



Radiology and Staging System

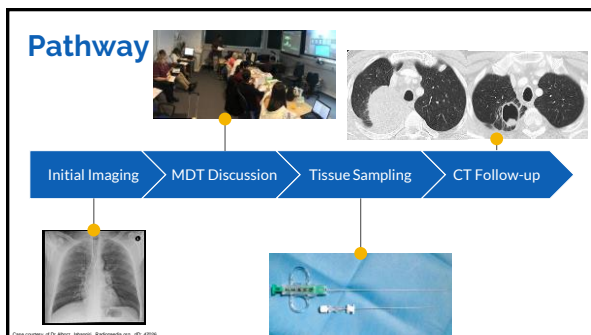




Dr Elena Stefan
The Princess Alexandra Hospital NHS Trust

Objectives

Role of the **Radiologist** in the Lung Cancer pathway.

- **Patient pathway**
Understanding a patient's route through the Radiology Department.
- **8th TNM Classification**
What changed? What are the challenges?
- **Tissue diagnosis**
My experience with CT-guided biopsy

- **Symptomatic patients**
 - Referred for X-ray by A&E or chest physician
 - GP referral for X-ray (cough, chest pain)
 - Referred for weight loss
- **Asymptomatic patients**
 - Incidental finding on CT performed for different pathology
 - Screening

GP Pathway

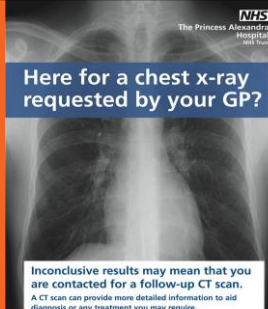
Abnormal GP chest X-ray straight to CT Pathway

- Implemented in November 2017
- Pathway has been speeded up by approx **7 days**
- This will speed up diagnosis and subsequent treatment

Evaluation of the first 18 months

- We look at imaging and histopathology
- Address IRMER requirements for direct recall of patients for CT
- Encourage patient awareness and find ways to reduce anxiety

We designed a poster that's displayed in the CT waiting rooms that aims to **reduce anxiety**.




Initial Imaging → MDT Discussion → Tissue Sampling → CT Follow-up

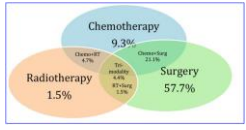
Multidisciplinary team meeting

- Patient's imaging is reviewed by radiologist prior to MDT meeting
- Relevant findings are discussed
- TNM classification and staging (usually once patient has had PET-CT)
 - Classification only done in multidisciplinary setting
- Decision for treatment is made

TNM 8th Edition




Region	Number	%
Europe	46,560	49
Asia	41,705	44
North America	4,660	5
Australia	1,593	1.7
South America	190	0.3
TOTAL	94,708	100



Rami-Porta et al. J Thorac Oncol 2014; 9: 1618-1624

TNM 8th Edition



Major changes in the 8th TNM edition for lung cancer

T descriptors

- Subdivisions T1-T2 with 1 cm increments till 5 cm
- T3-T4 new size criteria: 5-7 and >7 cm
- Subsolid lesion: invasive—solid part is measured for T factor
- Specific stage classification adapted to new T categories

N descriptors

- No changes—same nodal map as for 7th edition
- Subcategories suggested for N1 and N2 depending on number of stations involved


M descriptors

- M1b: single distant metastasis in a single organ
- M1c: multiple distant metastases in one or multiple organs

T, tumor; N, node; M, metastasis.

Adapted from Van Schil PE et al Ann Transl Med 2018; 10: 21037/atm.2017.06.45

TNM 8th Edition




T Component - 24 descriptors

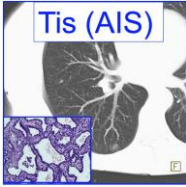
- Size (every cm counts!)
- Endobronchial location
- Atelectasis/pneumonitis
- Visceral pleural invasion
- Invasion of peripheral/central structures
- Separate tumour nodules in same lobe / same lung / contralateral lung

T₁	Tumor in situ/bronchus washings but not assessed in imaging or bronchoscopy
T₂	No evidence of tumor
T₃	Centimetric in situ
T_{1s}	≤ 3 cm surrounded by lung/visceral pleura, not involving main bronchus
T_{1mi}	Minimally invasive carcinoma
T_{1a}	≤ 3 cm
T_{1b}	> 3 to ≤ 4 cm
T_{1c}	> 4 to ≤ 5 cm
T₂	> 5 to ≤ 7 cm or involvement of main bronchus without carina, regardless of distance from carina or invasion visceral pleura or atelectasis or post obstructive pneumonitis extending to hilum
T_{2a}	> 5 to ≤ 6 cm
T_{2b}	> 6 to ≤ 7 cm
T₃	> 7 to ≤ 9 cm in greatest dimension or tumor of any size that involves chest wall, pericardium, phrenic nerve or satellite nodules in the same lobe
T₄	> 9 cm in greatest dimension or any tumor with invasion of mediastinum, diaphragm, heart, great vessels, recurrent laryngeal nerve, carina, trachea, esophagus, spine or separate tumor in different lobe of ipsilateral lung

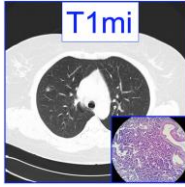
TNM 8th Edition



New T Categories




Tis (AIS)



T1mi

Travis W et al. J Thorac Oncol 2016; 11: 1204-1223.

Tumour size should always be measured in lung window



4.7 cm = T2b

5.2 cm = T3

Tumour size should always be measured in lung window.

TNM 8th Edition

T1a, T1b T1c

Tumour ≤1cm
Tumour >1cm, ≤2cm
Tumour >2cm, ≤3cm

Superficial spreading tumour of any size with its invasive component limited to the bronchial wall, which may extend proximal to the main bronchus in T1

Tumour ≤3cm; any associated bronchovascular invasion should not extend proximal to the lobar bronchus

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition

T1a, T1b T1c

Tumour ≤1cm
Tumour >1cm, ≤2cm
Tumour >2cm, ≤3cm

Superficial spreading tumour of any size with its invasive component limited to the bronchial wall, which may extend proximal to the main bronchus in T1

Tumour ≤3cm; any associated bronchovascular invasion should not extend proximal to the lobar bronchus

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition

T2a T2b

Tumour in the main bronchus < 3cm from the carina (without involvement of the carina) and/or associated atelectasis or obstructive pneumonia of the entire lung

Tumour >3cm, ≤4cm

Tumour ≤4cm; invasion of the visceral pleura

Tumour involves main bronchus, regardless of distance from carina but without carinal involvement

Associated atelectasis or obstructive pneumonia that extends to the hilar region, either involving part of the lung or the entire lung

Tumour >4cm, ≤5cm (with or without other T2 descriptions)

Note: If the tumour is associated with atelectasis or pneumonia, it is T2a if tumor < 4cm or if tumour size cannot be measured, it is T2b if tumor > 4cm, ≤ 5cm.

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition

T3

Tumour >3cm, ≤7cm

Chest wall invasion, including Pancoast tumours without invasion of costal body or spinal cord, involvement of the subcarinal vessels, or surgical resection of the superior branches of the bronchial plexus (S4 or above)

Invasion of parietal pleura

Phrenic nerve or parietal pericardium invasion

Separate tumour nodules in the lobe of the primary

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition

T4

Resected tumour with invasion of one or more of the following structures: costal body or spinal cord; main bronchus (S4 absent); subcarinal vessels

Tumour involves trachea and/or SVC, or other great vessel

Tumour involves aorta and/or ipsilateral brachial plexus

Tumour = T3m


Tumour accompanied by satellite nodules within different lobe

Tumour involves adjacent vertebral body

Tumour involves mediastinum and/or heart

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition



INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide

N Component


N-descriptors for the 8th edition, unchanged from the 7th

N-stage	Nodal descriptor
Nx	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in ipsilateral peribronchial and/or hilar lymph node and intrapulmonary node, including involvement by direct extension
N2	Metastasis in ipsilateral mediastinal and/or subcarinal lymph nodes
N3	Metastasis in contralateral mediastinal, contralateral hilar, ipsilateral, or contralateral scalene, or supraclavicular lymph node(s)

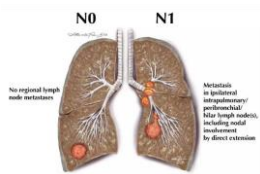
Adapted from Lim W et al. Quant Imaging Med Surg 2018 Mar 10:21037/qims.2018.08.02

[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition




INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide



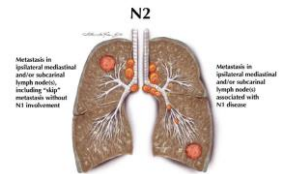
IASLC Staging Handbook in Thoracic Oncology

[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition




INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide



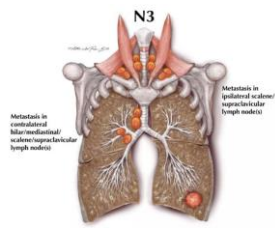
IASLC Staging Handbook in Thoracic Oncology

[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition




INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide



IASLC Staging Handbook in Thoracic Oncology

[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition



INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide

M Component

All intrathoracic metastases had similar prognosis


M1b - same prognosis as M1a

M-stage	Descriptor
M0	No distant metastasis
M1a	Separate tumor nodule(s) in a contralateral lobe; pleural nodules or malignant pleural or pericardial effusion
M1b	Single extrathoracic metastasis or involvement of a single distant (non-regional) node
M1c	Multiple extrathoracic metastases in one or several organs

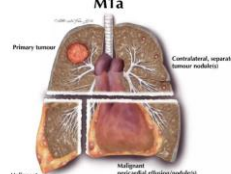
Adapted from Lim W et al. Quant Imaging Med Surg 2018 Mar 10:21037/qims.2018.08.02

[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition



INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide




*Note: when the pleural/pericardial effusions are negative after multiple microscopic examinations, and the fluid is macroscopically not an exudate, they should be excluded as a staging descriptor.

IASLC Staging Handbook in Thoracic Oncology


[Home](#) [Staging](#) [N1](#) [N2](#) [N3](#) [M1a](#) [M1b](#) [M1c](#) [M2](#) [M3](#)

TNM 8th Edition



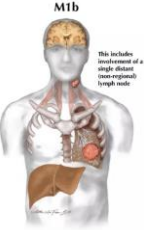
INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide

M1b



This includes involvement of a single distant non-regional lymph node.

M1b



This includes involvement of a single distant non-regional lymph node.

IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition



INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide

M1c



This includes multiple extrathoracic metastases in one or several organs.

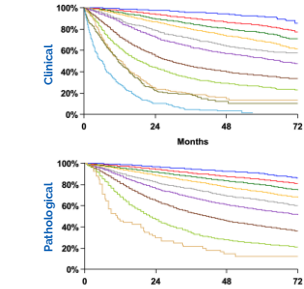
IASLC Staging Handbook in Thoracic Oncology

TNM 8th Edition

Stage groupings

	N0	N1	N2	N3	M1a any N	M1b any N	M1c any N
T1a	IA1	IB	IIIA	IIIB	IVA	IVA	IVB
T1b	IA2	IB	IIIA	IIIB	IVA	IVA	IVB
T1c	IA3	IB	IIIA	IIIB	IVA	IVA	IVB
T2a	IB	IIA	IIIA	IIIB	IVA	IVA	IVB
T2b	IIA	IIA	IIIA	IIIB	IVA	IVA	IVB
T3	IIIB	IIIA	IIIB	IIIC	IVA	IVA	IVB
T4	IIIA	IIIA	IIIB	IIIC	IVA	IVA	IVB

Goldstraw P et al. J Thorac Oncol 2016; 11: 39-51




Clinical

Pathological

Event/N	MEF	24 months	60 months	
IA1	80/174	NR	87%	80%
IA2	80/210	NR	84%	83%
IA3	54/247	NR	90%	77%
IB	80/132	NR	87%	80%
IIA	21/100	NR	73%	63%
IIA	80/143	88.0	72%	53%
IIA	20/200	29.3	55%	38%
IIIB	18/124	19.0	44%	28%
IIIC	8/100	12.0	24%	13%
IVA	33/44	11.5	23%	10%
IVB	3/3	6.0	10%	0%

Goldstraw P et al. J Thorac Oncol 2016; 11: 39-51

TNM 8th Edition



INTERNATIONAL ASSOCIATION FOR THE STUDY OF LUNG CANCER
Conquering Thoracic Cancer Worldwide

Multiple lesions - multiplicity defined by disease pattern

- Multiple primary tumours - one TNM for each tumour
- Separate tumour nodules - T3, T4, M1a
- Multiple adenocarcinoma with GGO/lepidic features - highest T (size / # of lesions) N M
- Pneumonic type adenocarcinoma - T3, T4, M1a

IASLC Staging Handbook in Thoracic Oncology

Initial Imaging
MDT Discussion
Tissue Sampling
CT Follow-up

Indication for needle biopsy

Oncological

- To establish the benign or malignant nature of a suspected tumour
- To classify a malignancy (including immunohistochemistry evaluation)
- To stage a patient with known (or suspected) malignant tumours elsewhere
- To obtain material for molecular analysis

Veltri A et al 2017 CIRSE Guidelines on Percutaneous Needle Biopsy

Contraindications

Absolute

- Refusal of consent
- Uncorrectable coagulopathy
- Lack of safe access

Relative

- Uncooperative patient
- Coagulopathies
- Significant comorbidities
- Pregnancy (radiation)

Indications → RPT Discussion → Tissue Sampling → Contraindications

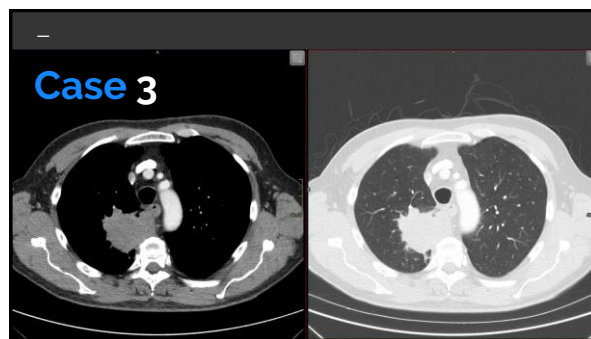
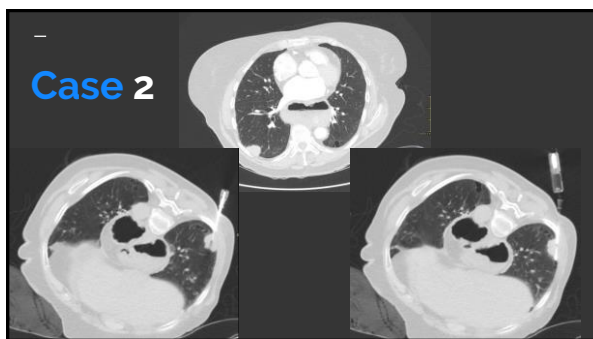
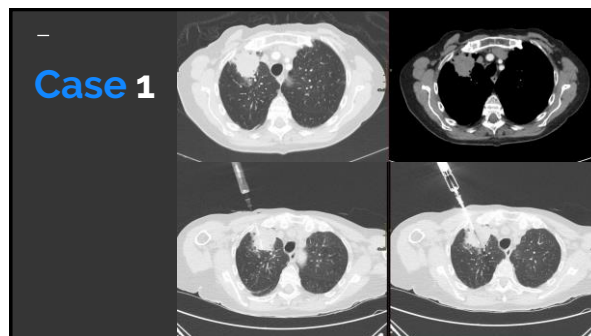
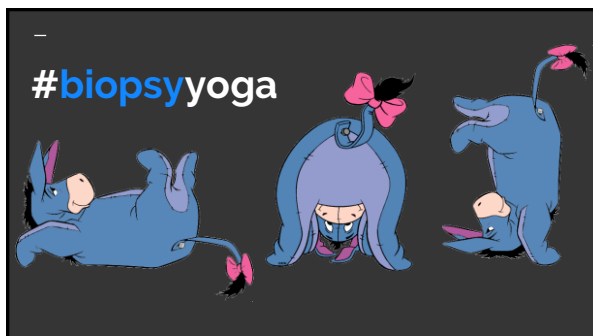
On the day

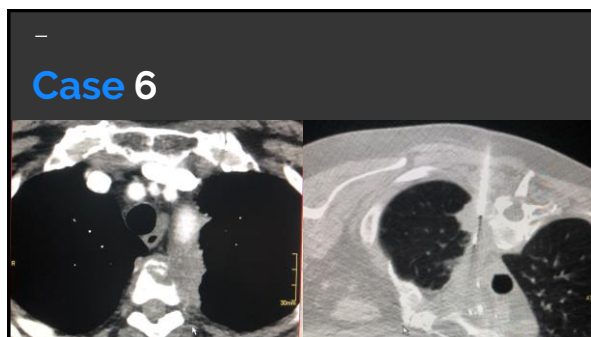
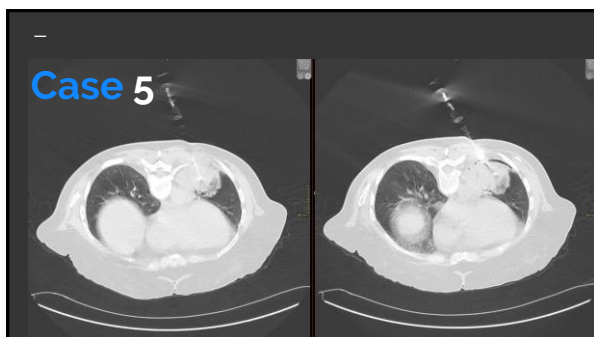
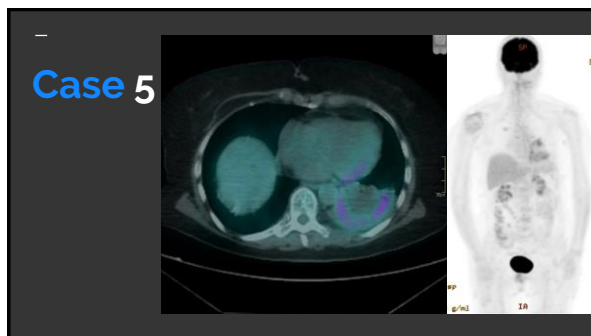
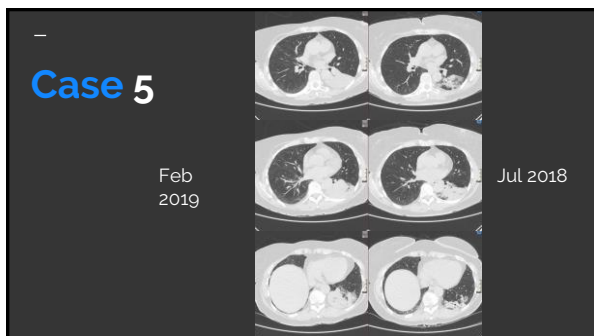
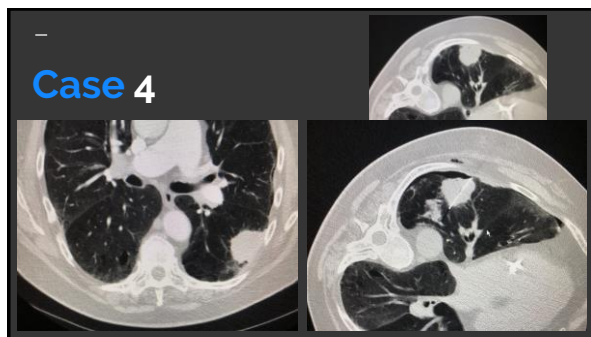
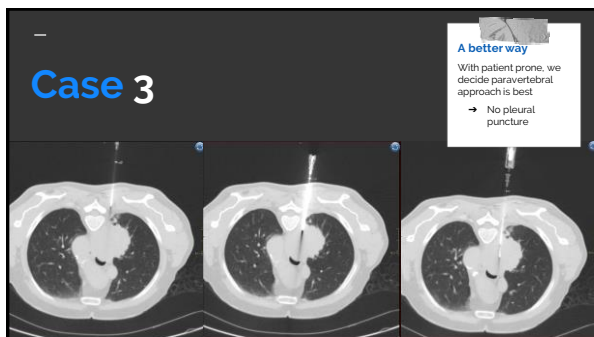
Informed consent is obtained

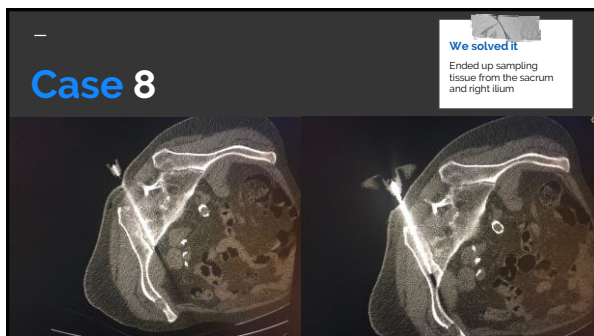
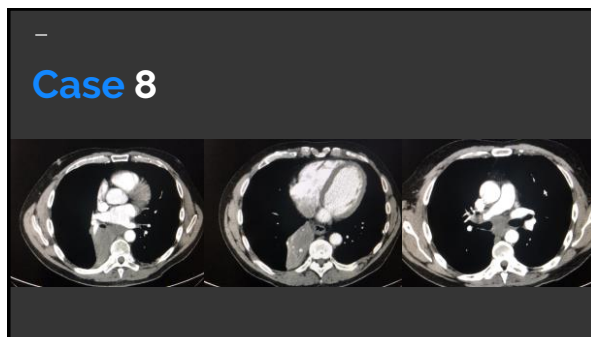
Blood tests results checked

Safety checklist in the CT room

Indications → RPT Discussion → Tissue Sampling → Contraindications







Initial Imaging
MDT Discussion
Tissue Sampling
CT Follow-up

CT Follow-up

- Assess disease burden, new lesions (RECIST, iRECIST)
- Post-treatment changes
- Incidental findings (pulmonary emboli, acute pathology, etc)

Role of imaging in the era of targeted therapy

- Slow progression
- Pseudo-progression
- Hyper progression
- Pneumonitis
- Decrease in density/cavitation of lung tumours

Initial Imaging
MDT Discussion
Tissue Sampling
CT Follow-up

CANCER IMAGING: DISRUPTING TECHNOLOGIES

1895

X-ray

radiograph

1956

Ultrasound

Grey-scale US

1972

CT

CT Scan

1973

MRI

MR imaging

1990

Hybrid

PET-MRI

2010

AI

DEEP LEARNING

Prof Koh DM, Attitudes and perceptions of AI and Machine Learning in Cancer Imaging

