159624	2022-01-02 00:00:00.0	[0-5]	MALE	295.60	295.60	257.00	11.00	1.20	1.20
2022-01-04	XR Gastrografin Enema	0.107136	2021-08-04 00:00:00.0	[0-5]	MALE	198.40	198.40	96.00	8.00	0.60	0.60
2021-12-20	XR Barium Enema	0.18063	2021-02-28 00:00:00.0	[0-5]	FEMALE	334.50	334.50	80.00	7.00	1.10	1.10
2021-12-19	XR Barium Enema	0.09061	2020-06-02 00:00:00.0	[0-5]	FEMALE	221.00	221.00	103.00	8.00	0.80	0.80
2021-12-12	XR Barium Enema	0.250938	2021-08-01 00:00:00.0	[0-5]	FEMALE	464.70	464.70	281.00	13.00	2.30	2.30

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-12-01	XR Barium Enema	0.072036	2021-08-01 00:00:00.0	[0-5]	FEMALE	133.40	133.40	25.00	6.00	0.60	0.60
2021-11-23	XR Barium Enema	0.015120000000000001	2021-10-10 00:00:00.0	[0-5]	FEMALE	28.00	28.00	57.00	9.00	0.20	0.20
2021-11-21	XR Barium Enema	0.04995	2021-10-28 00:00:00.0	[0-5]	MALE	92.50	92.50	37.00	11.00	0.30	0.30
2021-11-09	XR Barium Enema	0.018576	2021-10-09 00:00:00.0	[0-5]	MALE	34.40	34.40	27.00	10.00	0.20	0.20
2021-11-04	XR Barium	1.1637440000000001	2019-03-23 00:00:00.0	[0-5]	MALE	2838.40	2838.40	302.00	12.00	8.30	8.30

	Enema										
2021-11-03	XR Gastrografin Enema	0.016416	2021-11-02 00:00:00.0	[0-5]	MALE	30.40	30.40	31.00	7.00	0.20	0.20
2021-11-03	XR Barium Enema	0.024272	2019-03-23 00:00:00.0	[0-5]	MALE	59.20	59.20	13.00	1.00	0.20	0.20
2021-11-03	XR Gastrografin Enema	0.053406	2021-05-09 00:00:00.0	[0-5]	FEMALE	98.90	98.90	32.00	8.00	0.30	0.30
2021-10-27	XR Gastrografin	0.123533	2016-12-26 00:00:00.0	[0-5]	MALE	301.30	301.30	53.00	6.00	1.10	1.10

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema										
2021-10-24	XR Barium Enema	0.862966	2016-01-10 00:00:00.0	[0-5]	MALE	3319.10	3319.10	259.00	11.00	6.80	6.80
2021-10-24	XR Barium Enema	0.073431	2020-06-02 00:00:00.0	[0-5]	FEMALE	179.10	179.10	61.00	10.00	0.70	0.70
2021-10-11	XR Barium Enema	0.313404	2019-07-28 00:00:00.0	[0-5]	MALE	764.40	764.40	70.00	19.00	2.20	2.20
2021-10-06	XR Barium Enema	0.0536219999999999996	2021-09-30 00:00:00.0	[0-5]	FEMALE	99.30	99.30	134.00	6.00	0.80	0.80

2021-09-29	XR Barium Enema	0.755835	2017-04-29 00:00:00.0	[0-5]	FEMALE	1843.50	1843.50	388.00	21.00	6.30	6.30
2021-09-28	XR Barium Enema	0.591835	2019-02-24 00:00:00.0	[0-5]	MALE	1443.50	1443.50	486.00	36.00	6.00	6.00
2021-09-14	XR Barium Enema	0.16443	2021-06-11 00:00:00.0	[0-5]	MALE	304.50	304.50	95.00	10.00	1.40	1.40
2021-09-07	XR Barium Enema	0.116532	2021-07-04 00:00:00.0	[0-5]	MALE	215.80	215.80	132.00	9.00	0.90	0.90
2021-09-06	XR Barium Enema	0.392329000000000004	2018-02-03 00:00:00.0	[0-5]	MALE	956.90	956.90	99.00	8.00	2.30	2.30

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-08-29	XR Barium Enema	1.2995579999999998	2012-04-07 00:00:00.0	[6-10]	MALE	4998.30	4998.30	133.00	1.00	7.40	7.40
2021-08-29	XR Barium Enema	0.609466	2016-02-20 00:00:00.0	[0-5]	MALE	2344.10	2344.10	270.00	14.00	5.10	5.10
2021-08-17	XR Barium Enema	0	2018-05-18 00:00:00.0	[0-5]	MALE	0.00	0.00	102.00	11.00		
2021-08-15	XR Barium Enema	0	2021-05-04 00:00:00.0	[0-5]	MALE	0.00	0.00	42.00	15.00		
2021-08-10	XR Barium	0	2020-10-08 00:00:00.0	[0-5]	MALE	0.00	0.00	83.00	5.00		

	Enema							
2021-08-09	XR Barium Enema	0	2021-02-28 00:00:00.0	[0-5]	FEMALE	0.00	0.00	71.00	7.00
2021-08-04	XR Gastrografin Enema	0	2021-06-19 00:00:00.0	[0-5]	MALE	0.00	0.00	244.00	10.00
2021-08-01	XR Barium Enema	0	2021-04-19 00:00:00.0	[0-5]	MALE	0.00	0.00	127.00	12.00
2021-07-11	XR Barium Enema	0	2017-02-12 00:00:00.0	[0-5]	MALE	0.00	0.00	106.00	11.00

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-07-08	XR Barium Enema	0	2017-06-30 00:00:00.0	[0-5]	MALE	0.00	0.00	204.00	15.00		
2021-07-06	XR Barium Enema	0	2020-10-27 00:00:00.0	[0-5]	MALE	0.00	0.00	37.00	5.00		
2021-06-27	XR Barium Enema	0	2009-10-16 00:00:00.0	[11-15]	MALE	0.00	0.00	331.00	14.00		
2022-04-25	XR Barium Enema	0.2006099999999998	2021-07-03 00:00:00.0	[0-5]	MALE	371.50	371.50	225.00	15.00	1.50	1.50
2022-04-22	XR Gastrog	1.053208	2018-11-15 00:00:00.0	[0-5]	FEMALE	2568.80	2568.80	360.00	11.00	3.80	3.80

	rafin Enema										
2022-04-19	XR Barium Enema	0.085752000000000001	2022-04-18 00:00:00.0	[0-5]	MALE	158.80	158.80	178.00	8.00	1.20	1.20
2022-04-11	XR Barium Enema	0.03834	2022-04-05 00:00:00.0	[0-5]	MALE	71.00	71.00	54.00	6.00	0.50	0.50
2022-03-24	XR Barium Enema	0.268812	2021-04-07 00:00:00.0	[0-5]	MALE	497.80	497.80	171.00	8.00	1.80	1.80
2022-03-21	XR Barium Enema	0.031211999999999997	2022-03-01 00:00:00.0	[0-5]	FEMALE	57.80	57.80	53.00	11.00	0.40	0.40

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2022-03-20	XR Barium Enema	0.322036	2016-02-17 00:00:00.0	[6-10]	MALE	1238.60	1238.60	276.00	14.00	3.40	3.40
2022-03-16	XR Barium Enema	0.324864	2021-08-04 00:00:00.0	[0-5]	MALE	601.60	601.60	105.00	10.00	1.90	1.90
2022-03-08	XR Barium Enema	0.178021999999999999	2020-12-01 00:00:00.0	[0-5]	FEMALE	434.20	434.20	62.00	11.00	1.40	1.40
2022-03-07	XR Barium Enema	1.066624	2012-05-10 00:00:00.0	[6-10]	FEMALE	4102.40	4102.40	227.00	18.00	6.10	6.10
2022-03-06	XR Barium	0.216767000000000002	2017-09-02 00:00:00.0	[0-5]	MALE	528.70	528.70	85.00	11.00	1.60	1.60

	Enema										
2022-02-27	XR Barium Enema	0.949273	2017-04-29 00:00:00.0	[0-5]	FEMALE	2315.30	2315.30	399.00	17.00	5.00	5.00
2022-02-20	XR Barium Enema	0.165564	2022-02-18 00:00:00.0	[0-5]	MALE	306.60	306.60	208.00	23.00	2.10	2.10
2022-02-13	XR Barium Enema	0.157032	2021-05-27 00:00:00.0	[0-5]	FEMALE	290.80	290.80	123.00	6.00	0.80	0.80
2022-02-08	XR Barium Enema	0.880639	2017-03-11 00:00:00.0	[0-5]	FEMALE	2147.90	2147.90	203.00	8.00	5.80	5.80
2022-02-06	XR Barium	0.0158759999999999998	2022-01-21	[0-5]	FEMALE	29.40	29.40	47.00	12.00	0.20	0.20

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2022-01-23	XR Barium Enema	0.11160500000000001	2011-12-15 00:00:00.0	[6-10]	MALE	656.50	656.50	207.00	11.00	1.70	1.70
2022-01-23	XR Barium Enema	0.22079200000000002	2015-03-16 00:00:00.0	[6-10]	FEMALE	849.20	849.20	220.00	12.00	2.90	2.90
2022-01-12	XR Barium Enema	0.117588	2018-03-08 00:00:00.0	[0-5]	FEMALE	286.80	286.80	50.00	7.00	1.00	1.00
2022-01-09	XR Barium Enema	0.111564	2021-05-27 00:00:00.0	[0-5]	FEMALE	206.60	206.60	110.00	6.00	0.70	0.70

2022-01-04	XR Barium Enema	0.159624	2022-01-02 00:00:00.0	[0-5]	MALE	295.60	295.60	257.00	11.00	1.20	1.20
2022-01-04	XR Gastrografin Enema	0.107136	2021-08-04 00:00:00.0	[0-5]	MALE	198.40	198.40	96.00	8.00	0.60	0.60
2021-12-20	XR Barium Enema	0.18063	2021-02-28 00:00:00.0	[0-5]	FEMALE	334.50	334.50	80.00	7.00	1.10	1.10
2021-12-19	XR Barium Enema	0.09061	2020-06-02 00:00:00.0	[0-5]	FEMALE	221.00	221.00	103.00	8.00	0.80	0.80
2021-12-12	XR Barium	0.250938	2021-08-01	[0-5]	FEMALE	464.70	464.70	281.00	13.00	2.30	2.30

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
	Enema		00:00:00.0								
2021-12-01	XR Barium Enema	0.072036	2021-08-01 00:00:00.0	[0-5]	FEMALE	133.40	133.40	25.00	6.00	0.60	0.60
2021-11-23	XR Barium Enema	0.0151200000000 00001	2021-10-10 00:00:00.0	[0-5]	FEMALE	28.00	28.00	57.00	9.00	0.20	0.20
2021-11-21	XR Barium Enema	0.04995	2021-10-28 00:00:00.0	[0-5]	MALE	92.50	92.50	37.00	11.00	0.30	0.30
2021-11-09	XR Barium Enema	0.018576	2021-10-09 00:00:00.0	[0-5]	MALE	34.40	34.40	27.00	10.00	0.20	0.20

2021-11-04	XR Barium Enema	1.16374400000000001	2019-03-23 00:00:00.0	[0-5]	MALE	2838.40	2838.40	302.00	12.00	8.30	8.30
2021-11-03	XR Gastrografin Enema	0.016416	2021-11-02 00:00:00.0	[0-5]	MALE	30.40	30.40	31.00	7.00	0.20	0.20
2021-11-03	XR Barium Enema	0.024272	2019-03-23 00:00:00.0	[0-5]	MALE	59.20	59.20	13.00	1.00	0.20	0.20
2021-11-03	XR Gastrografin Enema	0.053406	2021-05-09 00:00:00.0	[0-5]	FEMALE	98.90	98.90	32.00	8.00	0.30	0.30

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-10-27	XR Gastrografin Enema	0.123533	2016-12-26 00:00:00.0	[0-5]	MALE	301.30	301.30	53.00	6.00	1.10	1.10
2021-10-24	XR Barium Enema	0.862966	2016-01-10 00:00:00.0	[0-5]	MALE	3319.10	3319.10	259.00	11.00	6.80	6.80
2021-10-24	XR Barium Enema	0.073431	2020-06-02 00:00:00.0	[0-5]	FEMALE	179.10	179.10	61.00	10.00	0.70	0.70
2021-10-11	XR Barium Enema	0.313404	2019-07-28 00:00:00.0	[0-5]	MALE	764.40	764.40	70.00	19.00	2.20	2.20
2021-10-06	XR	0.0536219999999999996	2021-09-30	[0-5]	FEMALE	99.30	99.30	134.00	6.00	0.80	0.80

	Barium Enema		00:00:00.0								
2021-09-29	XR Barium Enema	0.755835	2017-04-29 00:00:00.0	[0-5]	FEMALE	1843.50	1843.50	388.00	21.00	6.30	6.30
2021-09-28	XR Barium Enema	0.591835	2019-02-24 00:00:00.0	[0-5]	MALE	1443.50	1443.50	486.00	36.00	6.00	6.00
2021-09-14	XR Barium Enema	0.16443	2021-06-11 00:00:00.0	[0-5]	MALE	304.50	304.50	95.00	10.00	1.40	1.40
2021-09-07	XR Barium Enema	0.116532	2021-07-04 00:00:00.0	[0-5]	MALE	215.80	215.80	132.00	9.00	0.90	0.90

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-09-06	XR Barium Enema	0.392329000000000004	2018-02-03 00:00:00.0	[0-5]	MALE	956.90	956.90	99.00	8.00	2.30	2.30
2021-08-29	XR Barium Enema	1.2995579999999998	2012-04-07 00:00:00.0	[6-10]	MALE	4998.30	4998.30	133.00	1.00	7.40	7.40
2021-08-29	XR Barium Enema	0.609466	2016-02-20 00:00:00.0	[0-5]	MALE	2344.10	2344.10	270.00	14.00	5.10	5.10
2021-08-17	XR Barium Enema	0	2018-05-18 00:00:00.0	[0-5]	MALE	0.00	0.00	102.00	11.00		
2021-08-15	XR Barium	0	2021-05-04 00:00:00.0	[0-5]	MALE	0.00	0.00	42.00	15.00		

	Enema								
2021-08-10	XR Barium Enema	0	2020-10-08 00:00:00.0	[0-5]	MALE	0.00	0.00	83.00	5.00
2021-08-09	XR Barium Enema	0	2021-02-28 00:00:00.0	[0-5]	FEMALE	0.00	0.00	71.00	7.00
2021-08-04	XR Gastrografin Enema	0	2021-06-19 00:00:00.0	[0-5]	MALE	0.00	0.00	244.00	10.00
2021-08-01	XR Barium Enema	0	2021-04-19 00:00:00.0	[0-5]	MALE	0.00	0.00	127.00	12.00

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2021-07-11	XR Barium Enema	0	2017-02-12 00:00:00.0	[0-5]	MALE	0.00	0.00	106.00	11.00		
2021-07-08	XR Barium Enema	0	2017-06-30 00:00:00.0	[0-5]	MALE	0.00	0.00	204.00	15.00		
2021-07-06	XR Barium Enema	0	2020-10-27 00:00:00.0	[0-5]	MALE	0.00	0.00	37.00	5.00		
2021-06-27	XR Barium Enema	0	2009-10-16 00:00:00.0	[11-15]	MALE	0.00	0.00	331.00	14.00		
2022-04-25	XR Barium	0.20060999999999998	2021-07-03 00:00:00.0	[0-5]	MALE	371.50	371.50	225.00	15.00	1.50	1.50

	Enema										
2022-04-22	XR Gastrografin Enema	1.053208	2018-11-15 00:00:00.0	[0-5]	FEMALE	2568.80	2568.80	360.00	11.00	3.80	3.80
2022-04-19	XR Barium Enema	0.085752000000000001	2022-04-18 00:00:00.0	[0-5]	MALE	158.80	158.80	178.00	8.00	1.20	1.20
2022-04-11	XR Barium Enema	0.03834	2022-04-05 00:00:00.0	[0-5]	MALE	71.00	71.00	54.00	6.00	0.50	0.50
2022-03-24	XR Barium Enema	0.268812	2021-04-07 00:00:00.0	[0-5]	MALE	497.80	497.80	171.00	8.00	1.80	1.80

Study date (YYYY-MM-DD)	Local study description	Total Effective dose (msv)	Patient birthdate (YYYY-MM-DD)	Age class	Patient sex	Image and Fluoroscopy Dose Area Product (mGy.cm2)	Revised Total DAP (mGy.cm2)	Total Time of Fluoroscopy (s)	Total Number of Exposure	Entrance Dose (mGy)	Revised Total Entrance Dose (mGy.cm2)
2022-03-21	XR Barium Enema	0.031211999999999997	2022-03-01 00:00:00.0	[0-5]	FEMALE	57.80	57.80	53.00	11.00	0.40	0.40
2022-03-20	XR Barium Enema	0.322036	2016-02-17 00:00:00.0	[6-10]	MALE	1238.60	1238.60	276.00	14.00	3.40	3.40
2022-03-16	XR Barium Enema	0.324864	2021-08-04 00:00:00.0	[0-5]	MALE	601.60	601.60	105.00	10.00	1.90	1.90
2022-03-08	XR Barium Enema	0.178021999999999999	2020-12-01 00:00:00.0	[0-5]	FEMALE	434.20	434.20	62.00	11.00	1.40	1.40
2022-03-07	XR Barium	1.066624	2012-05-10 00:00:00.0	[6-10]	FEMALE	4102.40	4102.40	227.00	18.00	6.10	6.10

	Enema										
2022-03-06	XR Barium Enema	0.216767000000000002	2017-09-02 00:00:00.0	[0-5]	MALE	528.70	528.70	85.00	11.00	1.60	1.60
2022-02-27	XR Barium Enema	0.949273	2017-04-29 00:00:00.0	[0-5]	FEMALE	2315.30	2315.30	399.00	17.00	5.00	5.00
2022-02-20	XR Barium Enema	0.165564	2022-02-18 00:00:00.0	[0-5]	MALE	306.60	306.60	208.00	23.00	2.10	2.10
2022-02-13	XR Barium Enema	0.157032	2021-05-27 00:00:00.0	[0-5]	FEMALE	290.80	290.80	123.00	6.00	0.80	0.80
2022-02-08	XR Barium	0.880639	2017-03-11	[0-5]	FEMALE	2147.90	2147.90	203.00	8.00	5.80	5.80

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	Enema		00:00:00.0								
2022-02-06	XR Barium Enema	0.0158759999999999998	2022-01-21 00:00:00.0	[0-5]	FEMALE	29.40	29.40	47.00	12.00	0.20	0.20
2022-01-23	XR Barium Enema	0.11160500000000001	2011-12-15 00:00:00.0	[6-10]	MALE	656.50	656.50	207.00	11.00	1.70	1.70
2022-01-23	XR Barium Enema	0.22079200000000002	2015-03-16 00:00:00.0	[6-10]	FEMALE	849.20	849.20	220.00	12.00	2.90	2.90
2022-01-12	XR Barium Enema	0.117588	2018-03-08 00:00:00.0	[0-5]	FEMALE	286.80	286.80	50.00	7.00	1.00	1.00
2022-01-09	XR	0.111564	2021-05-27	[0-5]	FEMALE	206.60	206.60	110.00	6.00	0.70	0.70

	Barium Enema		00:00:00.0								
2022-01-04	XR Barium Enema	0.159624	2022-01-02 00:00:00.0	[0-5]	MALE	295.60	295.60	257.00	11.00	1.20	1.20
2022-01-04	XR Gastrografin Enema	0.107136	2021-08-04 00:00:00.0	[0-5]	MALE	198.40	198.40	96.00	8.00	0.60	0.60
2021-12-20	XR Barium Enema	0.18063	2021-02-28 00:00:00.0	[0-5]	FEMALE	334.50	334.50	80.00	7.00	1.10	1.10
2021-12-19	XR Barium	0.09061	2020-06-02	[0-5]	FEMALE	221.00	221.00	103.00	8.00	0.80	0.80