Understanding Cancer

A SERIES OF SIMPLE EDUCATIONAL VIDEOS FOR THE GENERAL PUBLIC

By Dr Hafsa Waseela Abbas

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Part 11: Diagnosis - CT scan

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What is an CT scan?

What is an CT scan?

A computerised tomography (CT) scan also known as CAT or computed tomography scans is a type of scan carried out by radiographers at the hospital.

What is an CT scan?

It uses X-rays and a computer to make detailed images of inside of the body from different angles.

ORGANS. BLOOD VESSELS. BONES.

What is an CT scan?

This is later combined and used to make three-dimensional (3D) x-ray image.

Source: Catalina imaging

Who invented the CT scan?

Godfrey Hounsfield is a biomedical engineer who invented the CT scan to help diagnose or detect conditions and disorders of the nervous system.

How can CT scans be used for cancer?

Identify and locate size and shape of tumours before further tests or treatment.
e.g. radiotherapy

How can CT scans be used for cancer?

A doctor can take a small sample using a needle (biopsy) for examination.

How can CT scans be used for cancer?

Monitoring conditions to check the size of the tumours during and after cancer treatment.

CT scan

Colorectal cancer (colon)

CT scan used for patients to plan tor surgery.

How far has the cancer spread/extended (metastasis)?

CT scan

Colorectal cancer (colon)

If metastasis is present, there will be:

- Thick tumour mass
- The tube of the large intestine inside become smaller.
- There is pericolic fat.

Organ sites involved in metastasis are: liver, lungs, bone and adrenal glands.

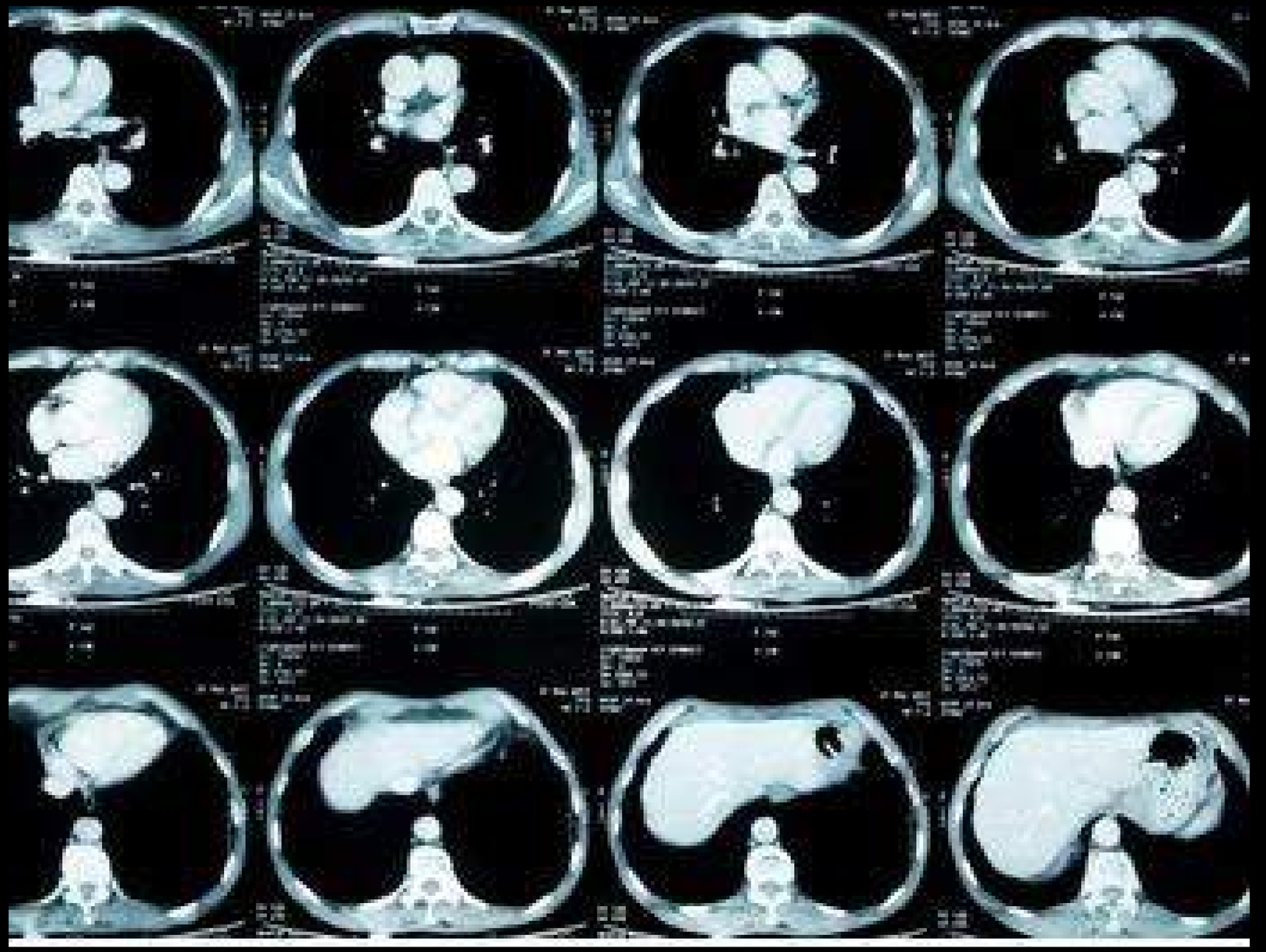
CT scan
Virtual colonoscopy

It is used for early stage cancers.

Cleaning the large intestine is needed to know which one is a mass and which one is poo (faeces).

Source: Horton et al. 2000

CT scan
Lung cancer



CT scan

Brain cancer

Source:
y Kamil (2015)

The area, position, shape of the brain tumours can be calculated using Morphological operations.

CT scan *Bladder cancer*

How far has the tumour spread?
Bone? Liver?
Are the lymph nodes swollen (lymphadenopathy)?
Is there obstruction in the reproductive system?

CT scan

Oesophageal cancer (throat cancer)

CT scan

Testicular cancer

This is done when there are high levels of the hormone HCG (More than 10000 u/l).

Patients with symptoms of advanced cancers (metastatic) may require a bone scan or a CT scan of the lung, pelvis and abdomen..

There can be symptoms of the central nervous system so a CT brain scan is done.

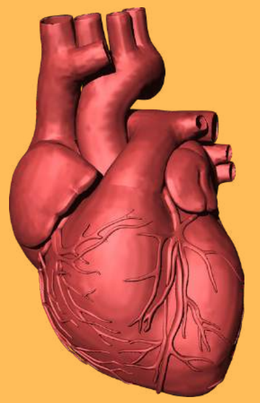
CT scan
Mesothelioma

Extent of the tumour mass.

Other uses of CT scan

To see:

- Damage to bones and joints.
- Injuries to organs.
- Blood circulation issues e.g. clots that can cause strokes, haemorrhage and other conditions.
- Abnormalities of the heart.
- Lung conditions e.g. pneumonia and emphysema.



How does a CT scan work?

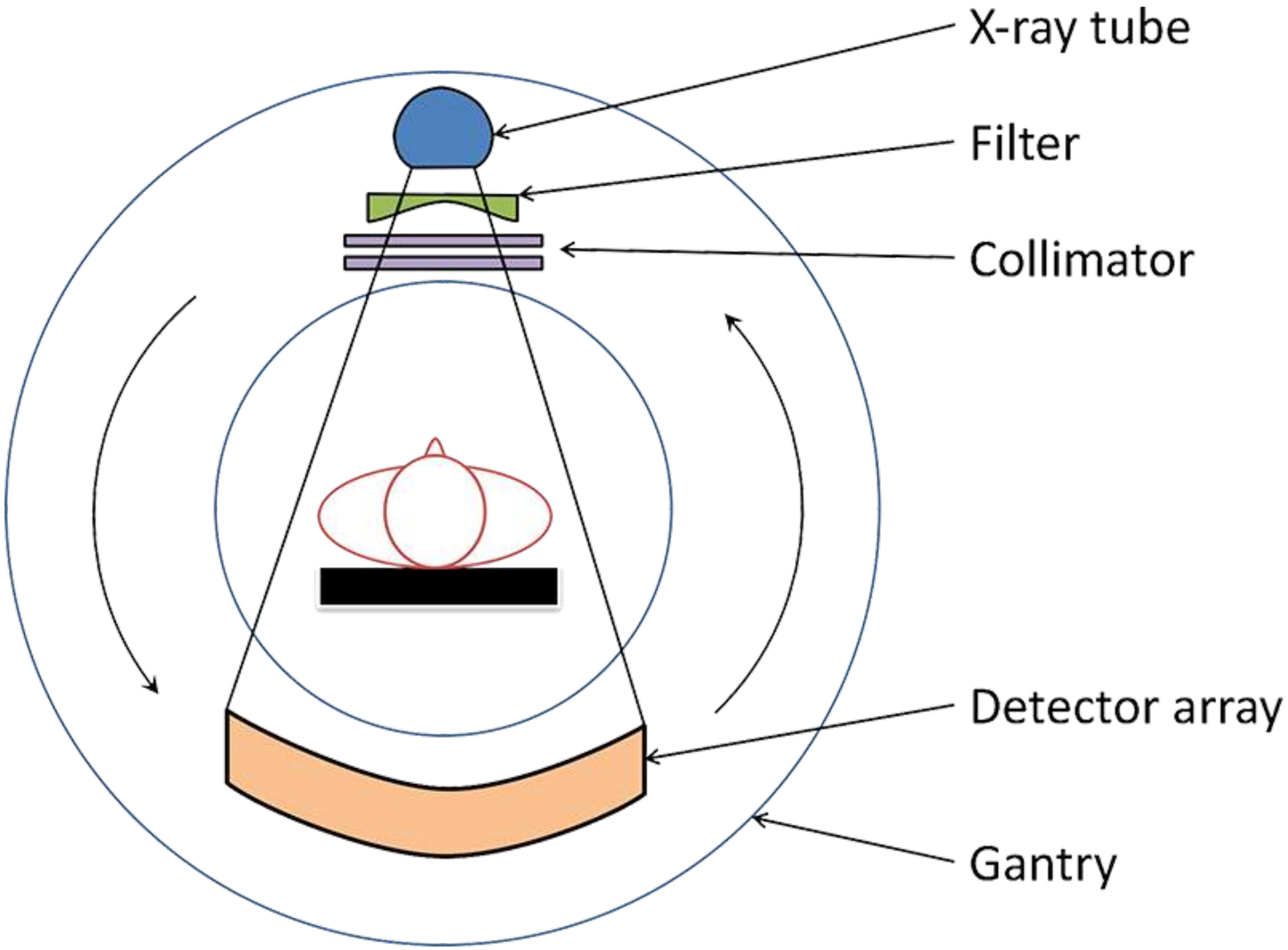
A traditional X-ray uses an X-ray tube that does not move (fixed).

How does a CT scan work?

A CT scanner is a X-ray source that rotates a donut-shaped opening called a gantry.

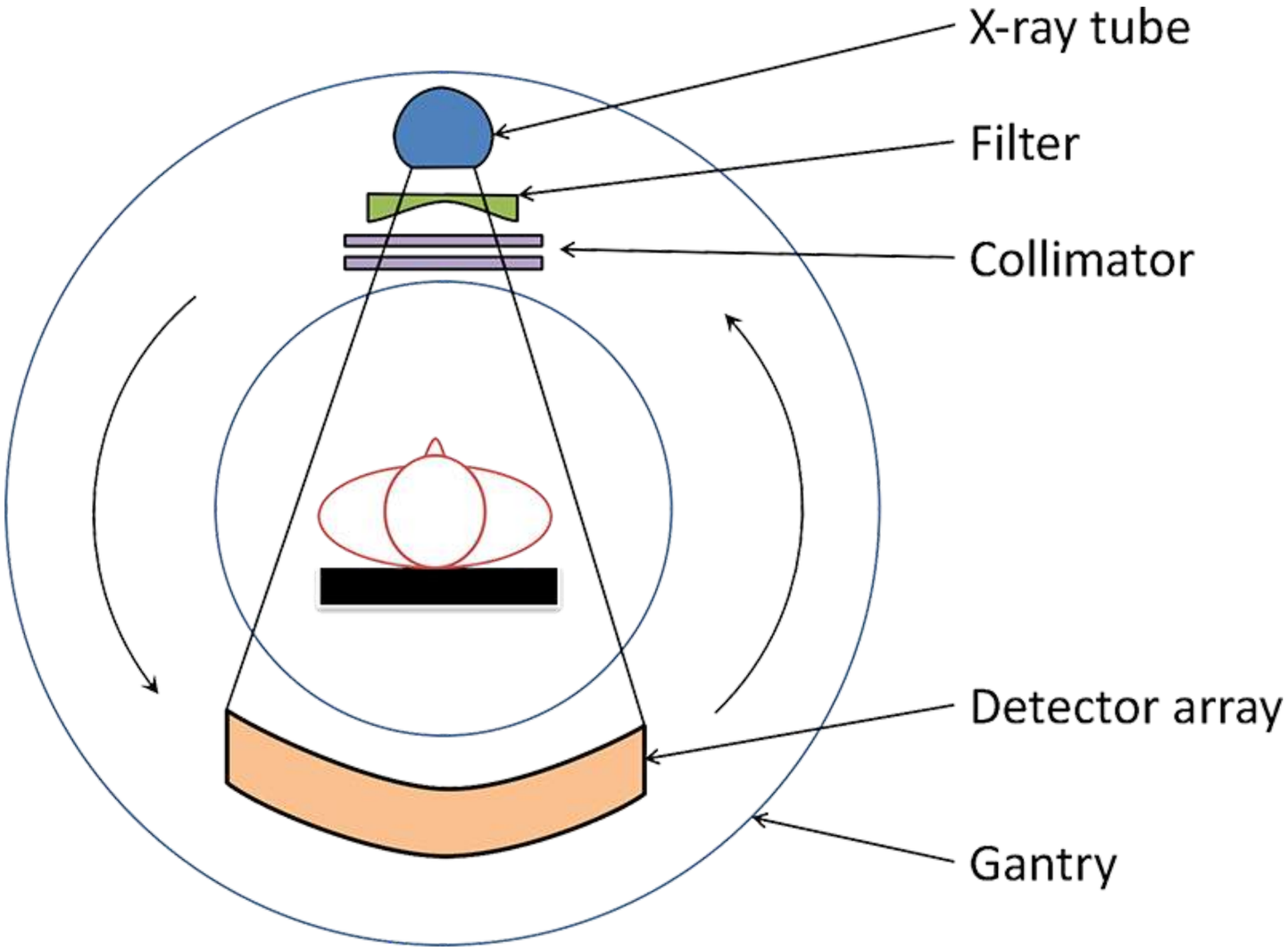
How does a CT scan work?

1) A beam of x-rays is directed to the patient and rotates around the body.



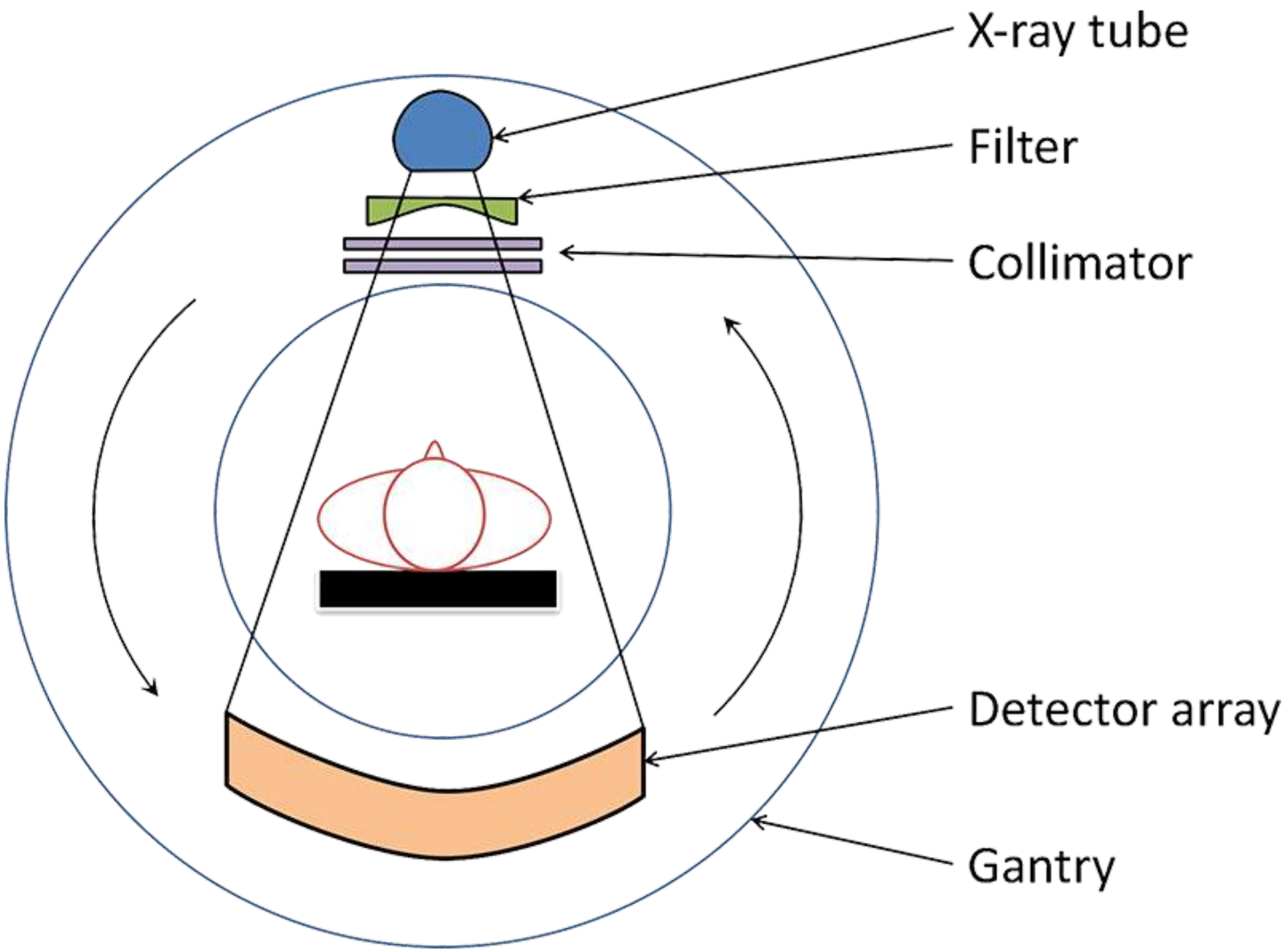
How does a CT scan work?

2) Every time the X-ray source finishes one full rotation. It uses a maths equation to make the 2D images.



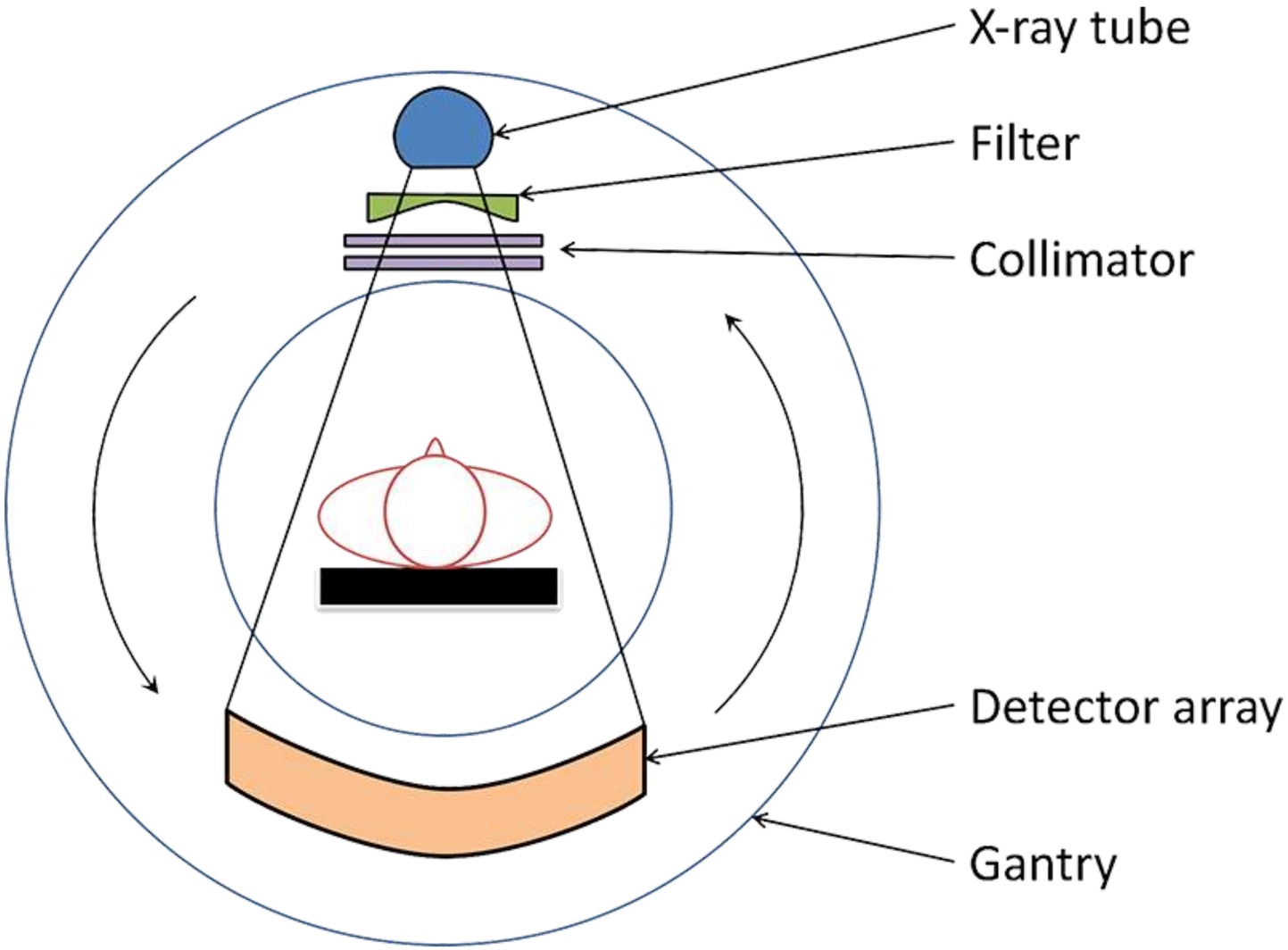
How does a CT scan work?

3) Opposite the X-ray source, there are digital X-ray detectors.



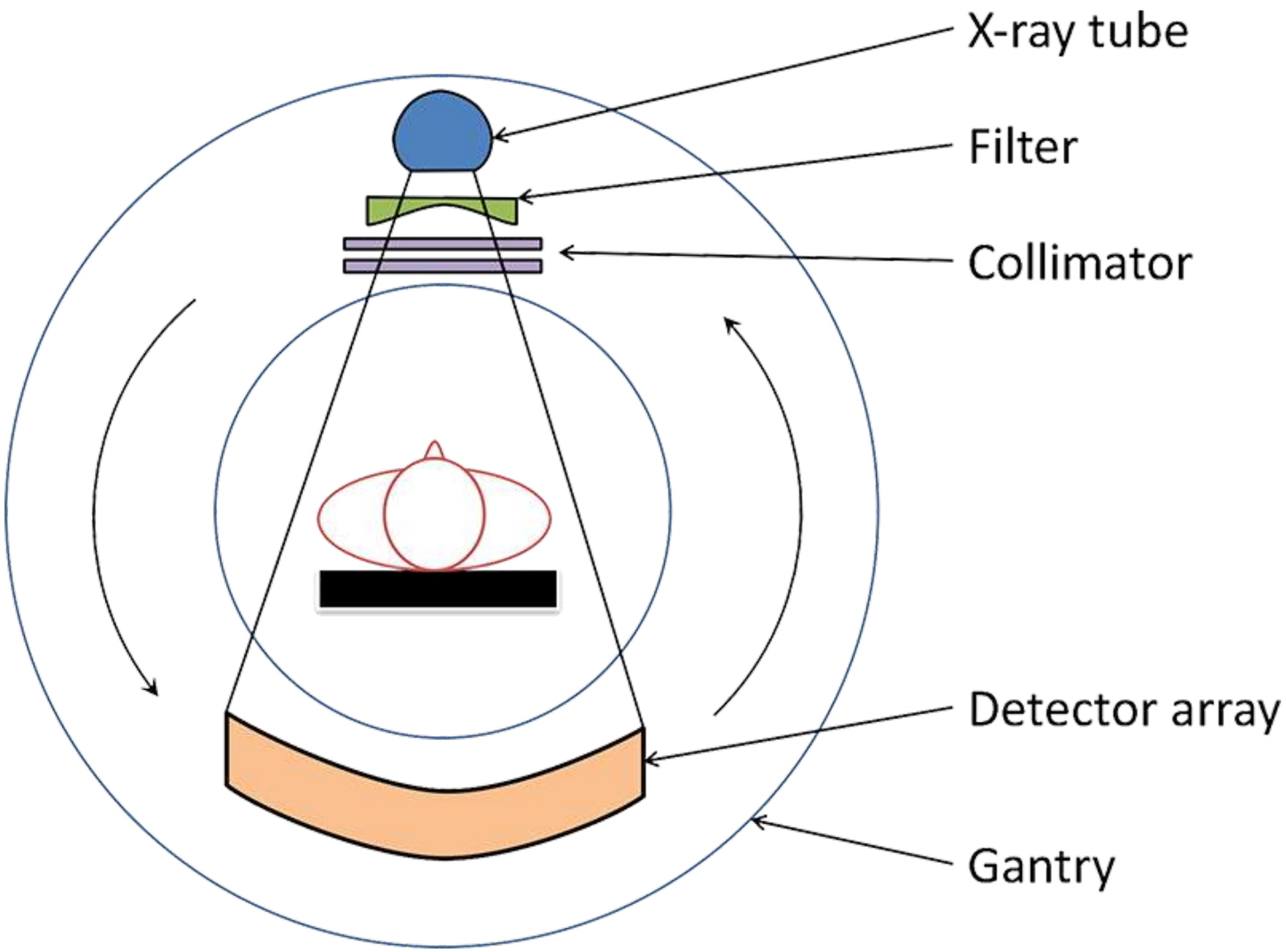
How does a CT scan work?

4) As X-rays leave the patient, it produces signals that is picked up by the detectors.



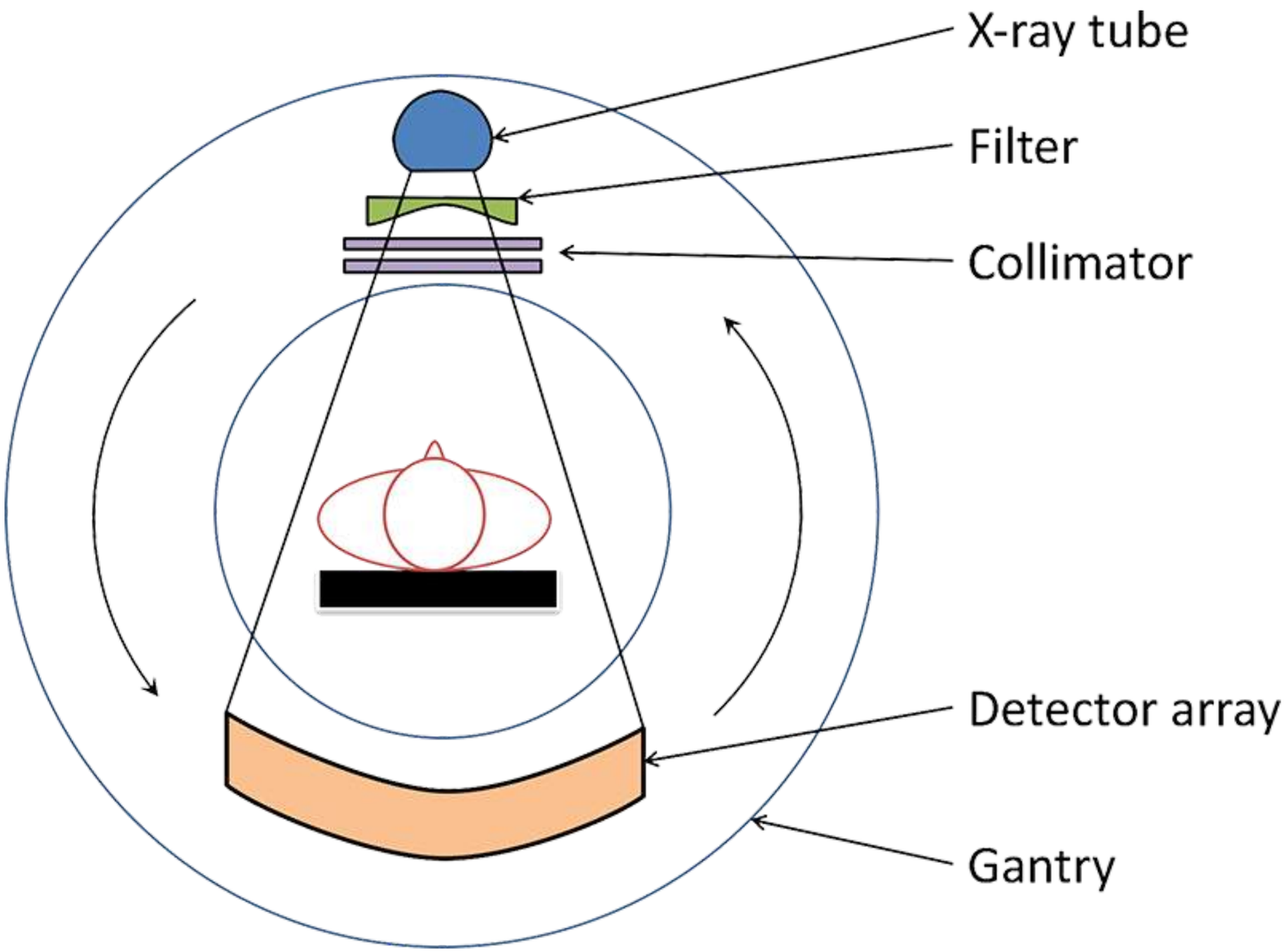
How does a CT scan work?

5) This is sent and processed by the computer.



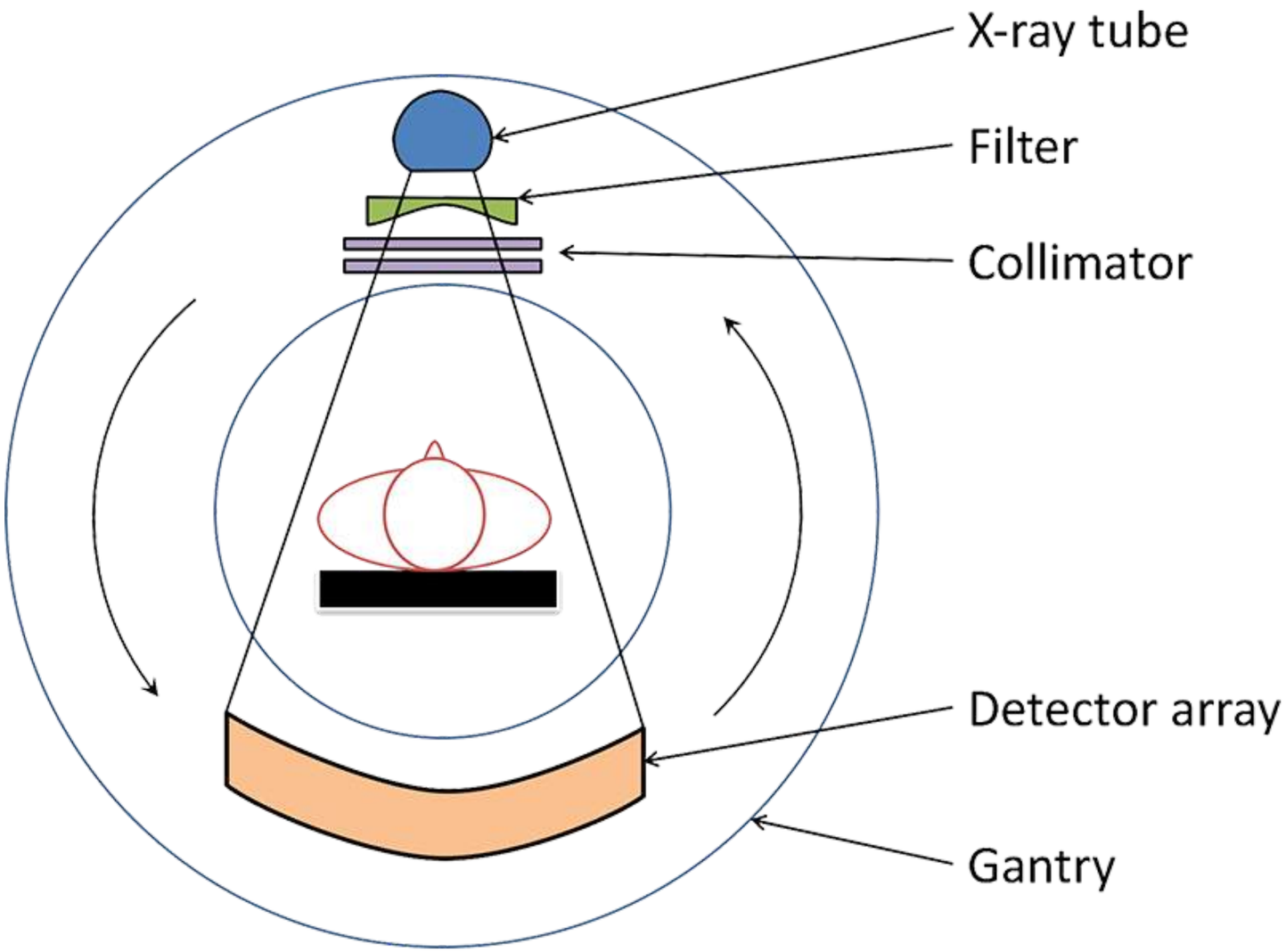
How does a CT scan work?

6) This creates images or 'slices' of the body called tomographic images.



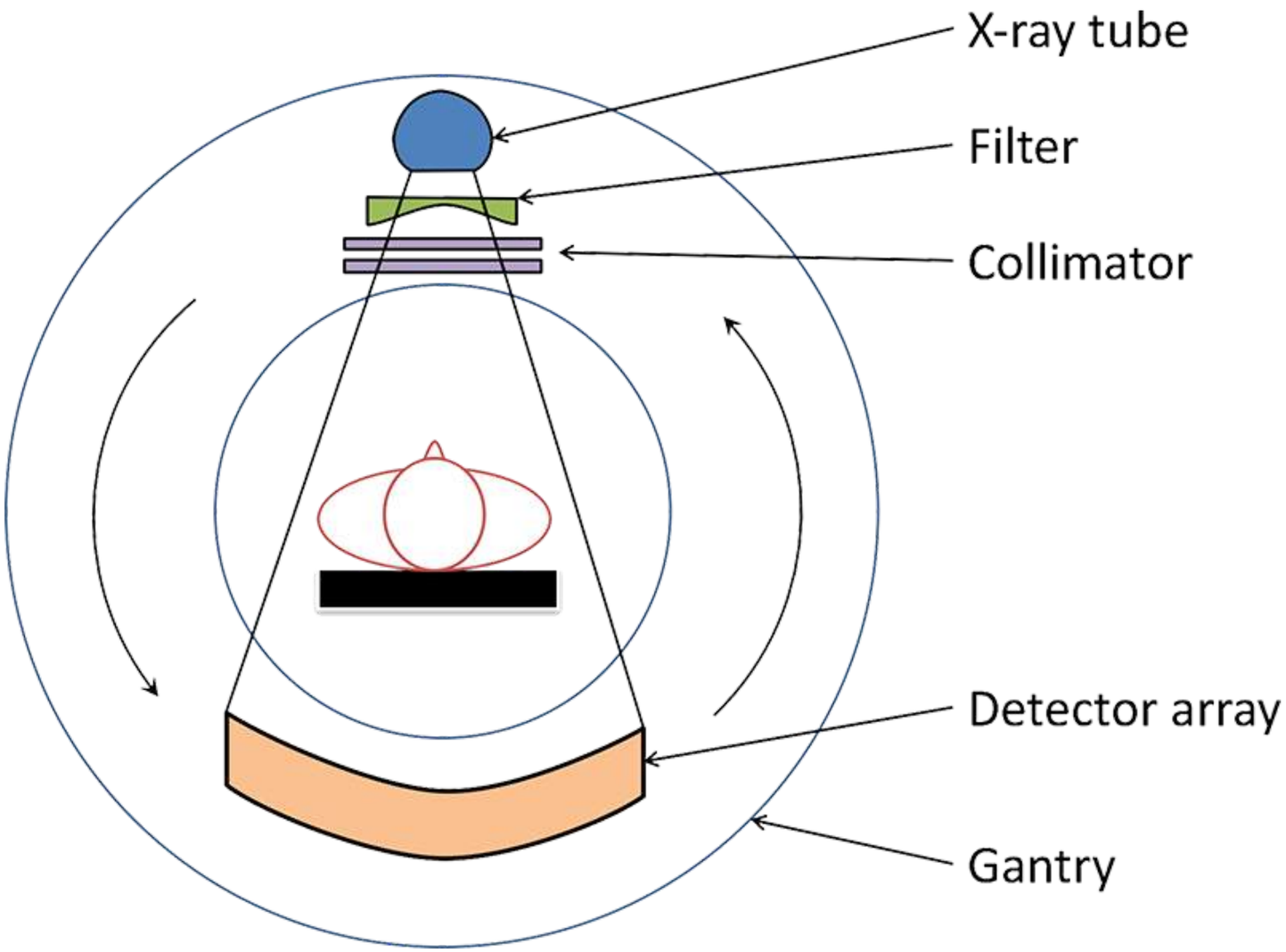
How does a CT scan work?

7) The thickness of the tissue in each slice varies and depends on the CT scan.
(1 to 10 mm)



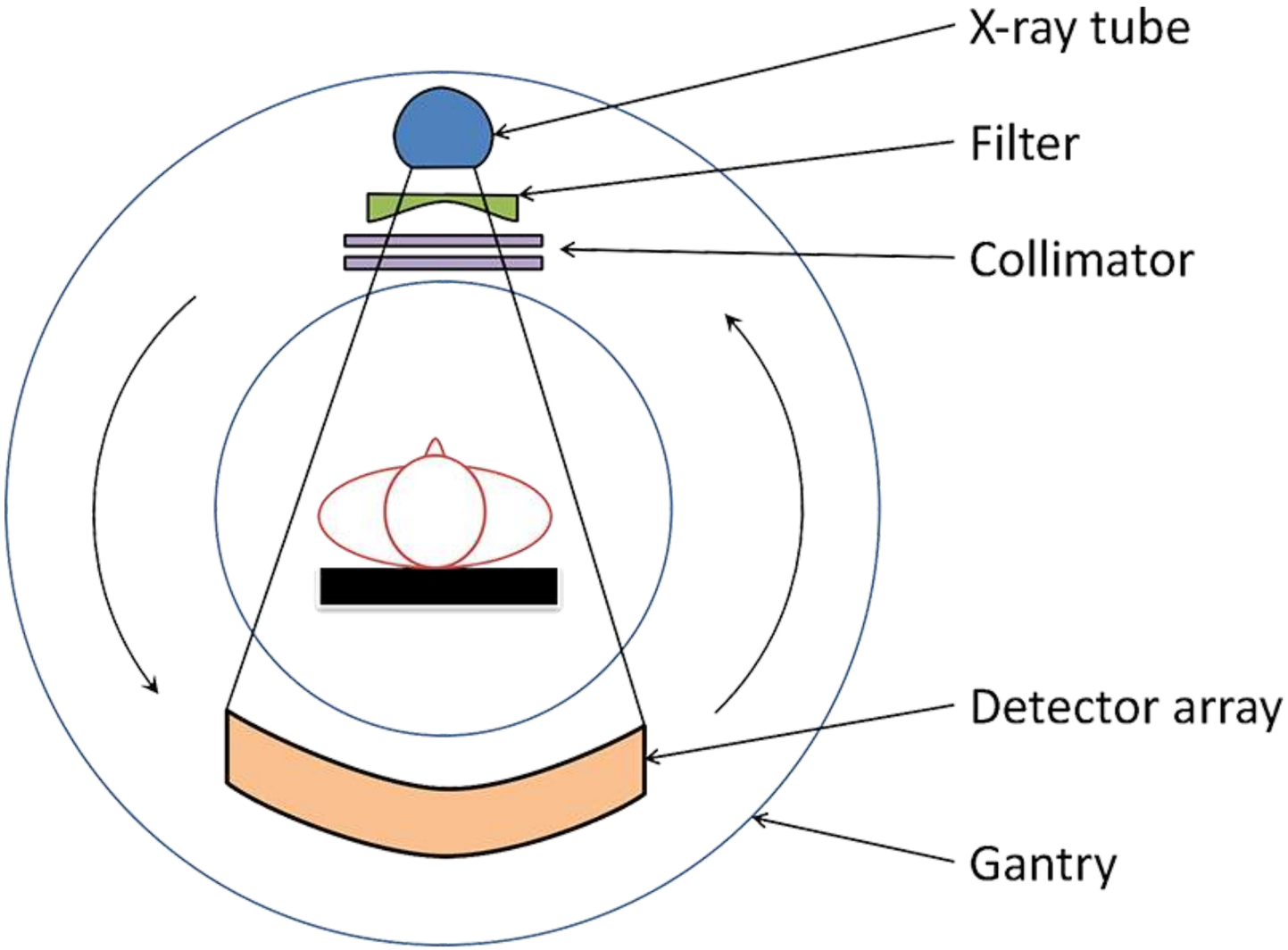
How does a CT scan work?

8) The whole process of the X-ray is repeated again to produce another slice.



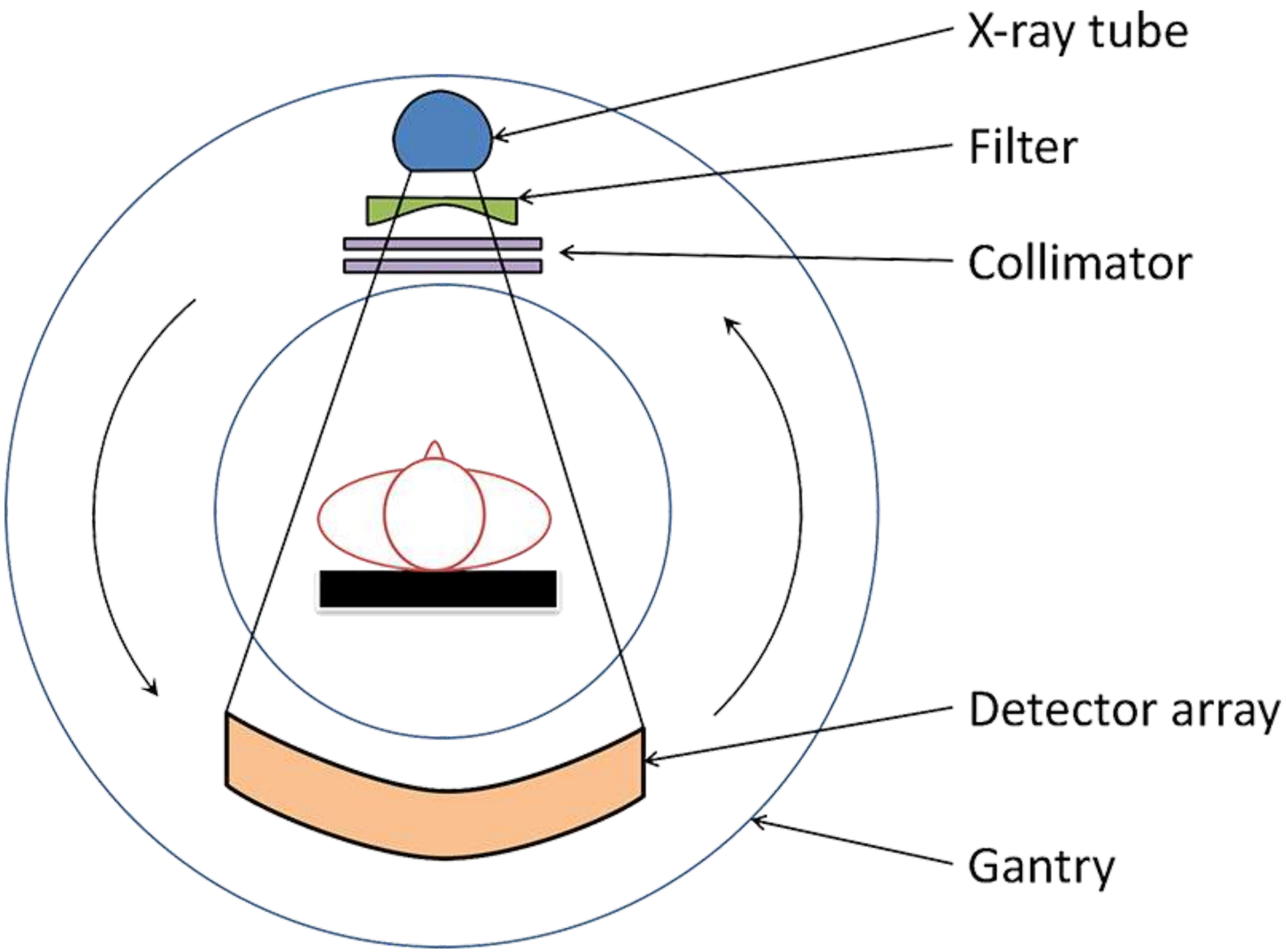
How does a CT scan work?

9) After a number of slices, they are joined together to form a 3D image of the patient.



How does a CT scan work?

10) They are more detailed than a normal x-ray.



The process

Before the CT scan.

The appointment letter will state any preparation regarding eating and drinking.

The process

Before the CT scan

What do you need to inform the hospital?

Allergies?

Pregnant?

Kidney problems?

Taking medications for diabetes?

The process

Before the CT scan

Removal of any metal objects takes place to not interfere with the X-rays e.g.

- Jewellery and piercing.
- Dentures (false teeth)
- Wigs
- Hearing aid

The process

Before the CT scan

The patient may be asked to wear a hospital gown or clothes that has no metal objects e.g.:

- Buttons
- belts
- wired bras
- Zips

The process

Sedatives

It is given to kill pain but it is not normally needed. This must be arranged before the appointment.

If the patient is worried or claustrophobic, it can help keep them relaxed.

The process

CT contrast agent.

Dense structures e.g. bone can be seen easily.

Soft tissues (non-bony) vary in their ability to see.

Contrast agents contain substances that improves the visual quality of the image.

The process

CT contrast agent.

It can be drunk, passed into the bottom (enema) or injected into the blood.

The process

CT contrast agent.

Iodine - injected into the blood to see the blood vessels.

Barium - oral contrast agent and is used to see the digestive system e.g. food pipe (oesophagus) and stomach.

The process

CT contrast agent.

It is harmless and safe to use.

The contrast passes out in the urine.

The process

What happens during the CT scan?

The patient will lie flat on a bed before moved into the CT scanner.

The process

What happens during the CT scan?

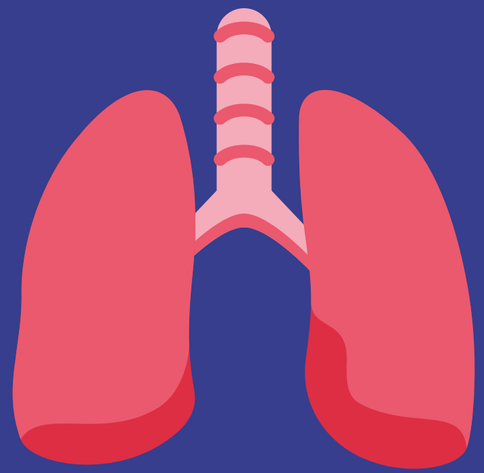
The radiographer controls the scanner in another room.

Communication can still be made where the patient can hear or speak to them.

The process

What happens during the CT scan?

The patient needs to remain still and breathe normally unless told to hold the breathe at specific stages.



The process

What happens during a CT scan?

The scan takes around 10 to 20 minutes.

The process

After the scan

Once the scan is done, the patient is moved outside the scanner.

The patient can resume as normal.

The process

After the scan

However, if a contrast is used to wait an hour in hospital to monitor safety to ensure no reaction.

The process

After the scan

After the computer completes processing the images, it is examined by a radiologist.

The process

After the scan

A radiologist is a doctor who examine the image and creates a report.

The process

After the scan

It is then sent to the G.P or another doctor who made the referral to discuss the results with the patient.

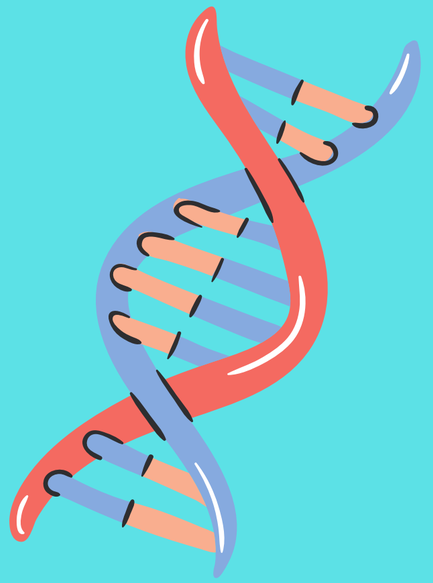
Precautions

It is a painless procedure.

Precautions

The amount of radiation exposed during the CT scan varies and depends on how much of the body is scanned.

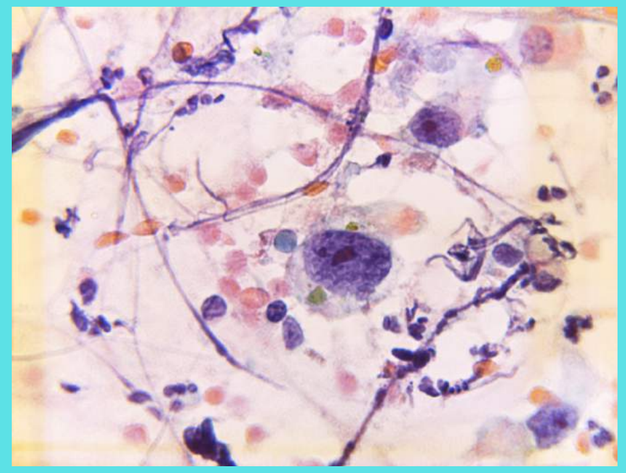
It has high energy that can damage DNA.



Precautions

Less than 1 in 2,000.

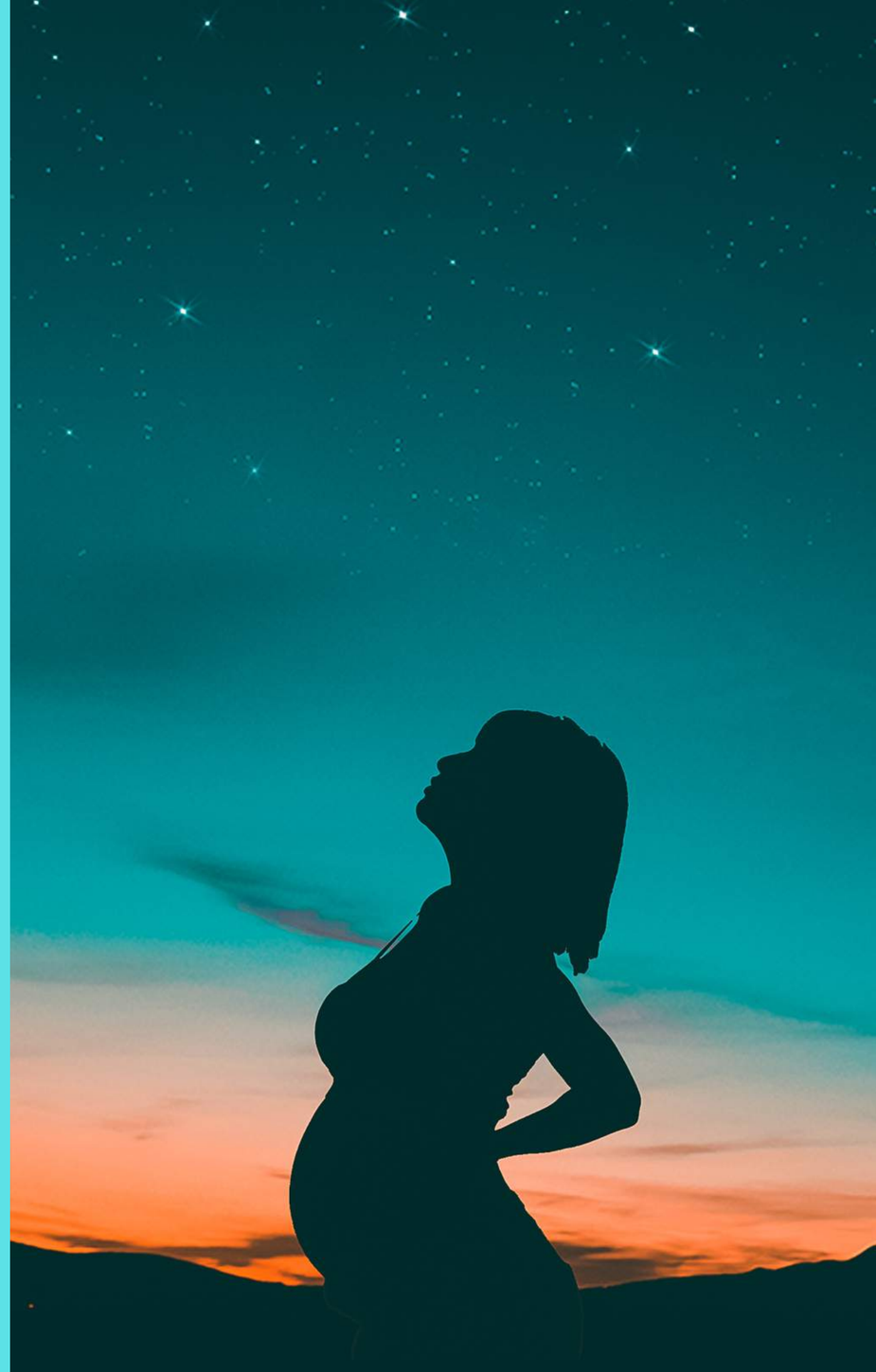
Limited risk of getting cancer from radiation.



Precautions

Emergency scans on pregnant women for imaging other areas and not the pelvis or abdomen (stomach and intestines).

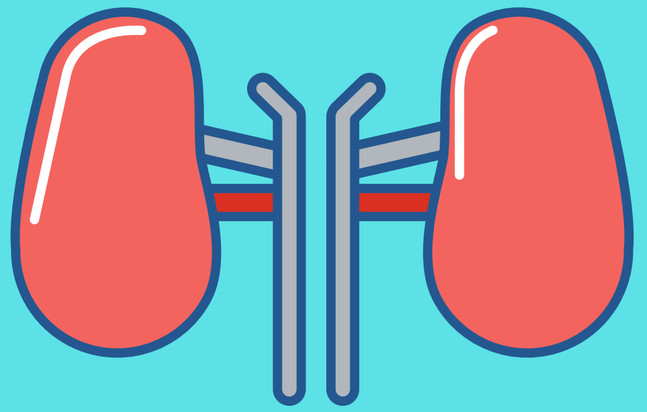
It is best to avoid because of the radiation dose.



Precautions

Allergic reaction due to the contrast agent.

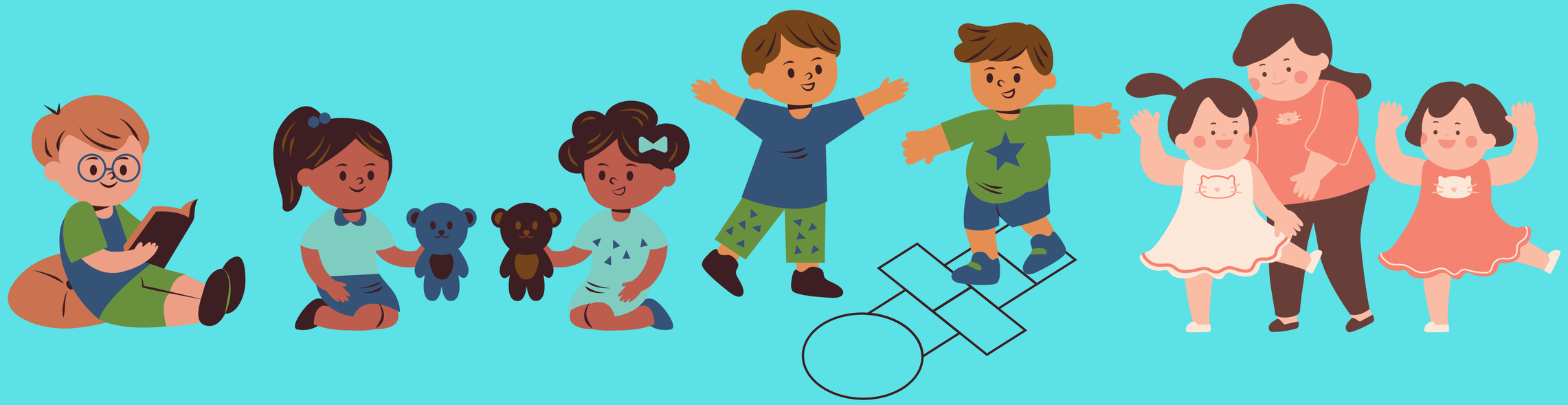
Precautions



Patients with kidney disease should not have contrast agent to stop damage to tissues and further affecting the kidneys.

Precautions

CT scanner must be adjusted or changed to do a CT scan if the patient is a child.

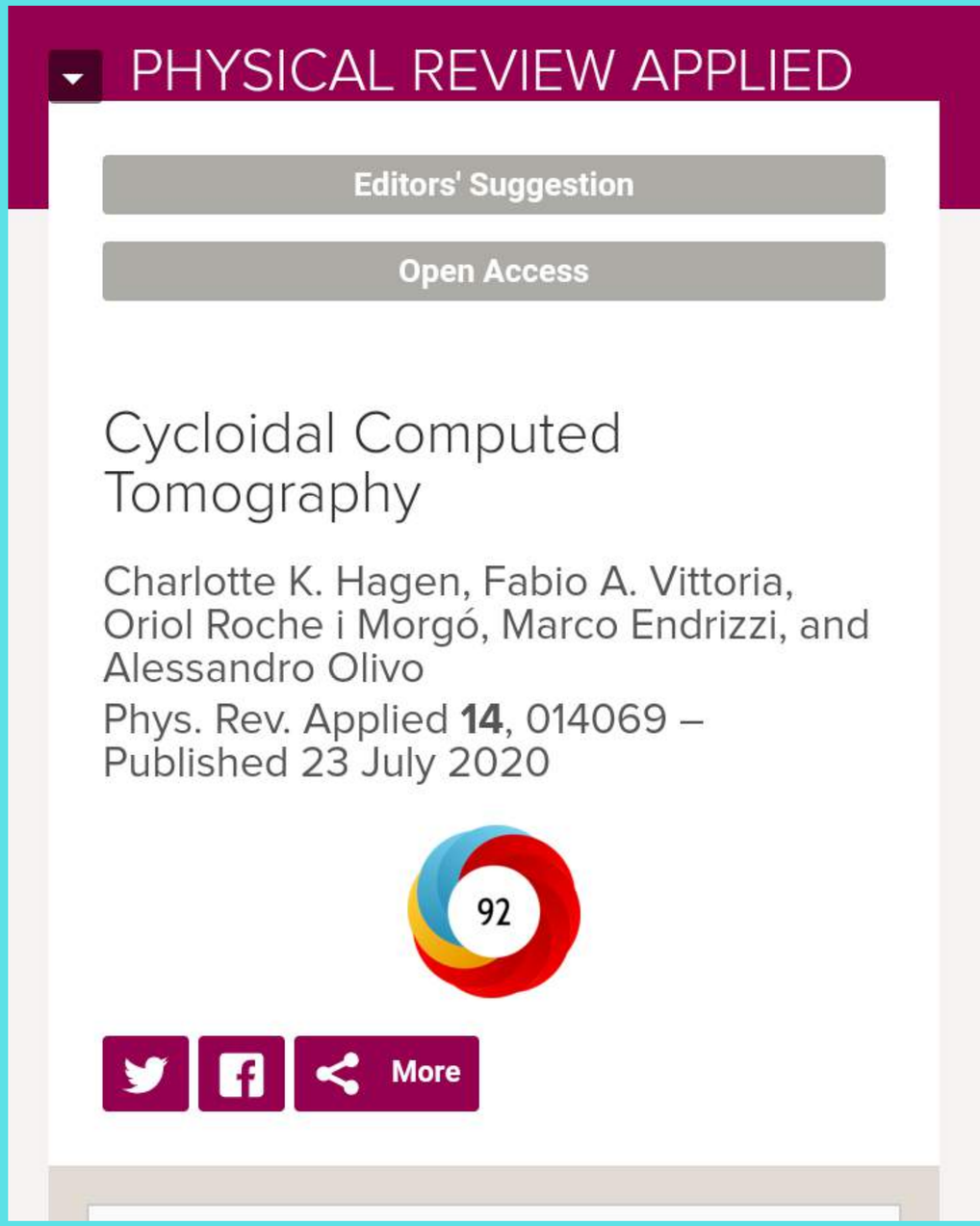


New developments

A new CT scan has been made by a research team at UCL to lower radiation dose.

It splits the X-ray beam into small ones called thin beamlets.

Source: Hagen, C. et al (2020)

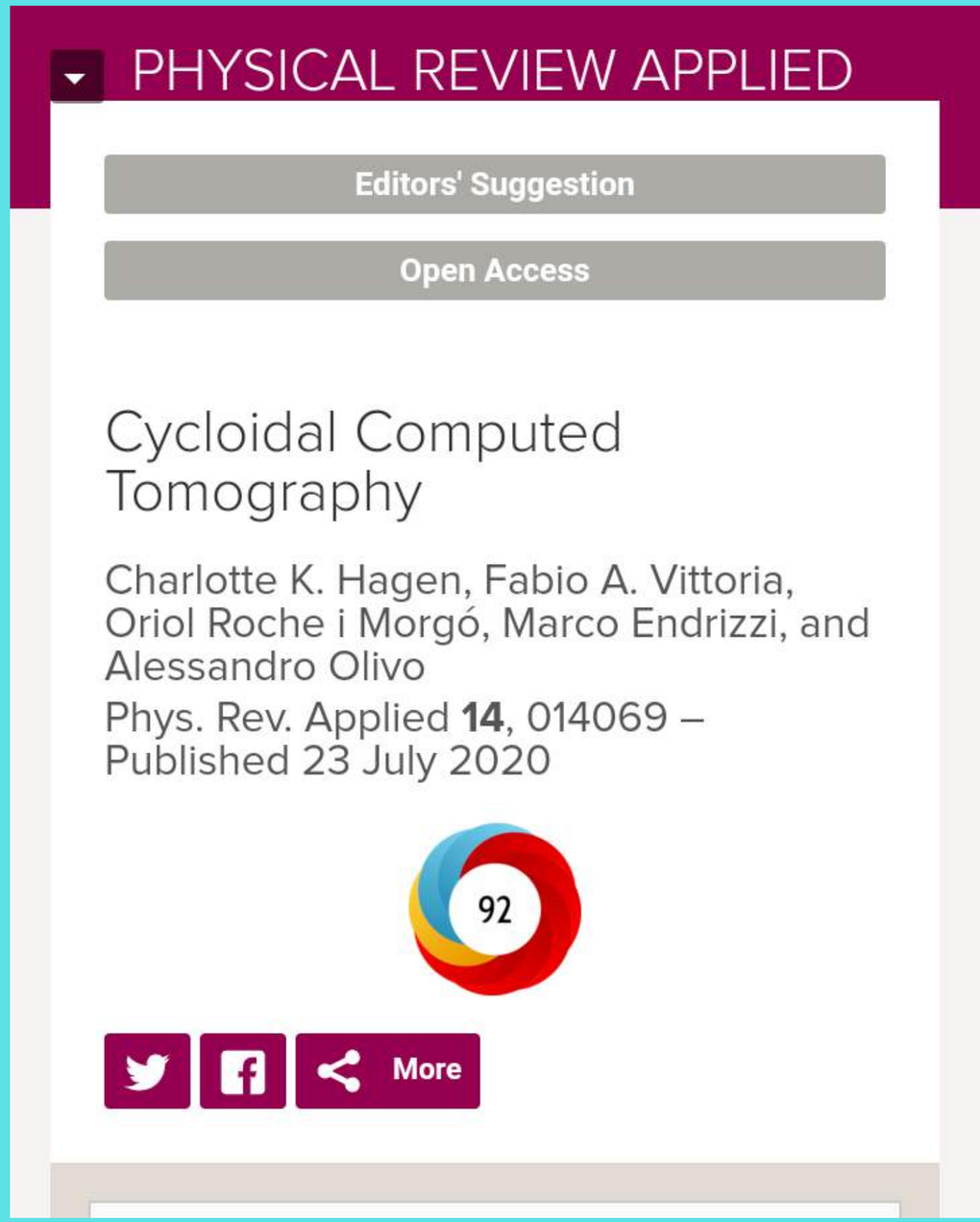


New developments

They move the sample in a cycloidal way quickly to ensure it is fully irradiates.

The quality of imaging is the SAME as normal CT scan or even better sharp images but at a lower dose.

Source: Hagen, C. et al (2020)



New developments

CT scan of the chest has been discovered to diagnose COVID-19 pneumonia.

A new filter called Golden Key tool and Convolution Neural networks can help improve quality of imaging and classify COVID-19 from normal cases and other lung diseases.

Source: Salamh et al. (2021)

Research Article | Open Access
Volume 2021 | Article ID 5554408 |
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A Study of a New Technique of the CT Scan View and Disease Classification Protocol Based on Level Challenges in Cases of Coronavirus Disease

Ahmed B. Salem Salamh [1], **Abdulrauf A. Salamah** [2] and Halil Ibrahim Akyüz [3]

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Academic Editor: André Luiz Ferreira COSTA

Published: 19 Mar 2021

New developments

This helps lower the workload of the radiologist and help in decision making!

Source: Salamh et al. (2021)

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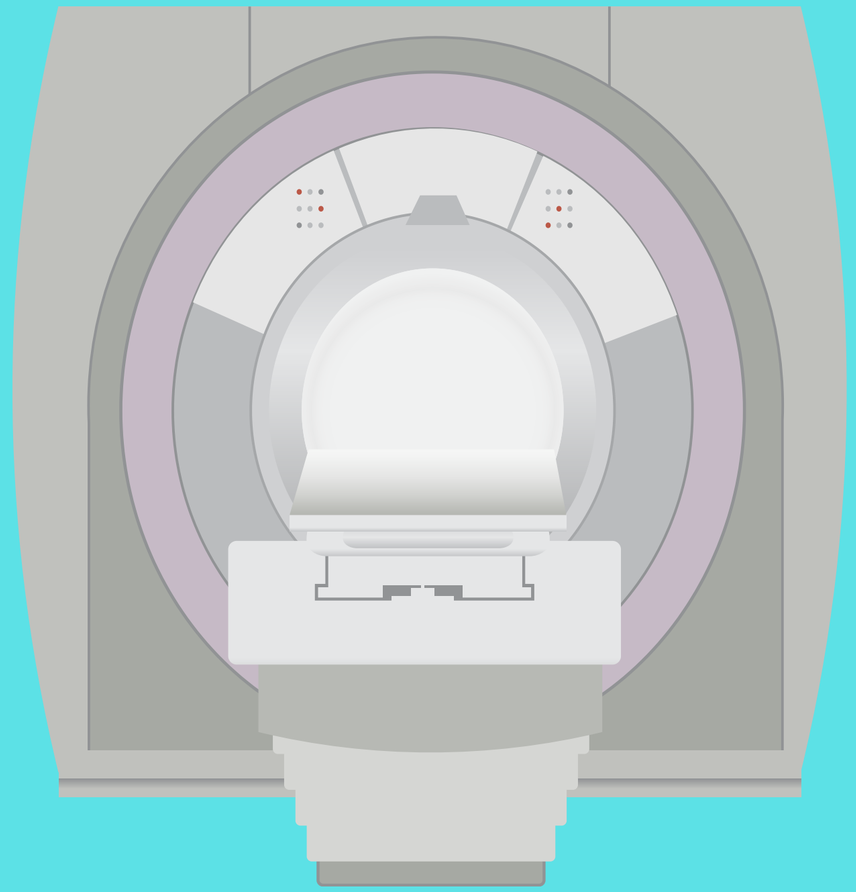
Overall, CT scan makes detailed images to help detect how different tumours have spread and aid in choosing the right treatment.

It also help detect other diseases too!



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Part 12: Diagnosis - Ultrasound scan

UPCOMING VIDEO RELEASING SOON!

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Hagen, C., Vittoria, F., Morgo, O., Endrizzi, M. and Olivo, A. (2020) Cycloidal Computed Tomography. Applied Physical Reviews 14, 014069.

Horton, K. Abrams, R. and Fishman, E. (2000) Spiral CT of Colon Cancer: Imaging Features and Role in Management. HomeRadioGraphics. 20 (2).

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Ahmed, B., Salamh, S., Salamah, A. and Akyuz, H. (2021) A study of a new technique of the CT scan view and disease classification protocol based on level challenges in cases of coronavirus disease. Radiology research and practice. 2021, 5554408.