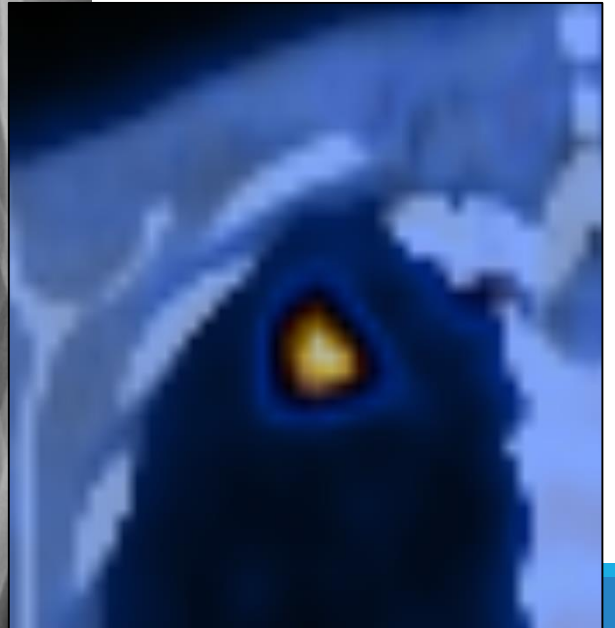
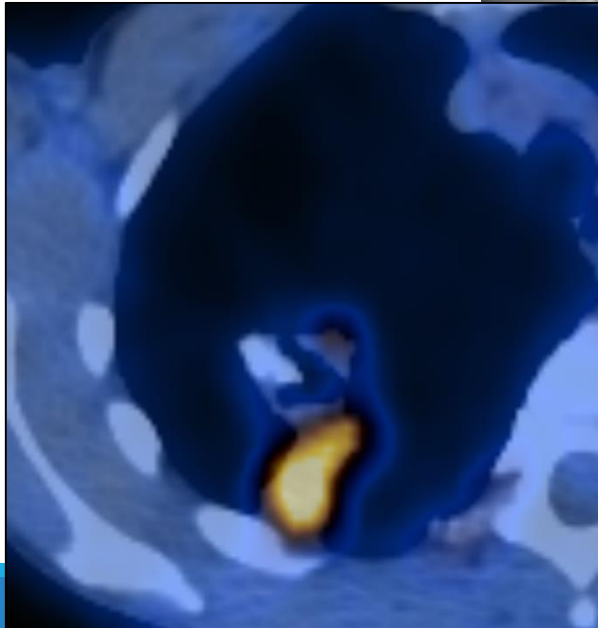
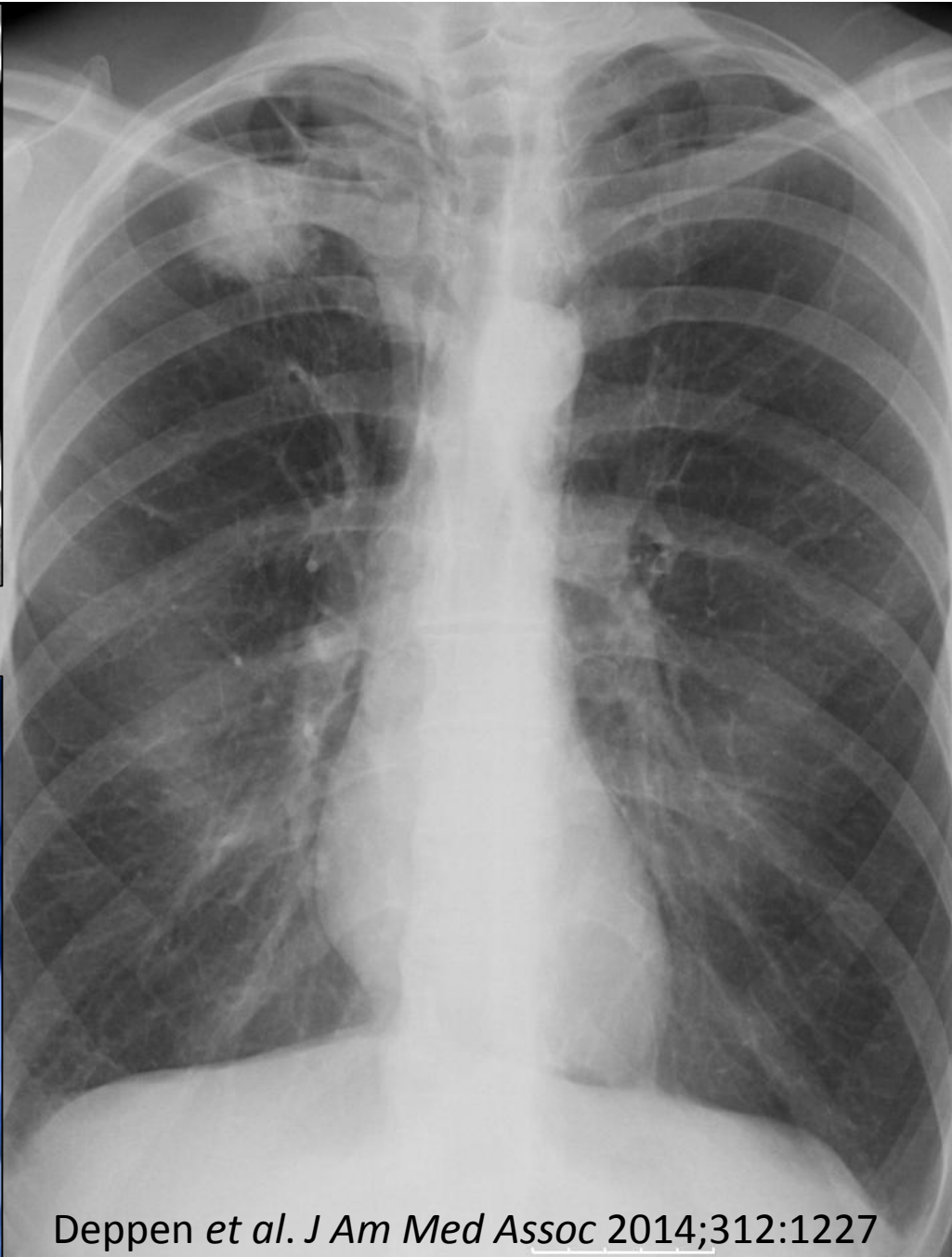


Advanced Radiographic Practice in Adult Chest Imaging

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Visiting Lecturer & PhD Student – Canterbury Christ Church University, Kent, UK



Deppen *et al.* *J Am Med Assoc* 2014;312:1227

Overview

- Why advanced radiographer practice?
- Justification of imaging requests
- Image acquisition & quality
- Why radiographer image interpretation?
- Evidence base: Radiographer reporting
- Contribution to patient care

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What is an Advanced Practitioner?

- Registered radiographer
- Postgraduate study & mentorship
- Defined scope of practice
- 4 key domains



The Society & College of
Radiographers



Why Advanced Practitioner Radiographers?

- Radiographers fundamental to the diagnostic pathway
- First practitioner to see the image
- Provide complete service:
justification – acquisition – interpretation

-
- Why advanced radiographer practice?
 - **Justification of imaging requests**
 - Image acquisition & quality
 - Why radiographer image interpretation?
 - Evidence base: Radiographer reporting
 - Contribution to patient care

Justification of Medical Exposures

- Legislation in UK regarding medical radiation exposures: IR(ME)R 2000
- Referring clinician required to explain clinical benefit, detailed to enable exposure
- Radiographers act as gatekeepers

-
- Why advanced radiographer practice?
 - Justification of imaging requests
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 - Why radiographer image interpretation?
 - Evidence base: Radiographer reporting
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Image Acquisition & Quality

- Request queries
- Assist/mentor junior radiographers & assistant practitioners
- Initial interpretation
- Plain imaging queries & patient questions
- Lead quality audits

-
- Why advanced radiographer practice?
 - Justification of imaging requests
 - Image acquisition & quality
 - **Why radiographer image interpretation?**
 - Evidence base: Radiographer reporting
 - Contribution to patient care

Evolution of Radiographer Image Interpretation

- Swinburne (1971) “pattern recognition” by trained radiographers
- Berman *et al.* (1985) “red dot” for MSK trauma
- College of Radiographers [UK] (2013) Preliminary Clinical Evaluation and Clinical Reporting by Radiographers: Policy and Practice Guidance

-
- Why advanced radiographer practice?
 - Justification of imaging requests
 - Image acquisition & quality
 - Why radiographer image interpretation?
 - **Evidence base: Radiographer reporting**
 - Contribution to patient care

Evidence Base – Skeletal

- Piper *et al.* (2005) Structured exam: 27 radiographers; ~2,700 x-rays; sensitivity (93%), specificity (92%) and accuracy (93%)
- Piper *et al.* (1999) Multisite clinical evaluation: 10 radiographers; 7,170 reports; accuracy 97% - 99%
- Brealey *et al.* (2005) Meta-analysis provided definitive evidence: 28,900 examinations; 92% sens 97% spec

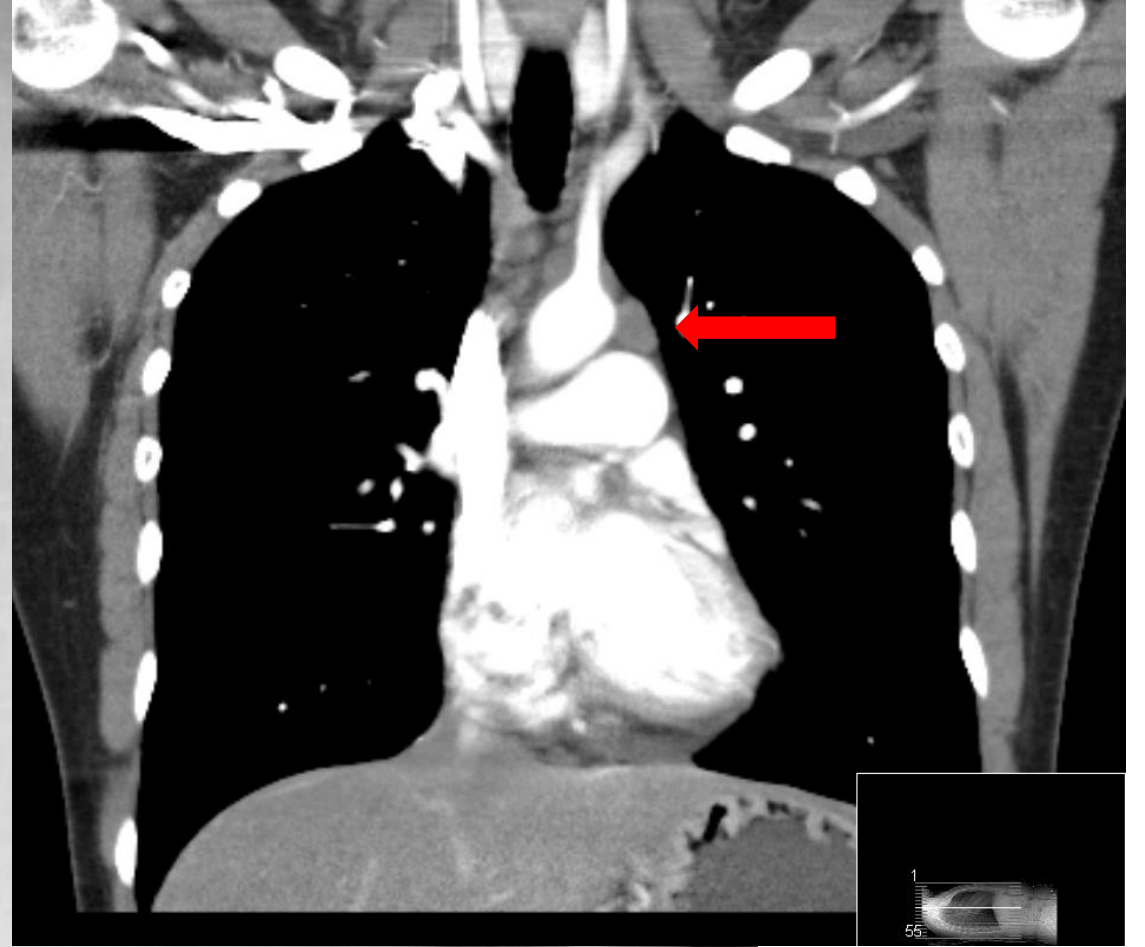
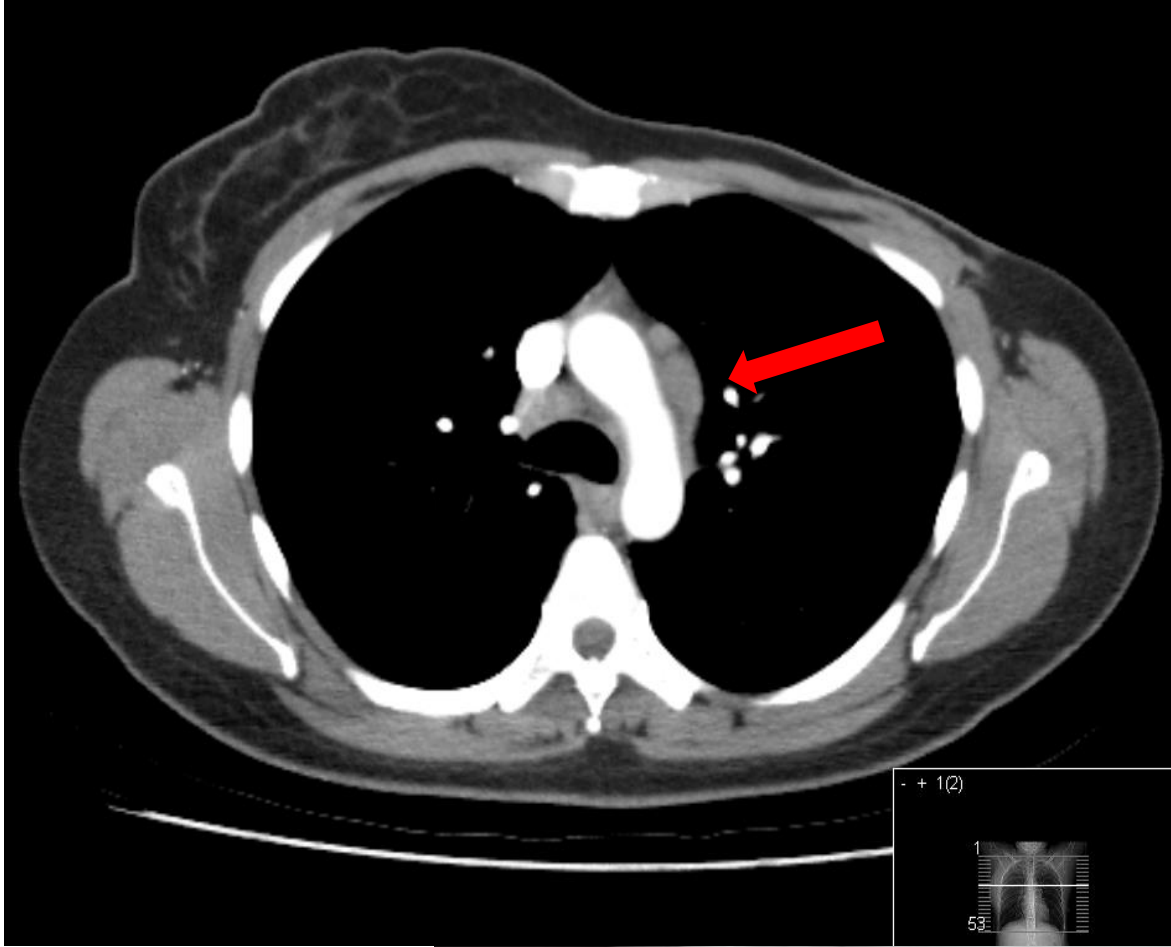
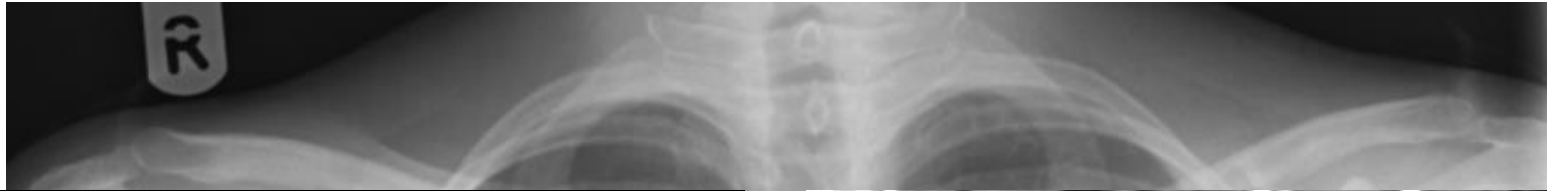
Evidence Base – Chest X-rays

- Sheft *et al.* (1970) Cancer detection in CXR image bank: 100 cases; 2 radiographers – 4 & 8 FN, 2 radiologists – 7 & 8 FN
- Flehinger *et al.* (1978) Clinical evaluation: ~3,000 x-rays; 2 radiographers; Low FN errors (2% & 3.2%) when reading with consultant radiologists
- Sonnex *et al.* (2001) 'Red Dot' system in specialist hospital; High sensitivity (90%) & specificity (99%)

From Abnormality Detection to Definitive Reporting

Chest X-rays – Definitive Radiographer Reports

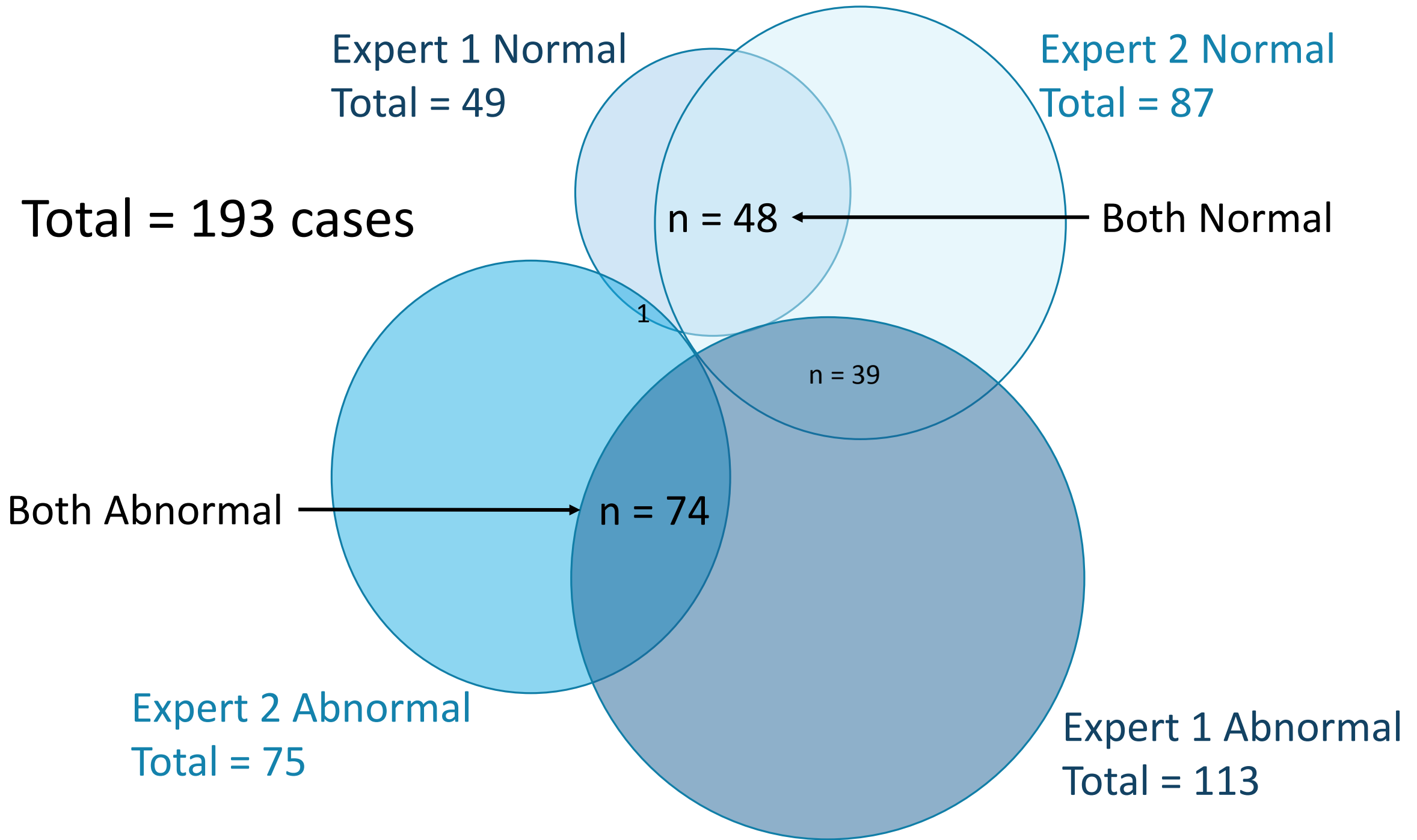
- Piper *et al.* (2014) Structured examination: 40 radiographers, 4,000 CXRs; 95% sensitivity & specificity, 89% agreement
- Woznitza *et al.* (2014) Clinical audit: 100 cases; 1 radiographer, 3 consultant radiologists; high concordance 92% (K = 0.83), 96% (K = 0.91), 96% (K = 0.91)

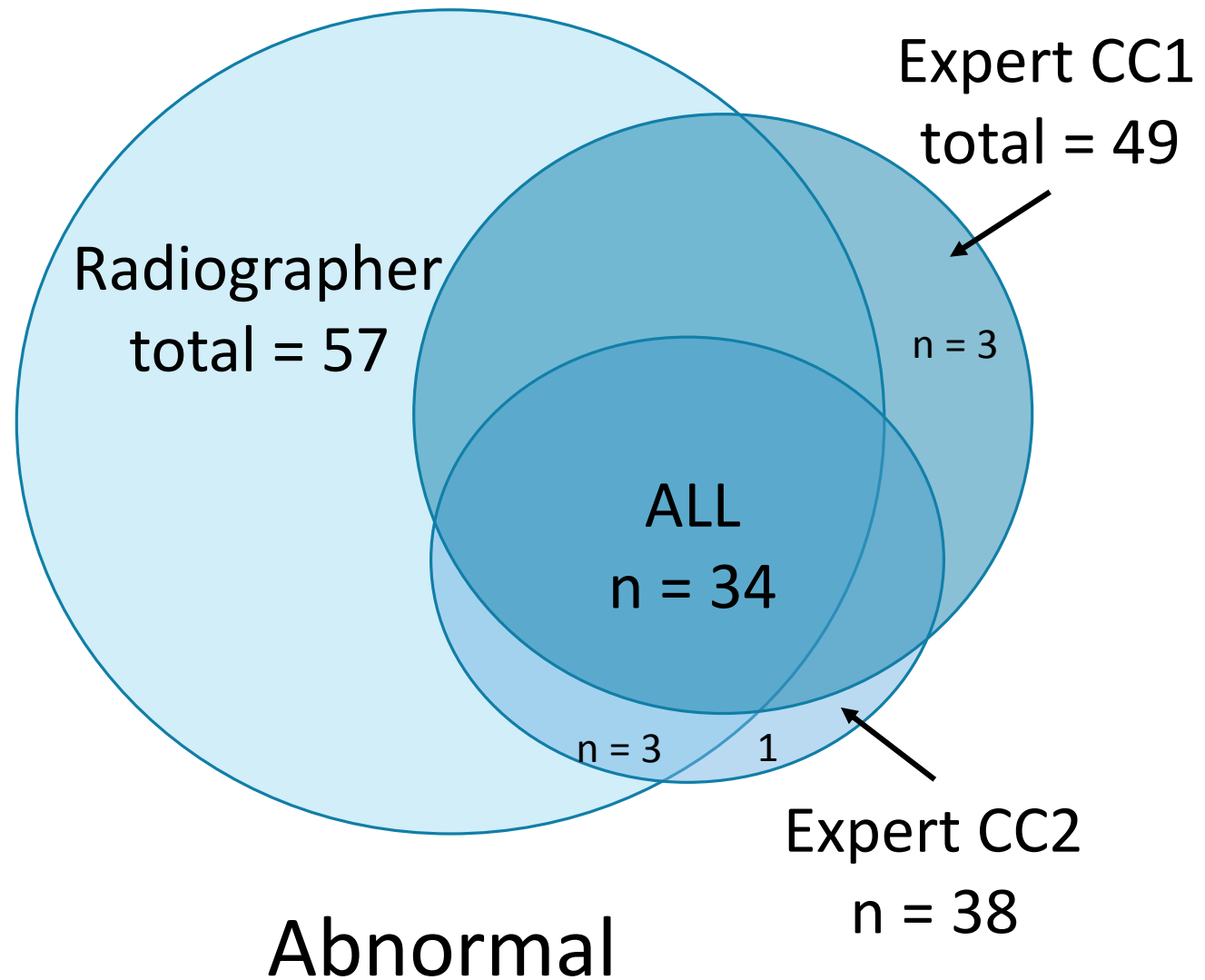
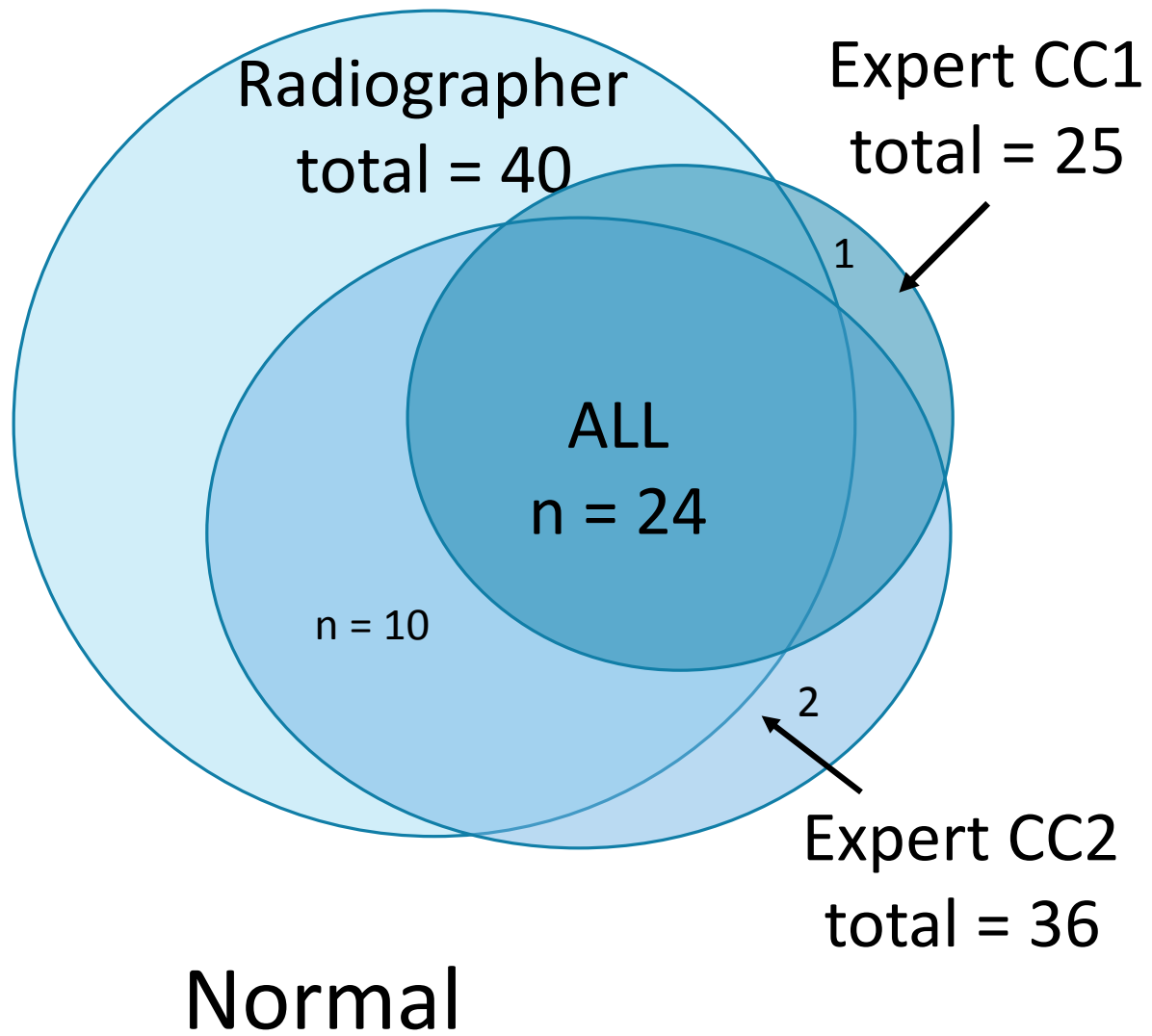


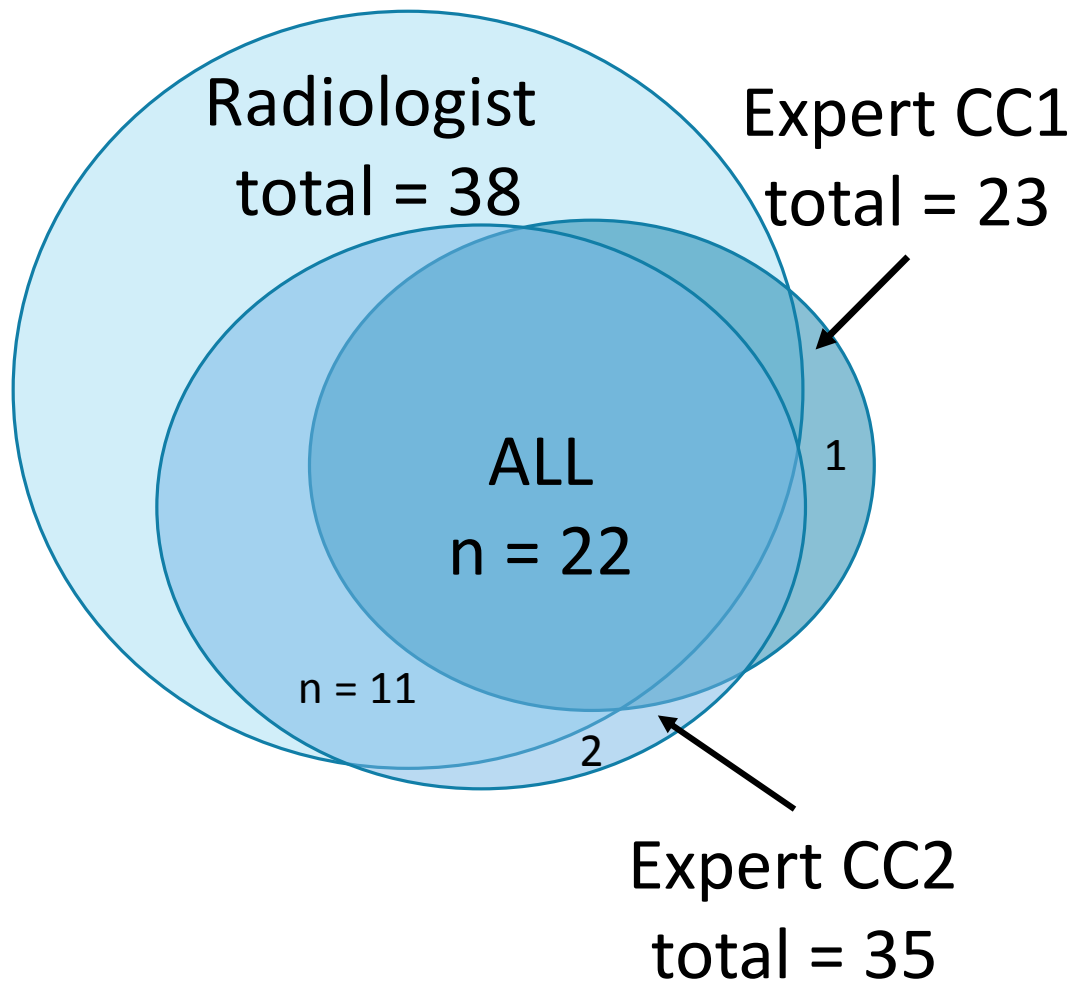
Robust Clinical Audit with Independent Expert Chest Radiologists

Chest X-rays – Agreement of Experts

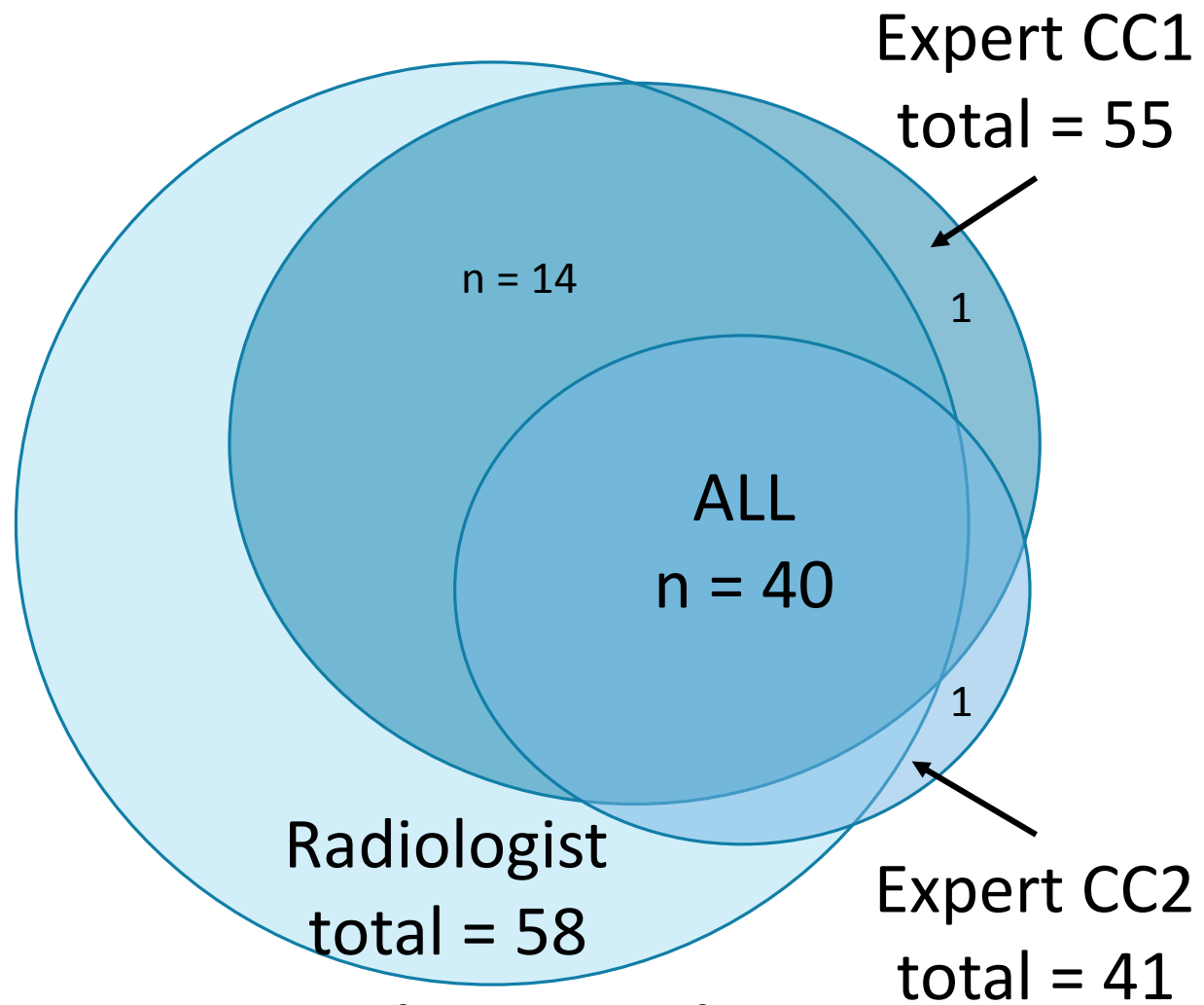
- Random stratified sample of CXRs
- Two independent expert consultant chest radiologists, blinded to clinical report
- Reports compared for agreement: Kappa [K] and McNemar statistics
- 193 cases included; 79 (41%) normal clinical report





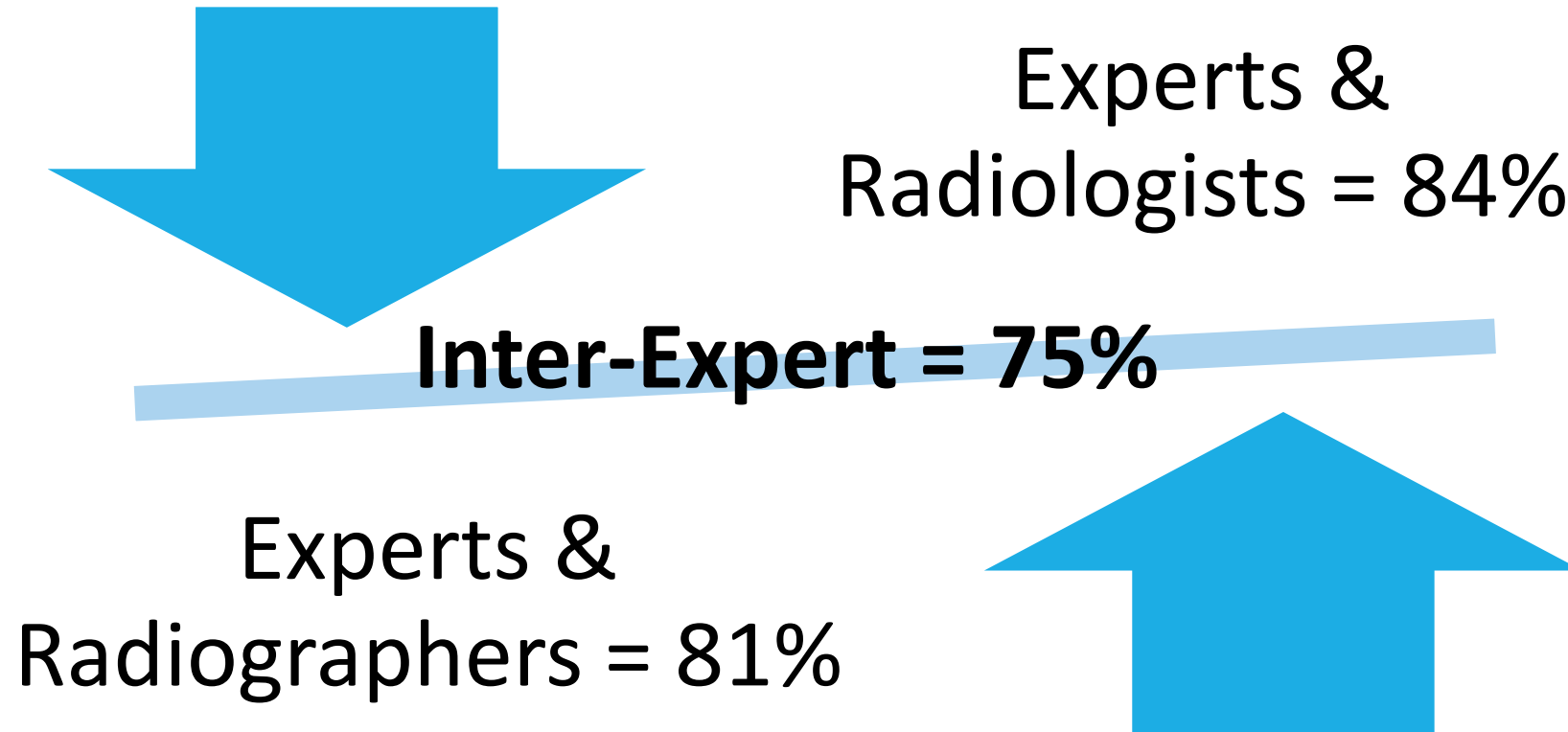


Normal

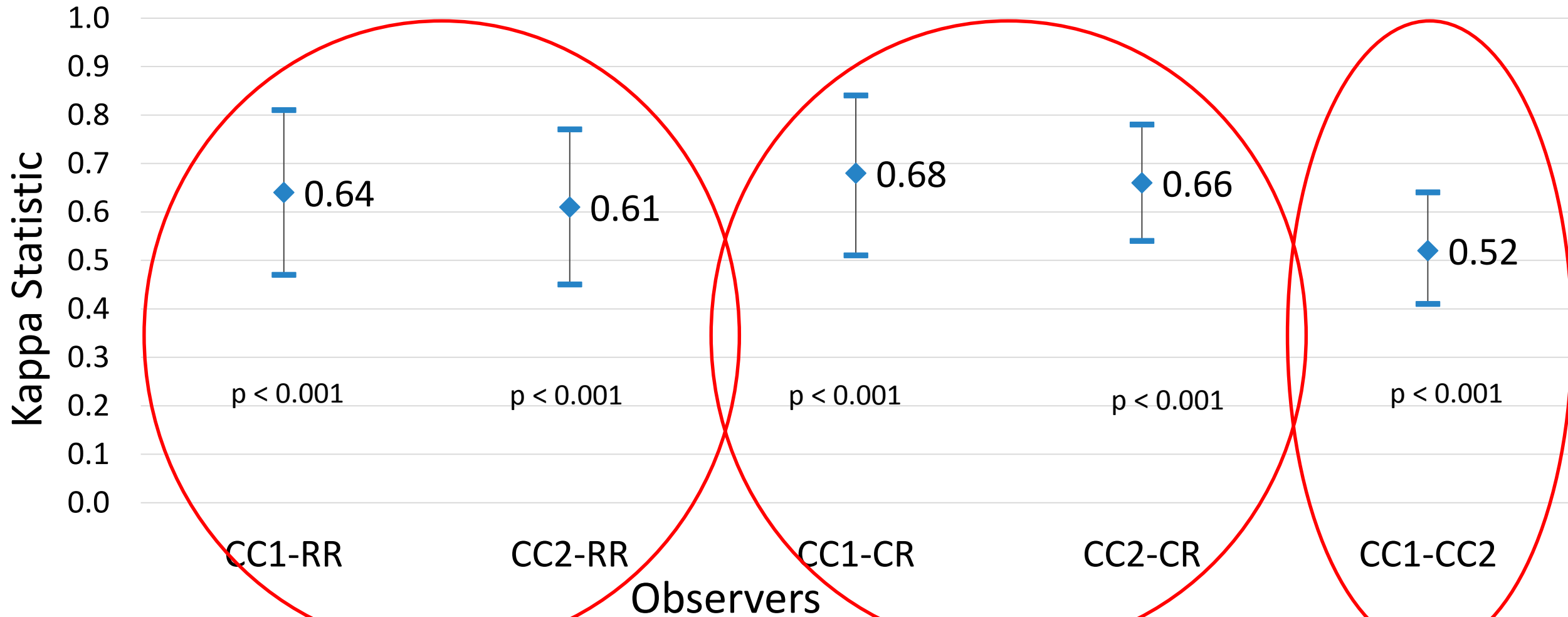


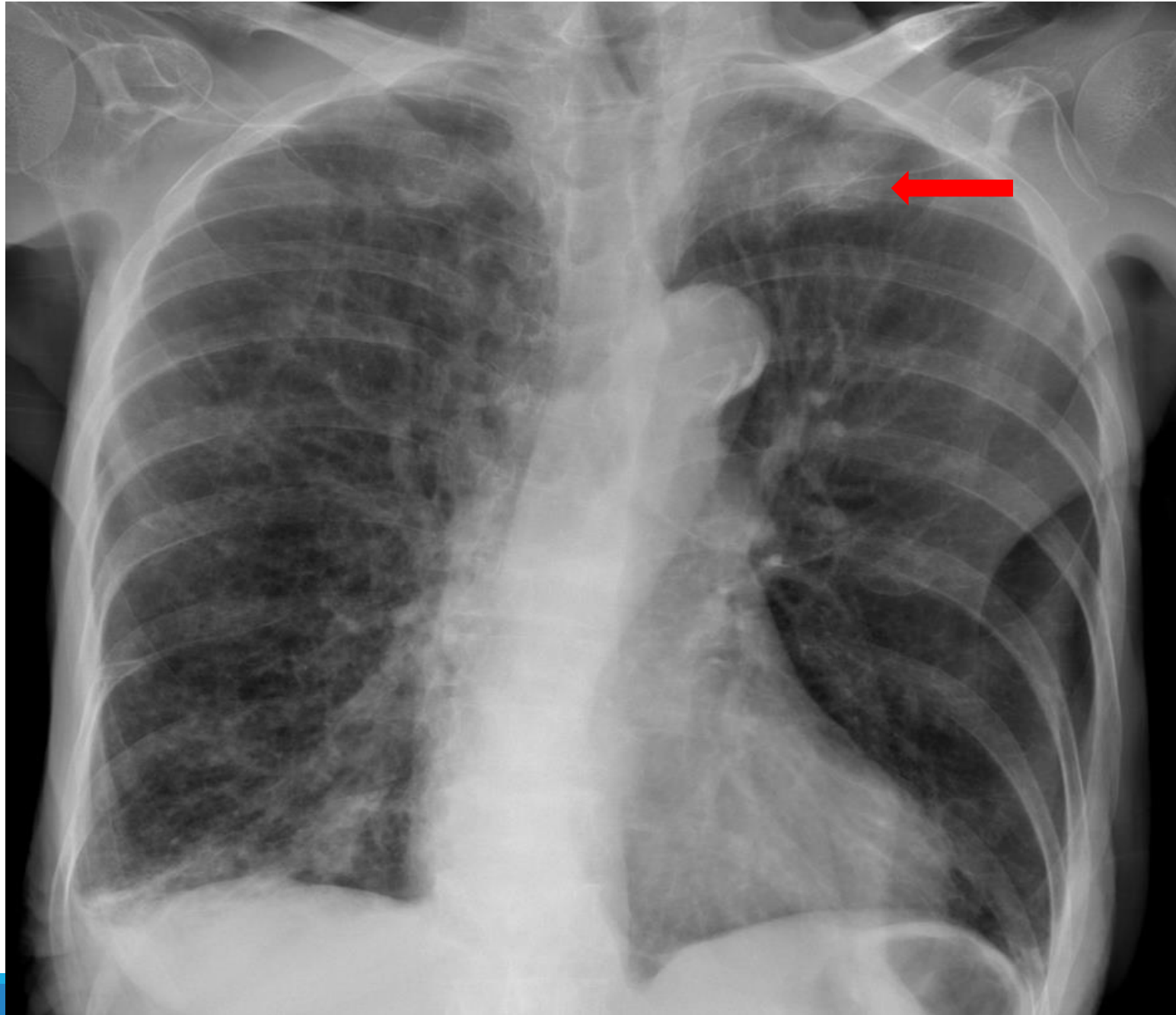
Abnormal

Observer Agreement: Experts & Clinical Report

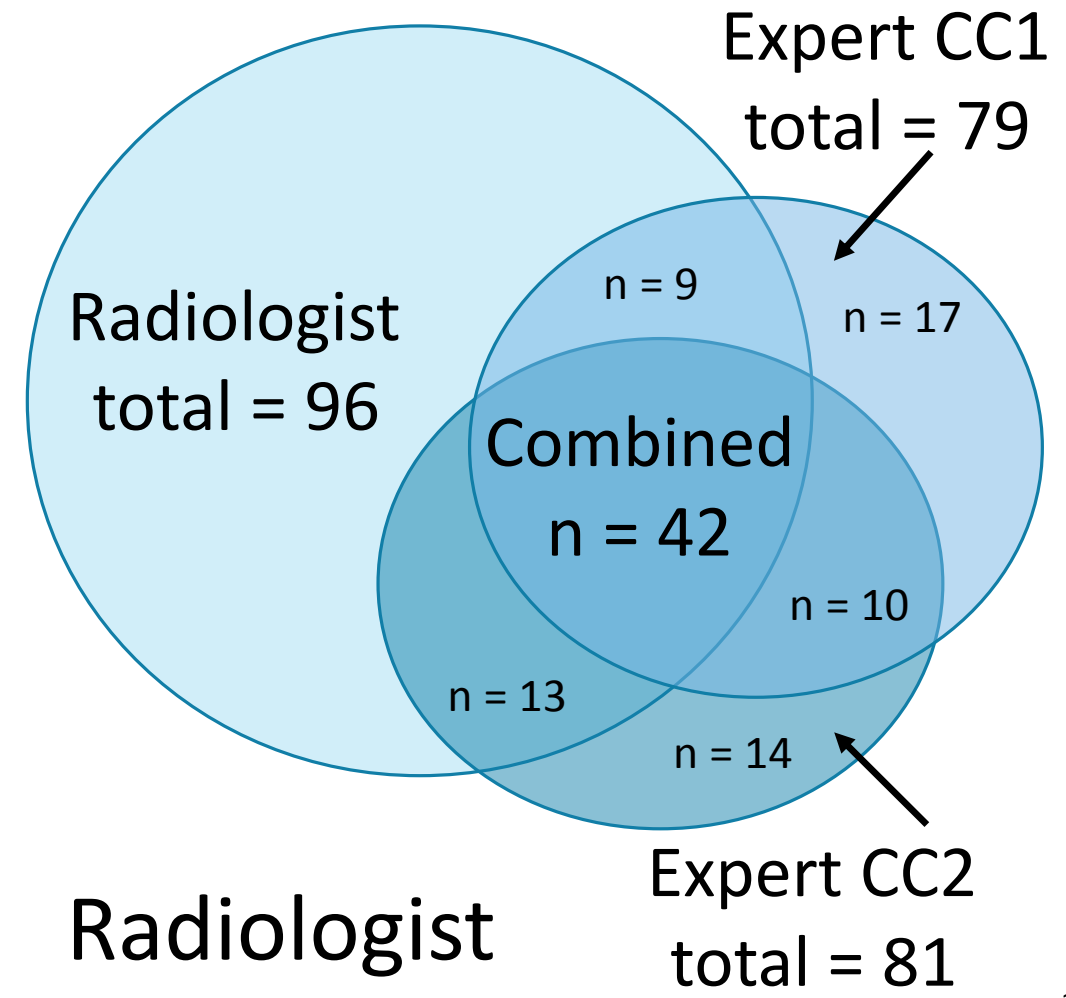
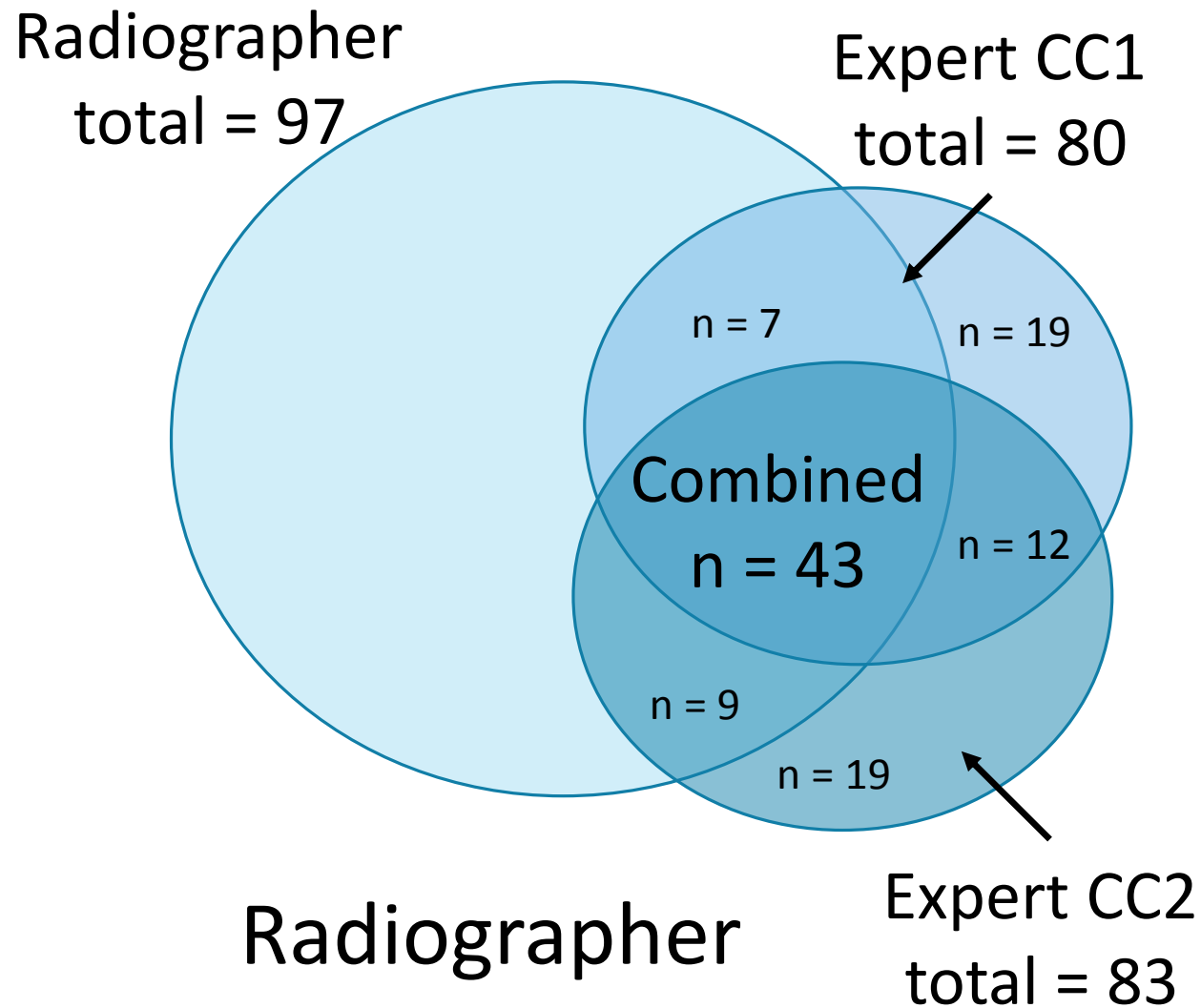


Observer Agreement: Kappa

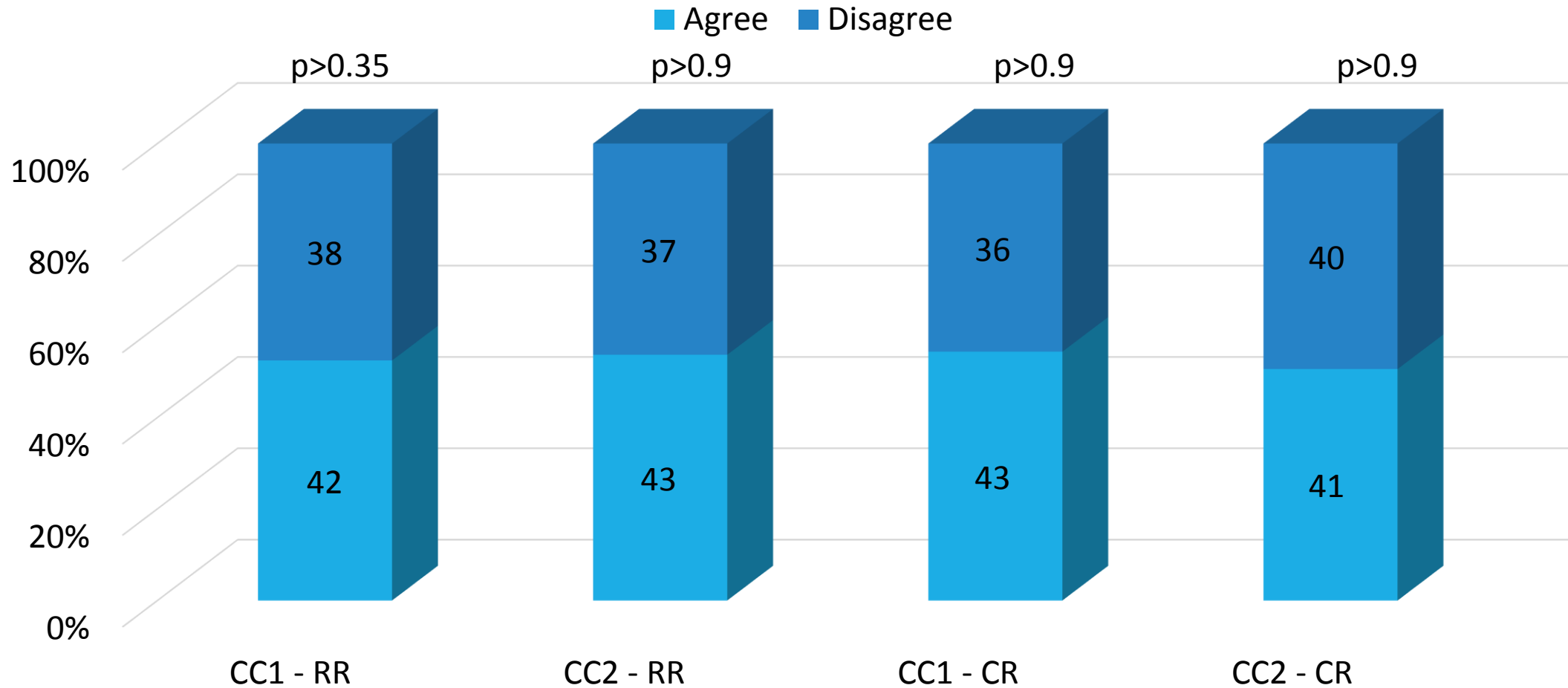




Observer Agreement: Experts & Radiographer Clinical Report



Report Agreement: Experts & Clinical Report



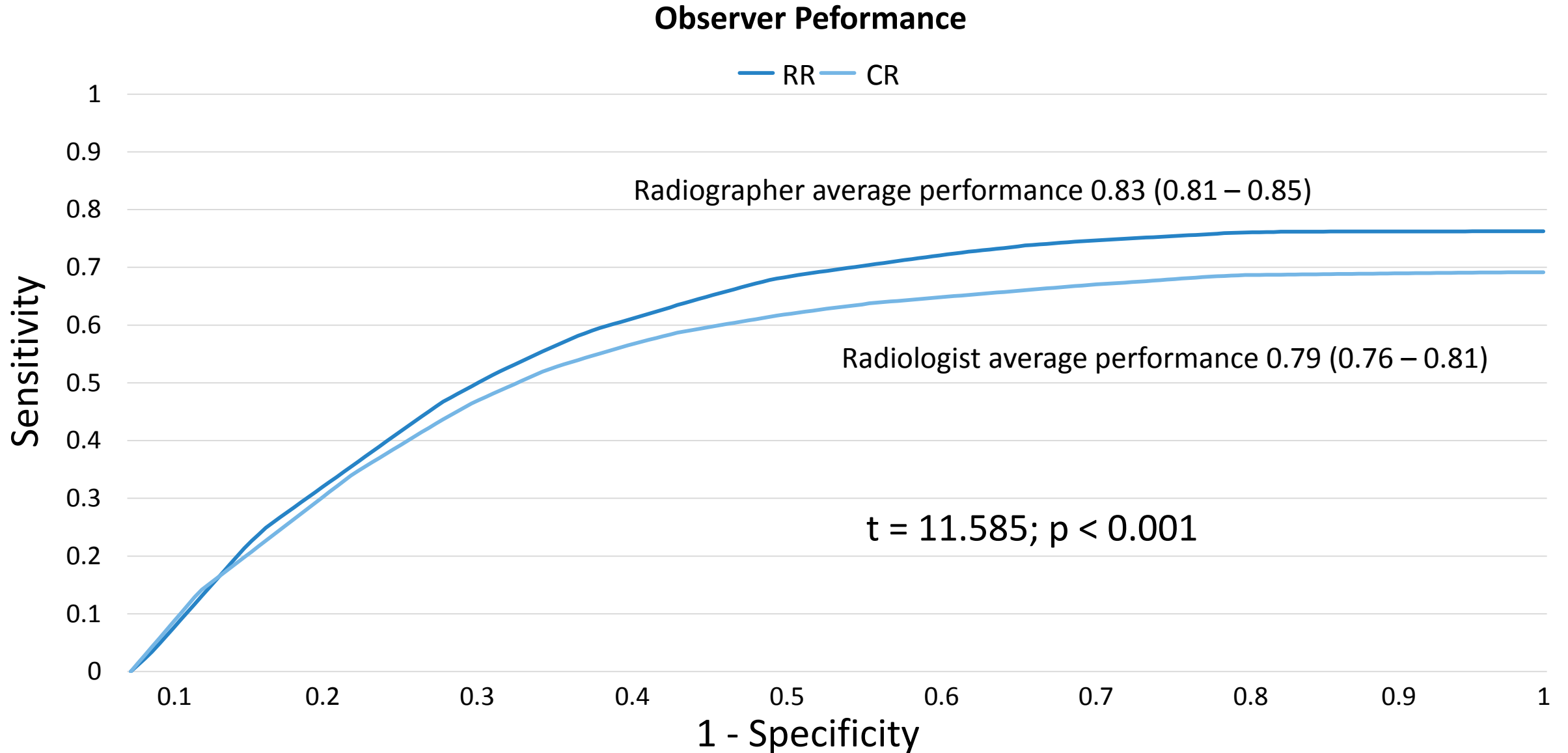
CC1 = Expert 1 CC2 = Expert 2 RR = Reporting Radiographer CR = Consultant Radiologist

Rigorous Assessment of Chest X-ray Diagnostic Accuracy: Comparison between Consultant Radiologists and Reporting Radiographers

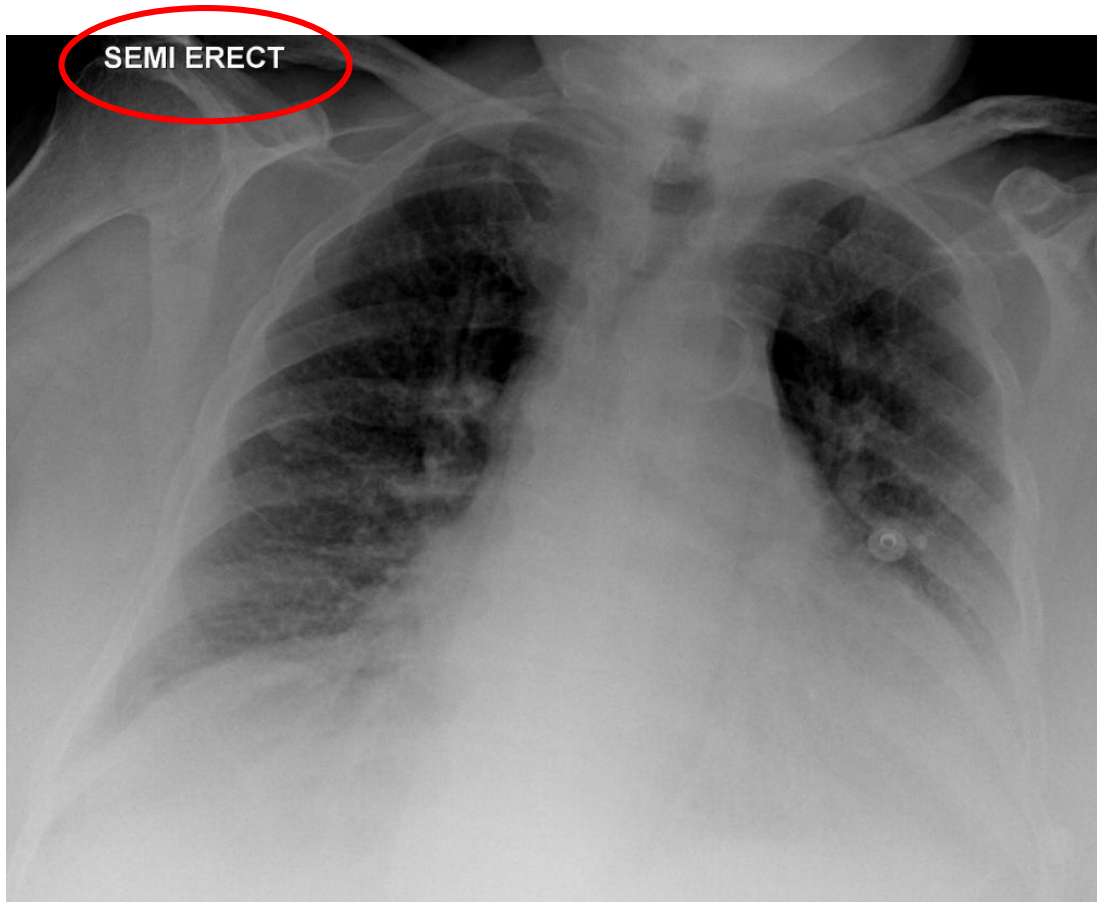
Diagnostic Accuracy – Adult Chest X-rays

- 10 consultant radiologists & 11 reporting radiographers
- 106 adult chest x-rays with robust reference standard diagnosis
- Normal reporting conditions
- Reporting radiographers must be comparable to consultant radiologists

Diagnostic Accuracy – Figure of Merit

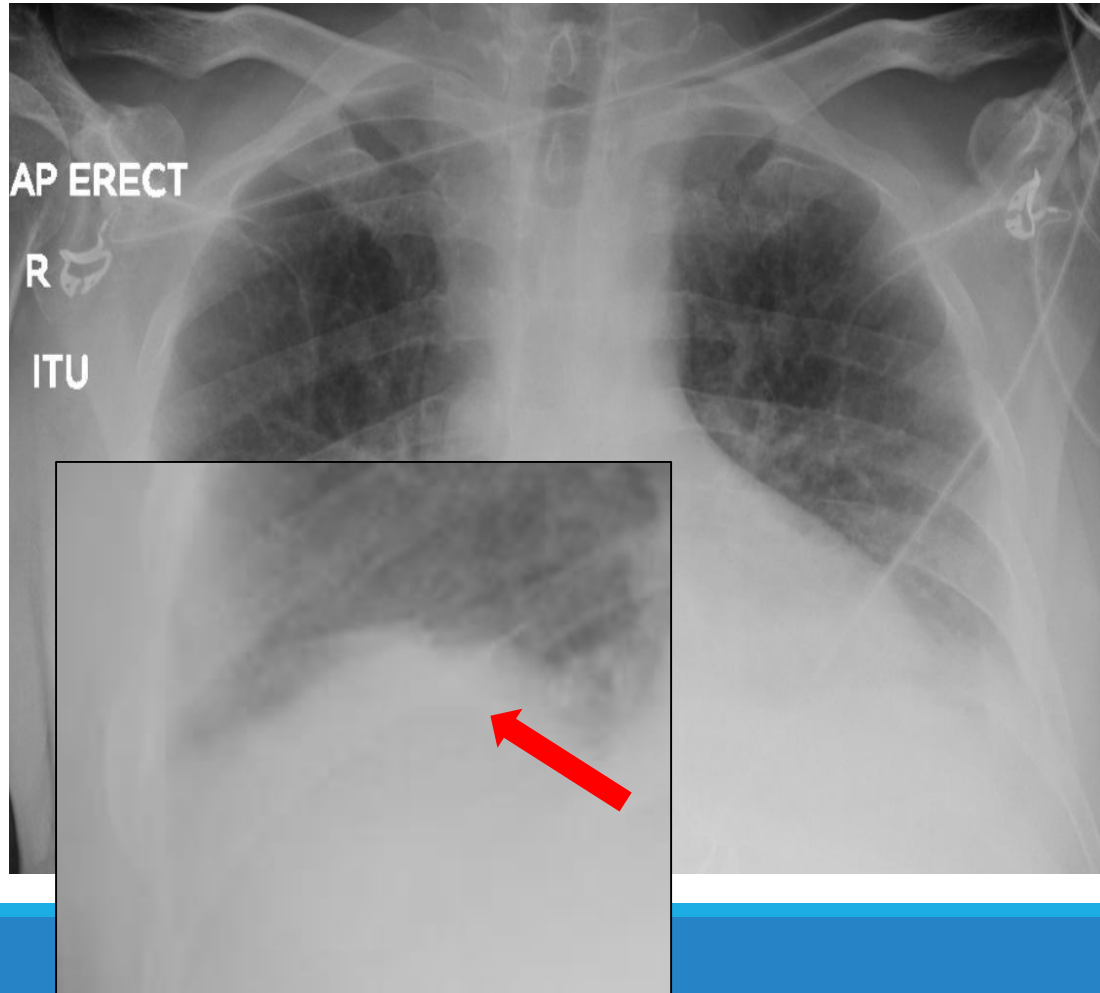


Pathology: False Positives



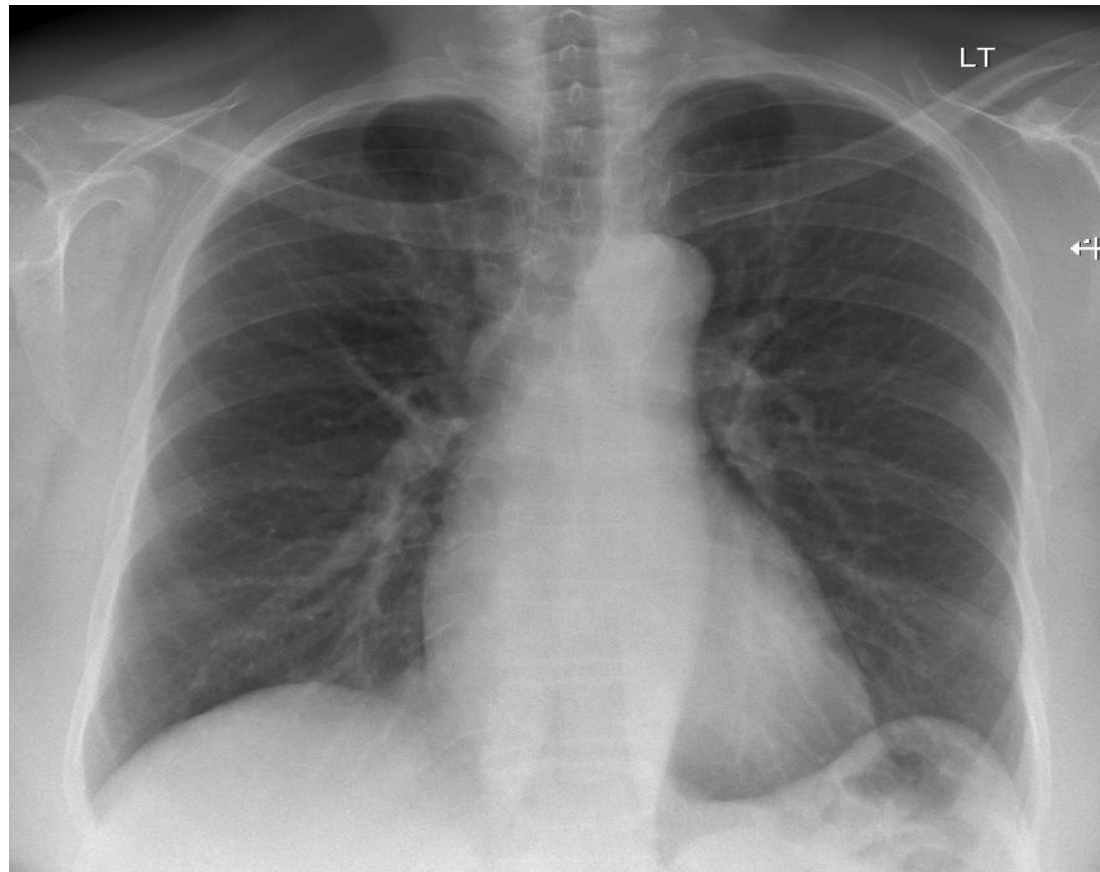
Feature	Observations	
	RR	CR
Cardiomegaly	71	57

Pathology: False Positives



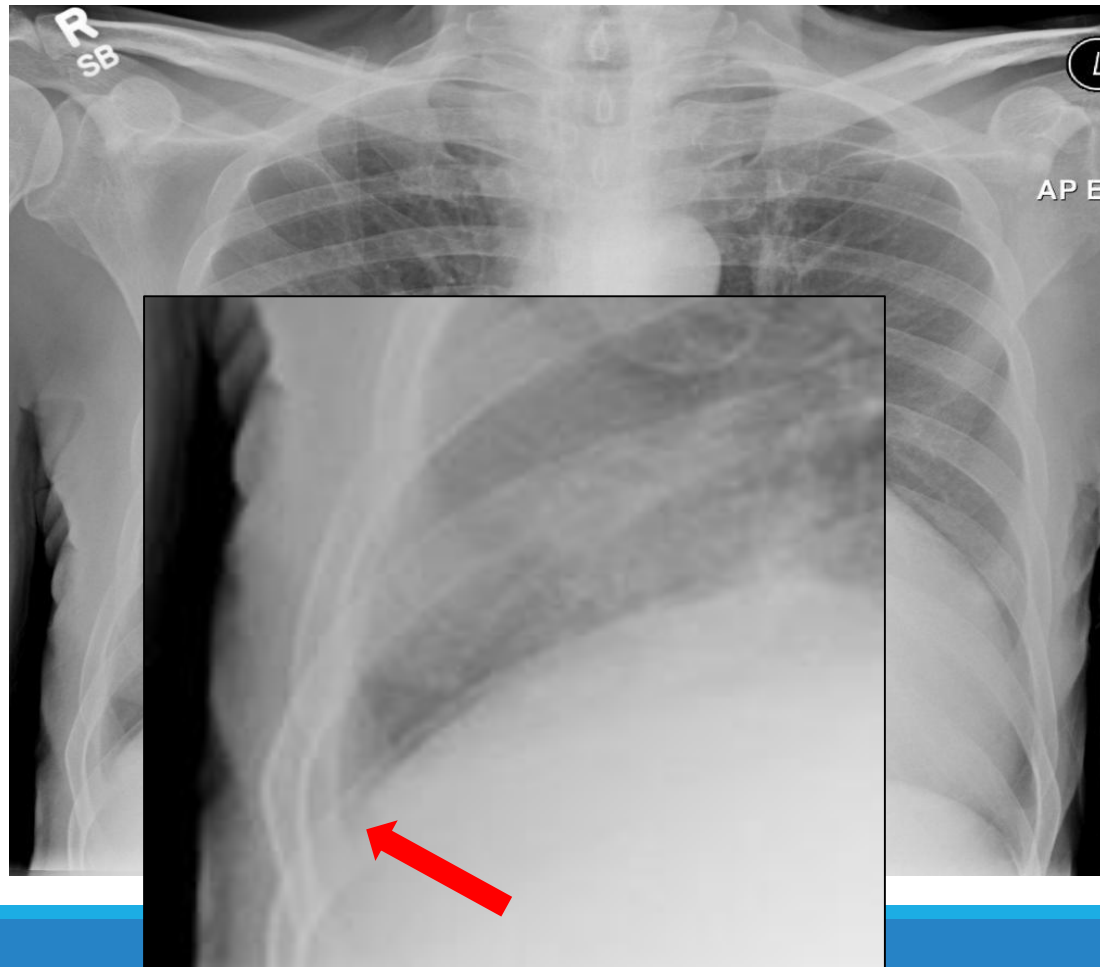
Feature	Observations	
	RR	CR
Cardiomegaly	71	57
Unilateral Consolidation	52	61

Pathology: False Positives



Feature	Observations	
	RR	CR
Cardiomegaly	71	57
Unilateral Consolidation	52	61
Chronic Obstructive Pulmonary Disease	40	32

Pathology: False Negatives



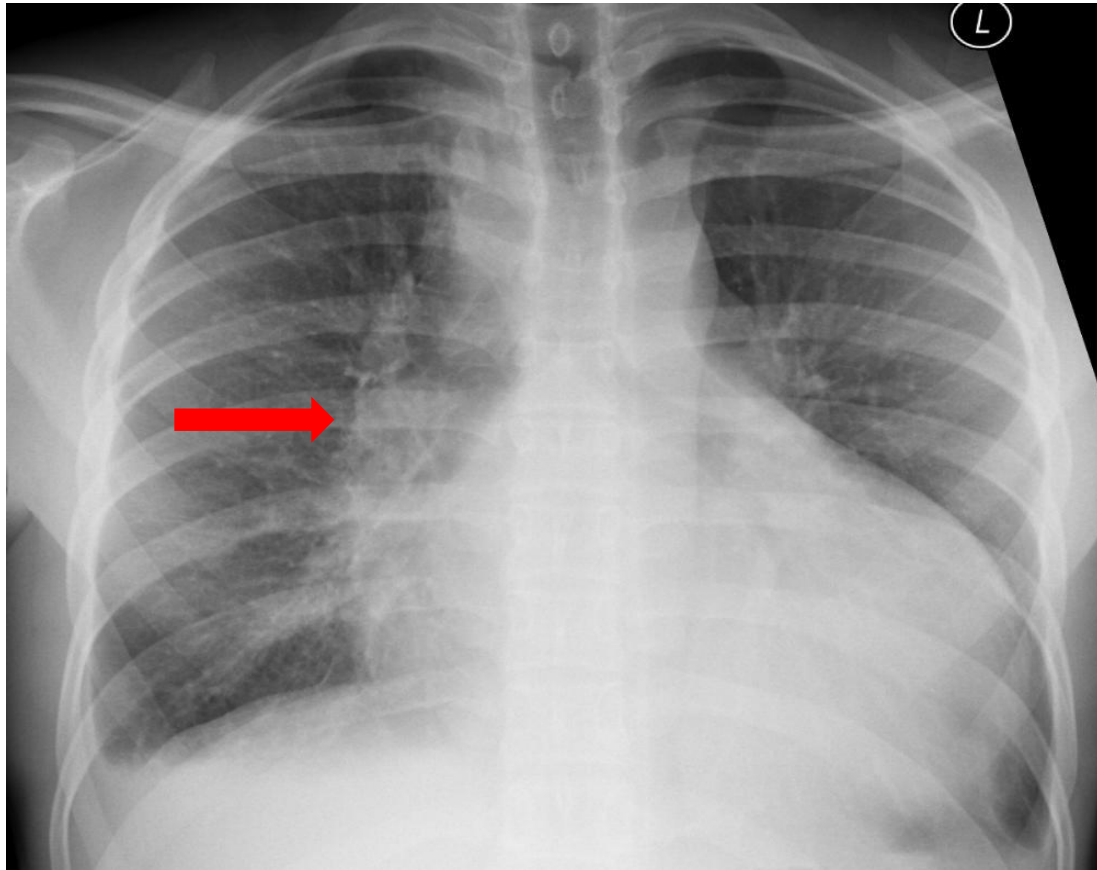
Feature	Observations	
	RR	CR
Unilateral Pleural Effusion	36	32

Pathology: False Negatives

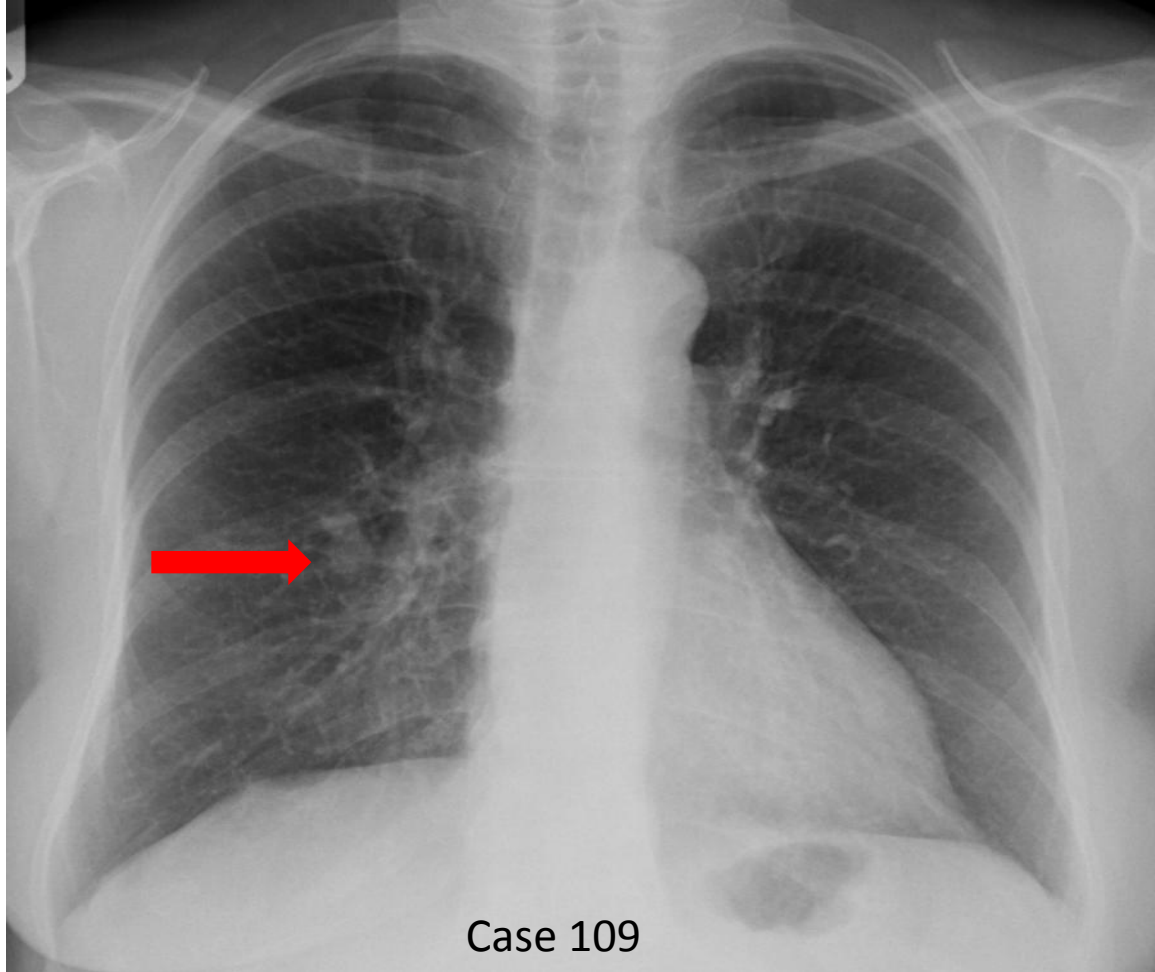


Feature	Observations	
	RR	CR
Unilateral Pleural Effusion	36	32
Interstitial Opacification	19	22

Pathology: False Negatives

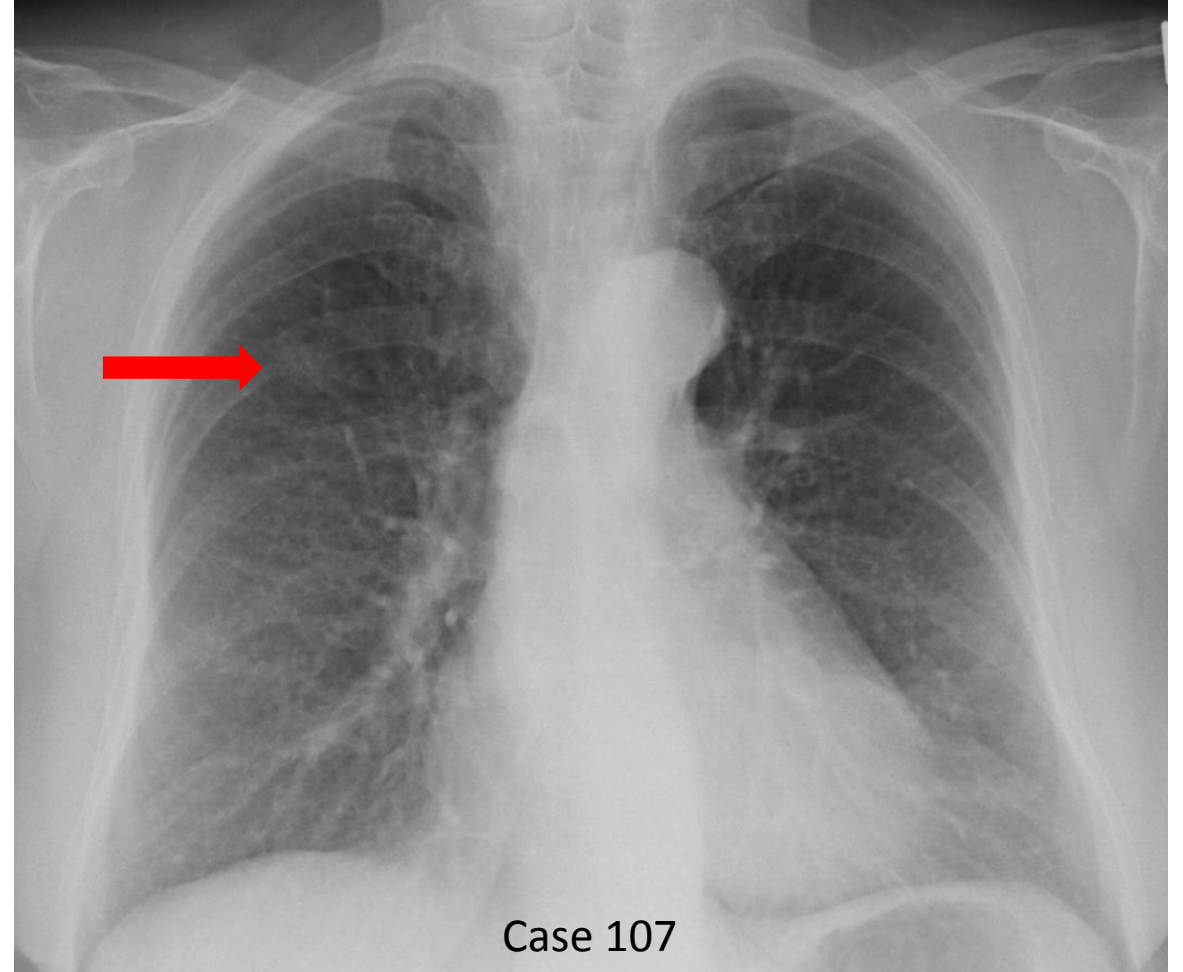


Feature	Observations	
	RR	CR
Unilateral Pleural Effusion	36	32
Interstitial Opacification	19	22
Hilar Enlargement	14	15



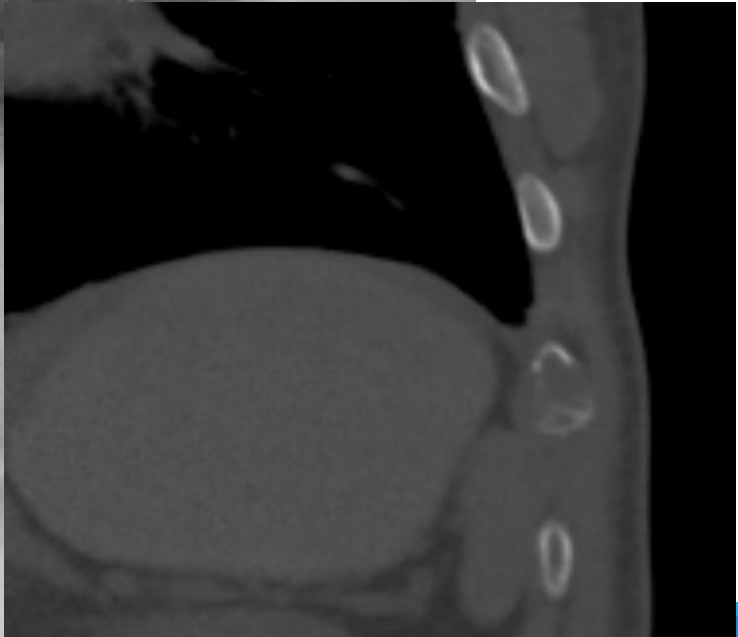
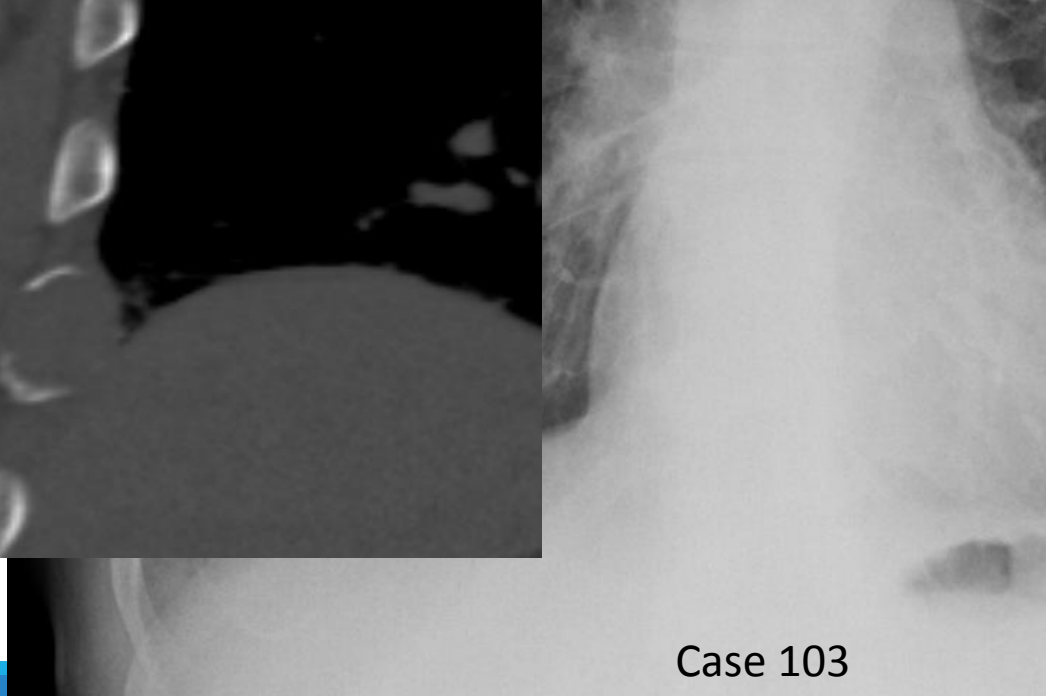
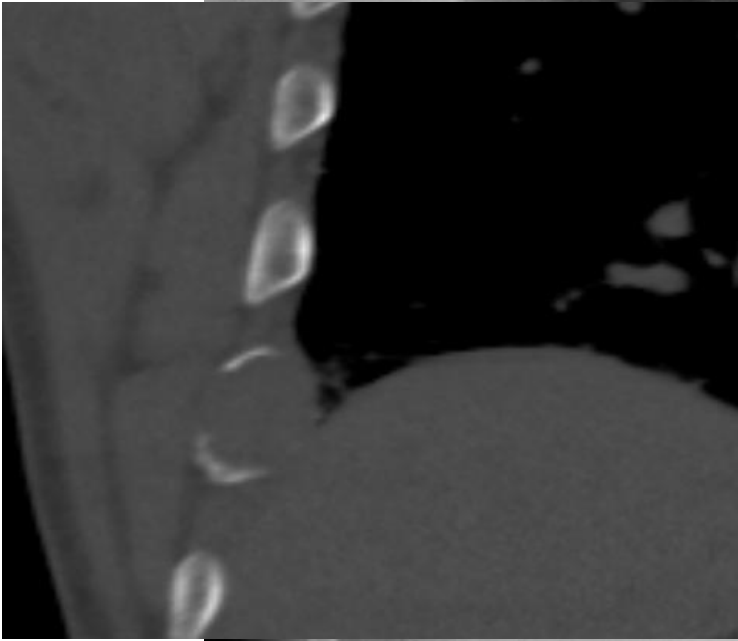
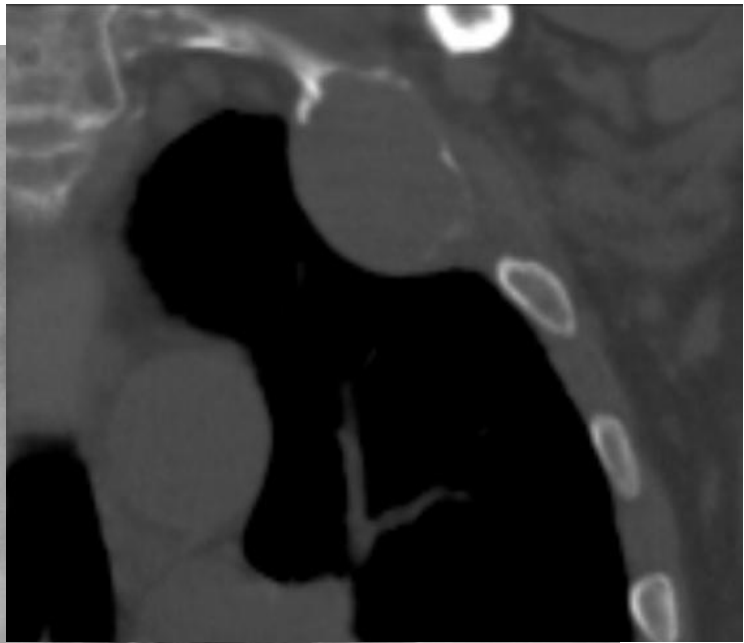
Radiographers
Radiologists

$8/11 = 72\%$
 $6/9 = 67\%$

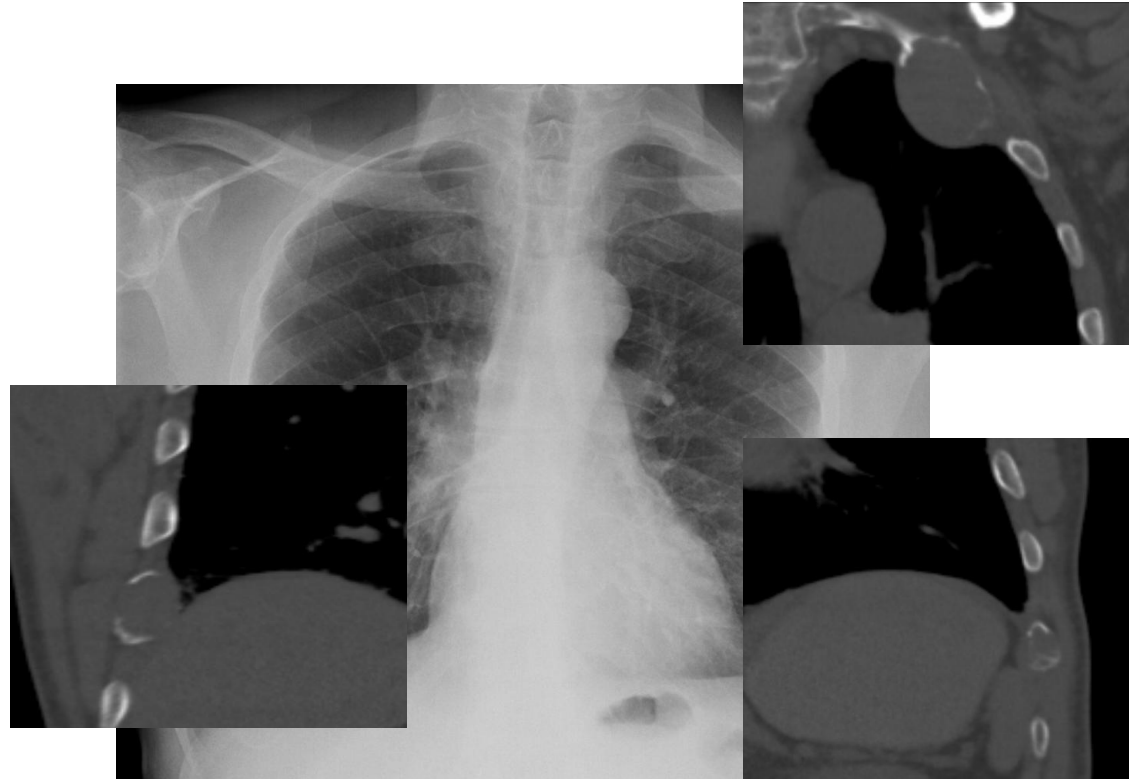


Radiographers
Radiologists

$8/11 = 72\%$
 $7/10 = 70\%$



Case 103

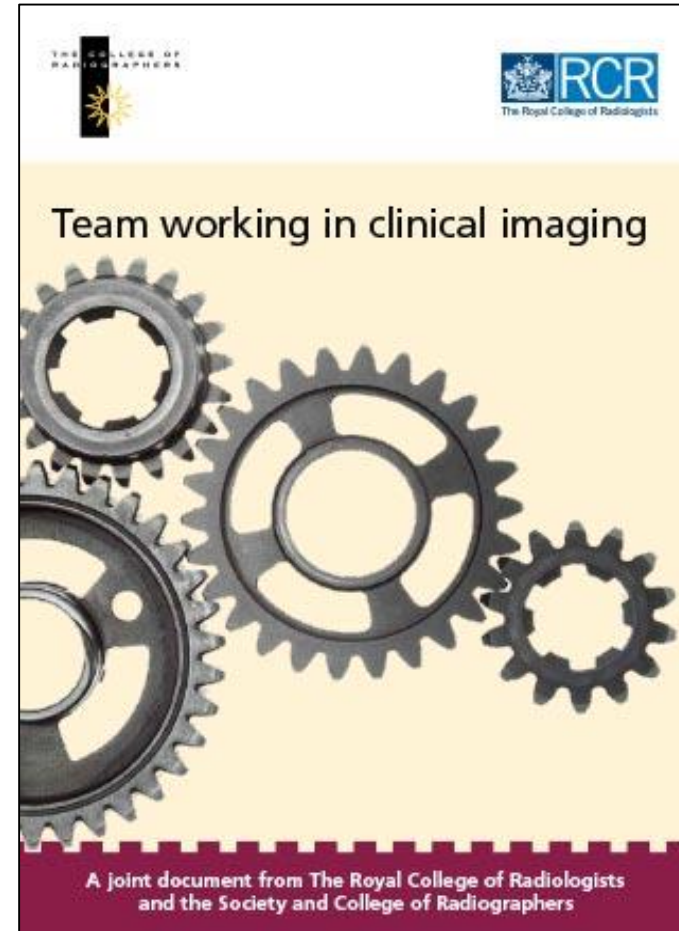


Lesions	Reporting Radiographers (n=11)	Percentage Correct	Consultant Radiologists (n=10)	Percentage Correct	Comments
All 3 lesions	0	0	2	20	rib lesions (x3) = myeloma
1 -2 lesions	7	63.6	4	40	missed in clinical practice by CR
No lesions	4	36.4	4	40	

-
- Why advanced radiographer practice?
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 - Why radiographer image interpretation?
 - Evidence base: Radiographer reporting
 - **Contribution to patient care**

Contribution to Patient Care

- Patient focused care
- Rapid rise in workload
- Political/economic climate

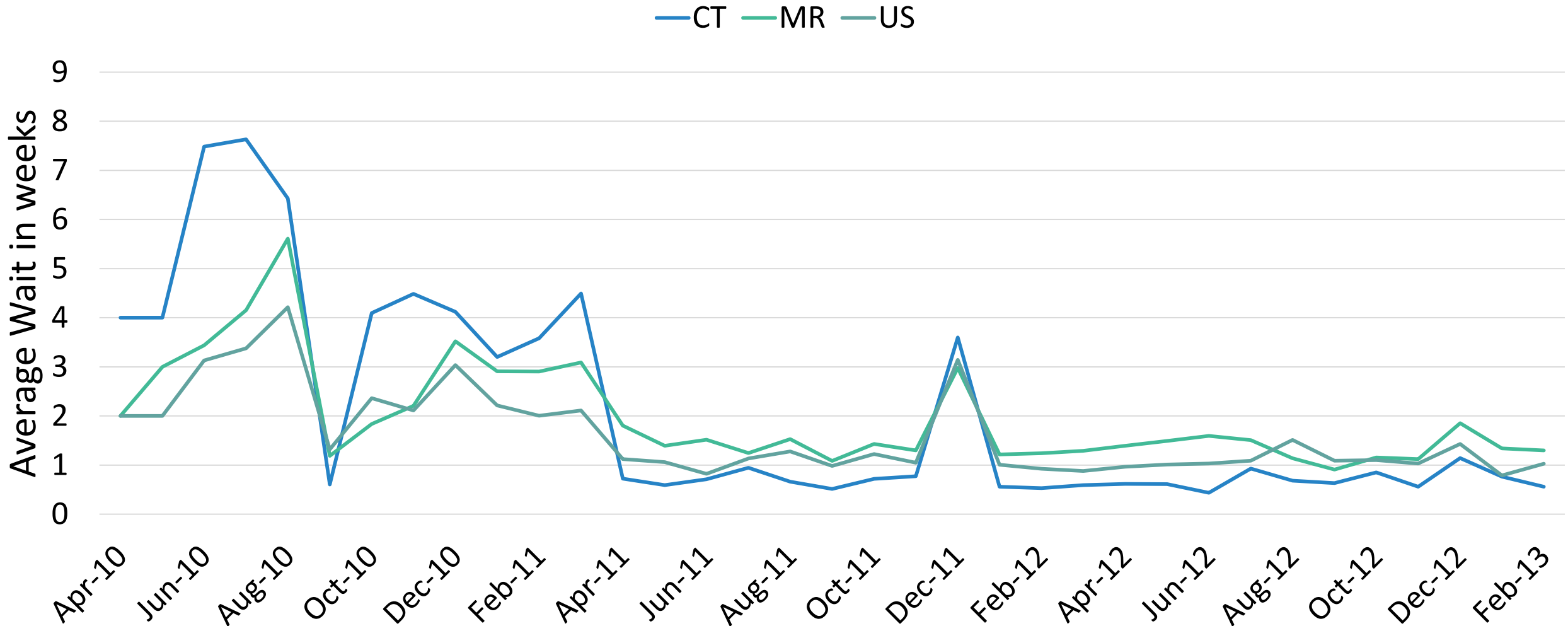


Contribution to Care: Service Evaluation

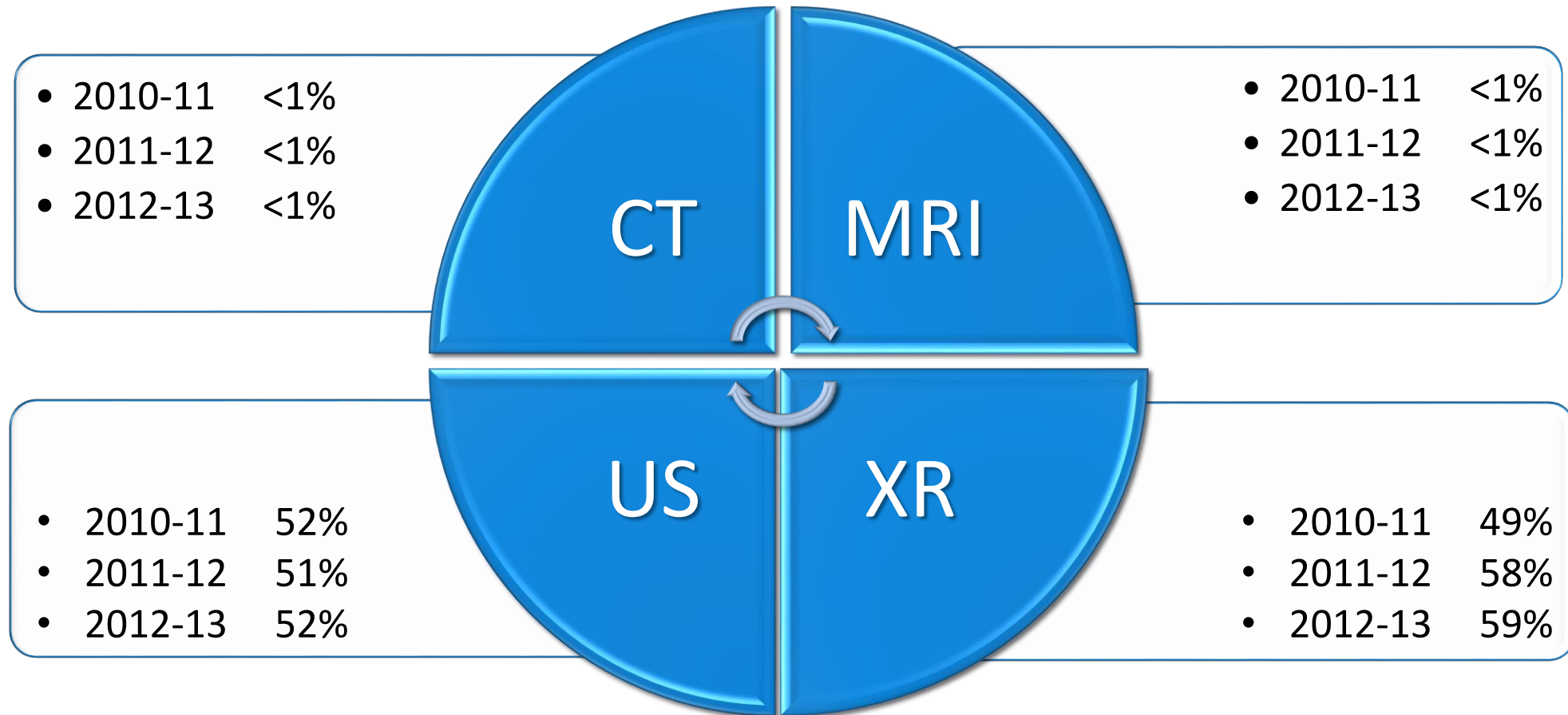
Woznitza *et al.* (2014) Service evaluation at single department

- Retrospective interrogation of Radiology Information System
 - Efficiency: Waiting Times, Radiographer Reports
 - Effectiveness: Report Turnaround Time, Discrepancies

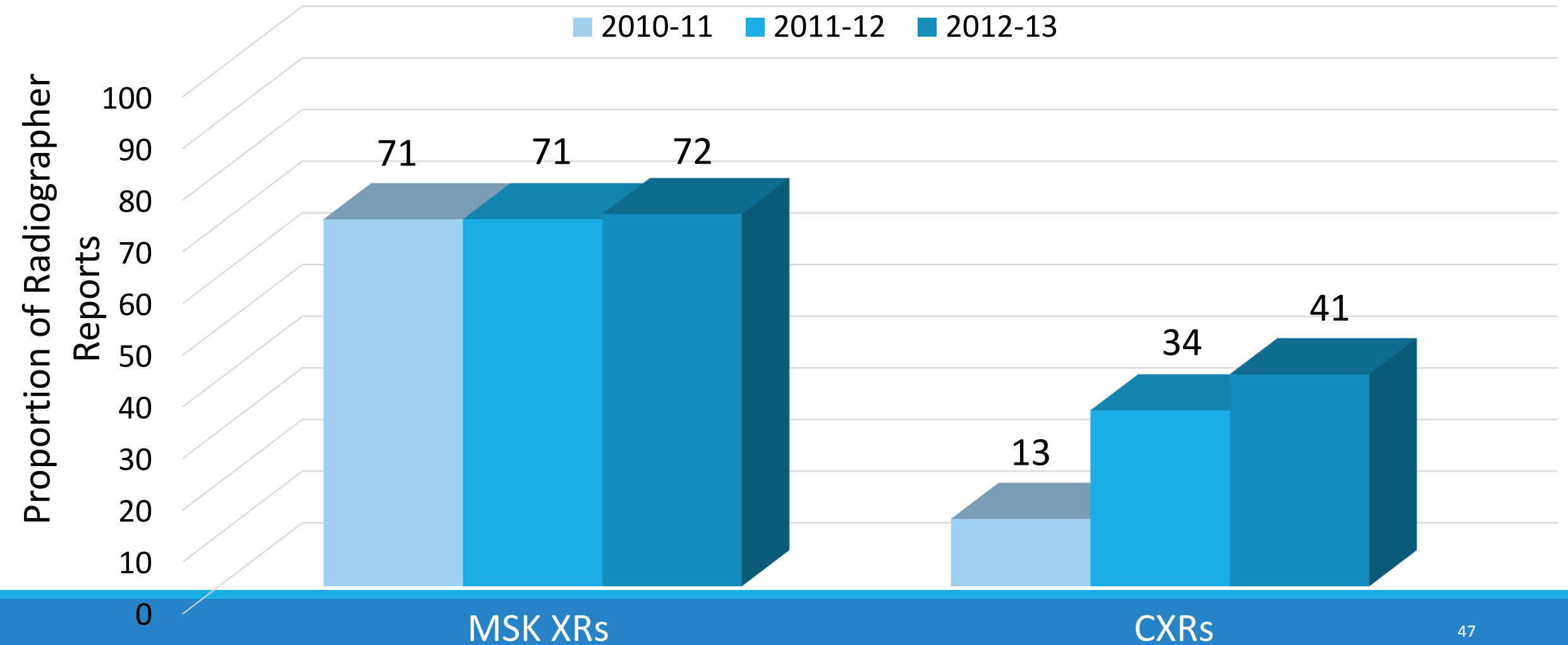
Efficiency: Waiting Time by Modality



Efficiency: Proportion of Reporting Radiographer & Sonographer Output



Efficiency: Radiographer Reporting

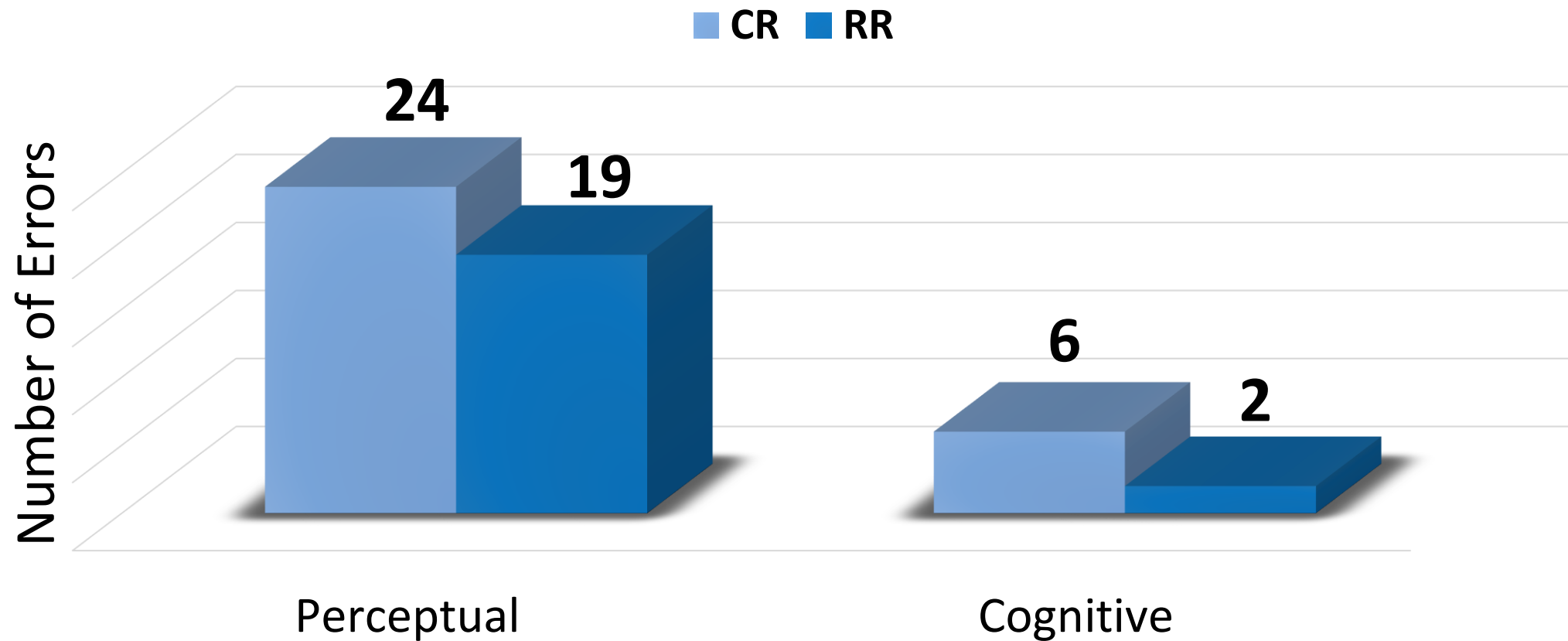


Effectiveness: Safe Practice?

Observer & X-ray Type	Error Grade & Number of Errors			
	Grade 2	Grade 3	Grade 4	Grade 5
RR MSK	4	2	6	0
CR MSK	0	1	6	1
RR CXR	0	1	7	1
CR CXR	1	2	15	4

RR = Reporting Radiographer CR = Consultant Radiologist

Effectiveness: Safe Practice?



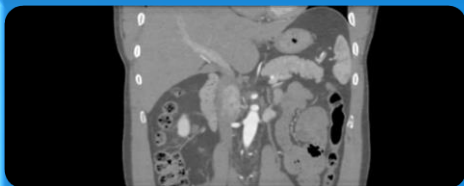
Effectiveness: Report Turnaround Time



Reduction in departmental RTAT across the study period



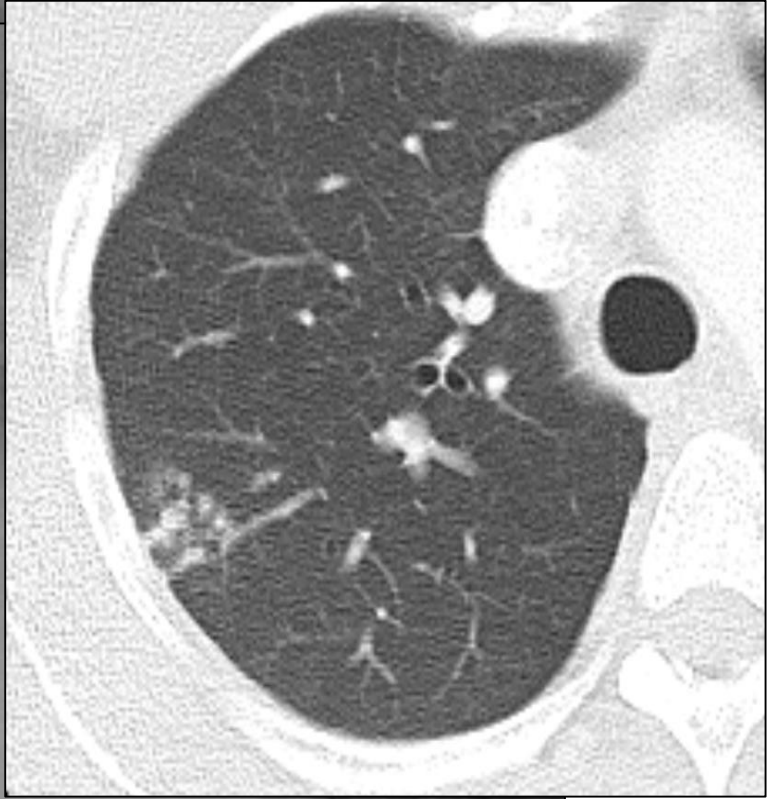
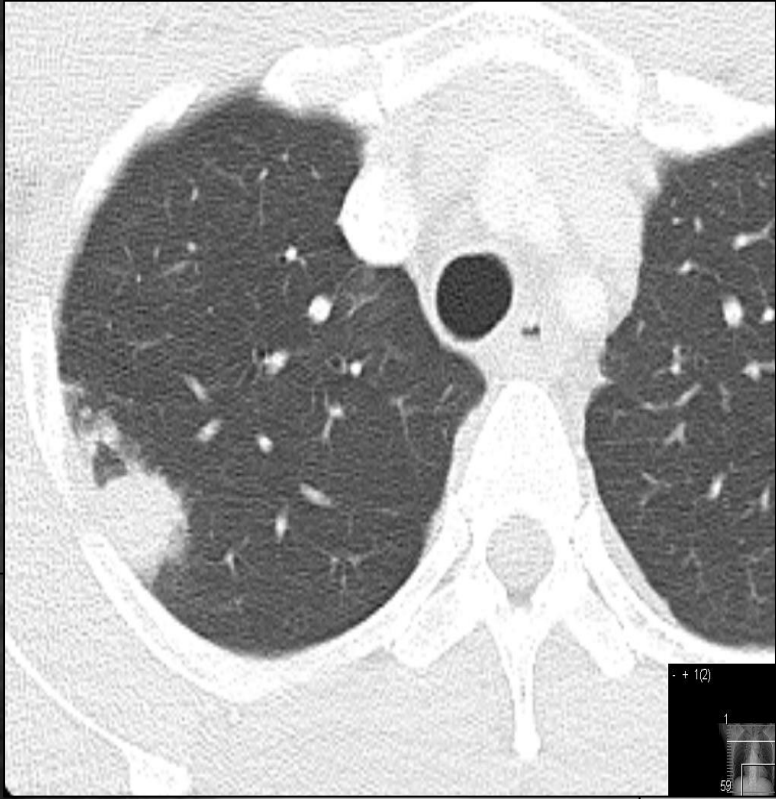
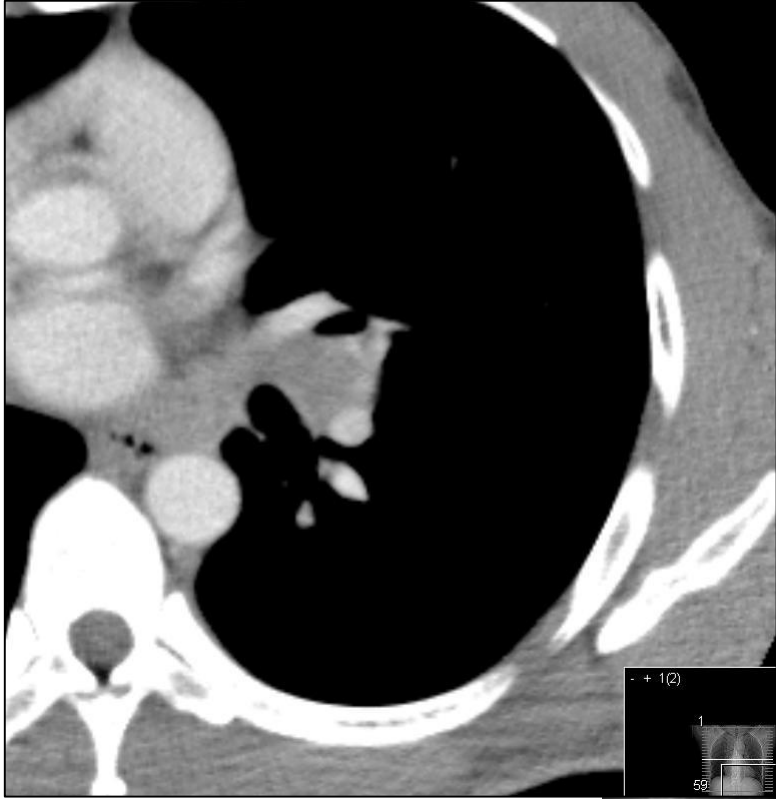
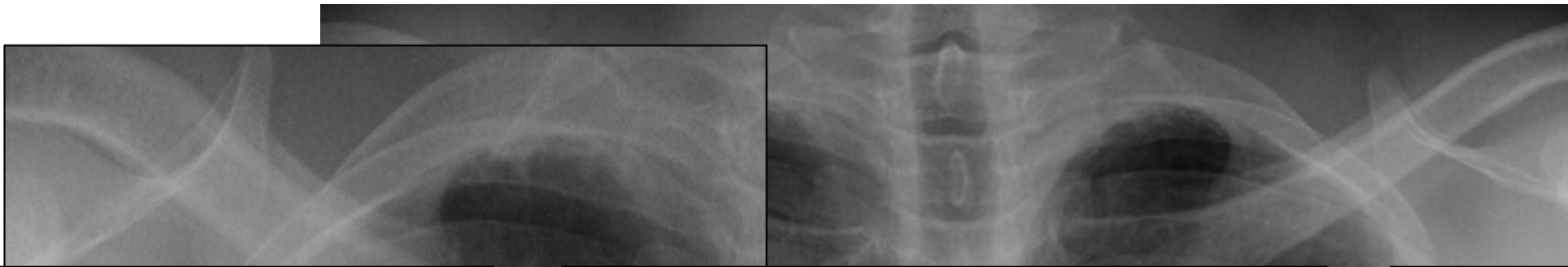
One-way multivariate analysis of variance demonstrated mixed results



Significant reduction MRI RTAT for the study period ($p=0.002$),
CT RTAT also decreased, however not statistically significant ($p=0.216$)



Average X-ray RTAT **increased** between 2011-12/2012-13 ($p<0.001$)



Conclusions

- Advanced radiographer practice improves patient care
- Growing evidence base for radiographer adult chest reporting
- Radiographer reporting contributes to patient focused radiology service

Acknowledgements

- College of Radiographers Research Award
- Mr. Keith Piper – PhD Supervisor
- Prof. Graham Bothamley, Dr. Stephen Burke and Dr. Narendra Aladangady – Research and Clinical Mentors
- Ms. Kate Grayson and Dr. Sabina Hulbert – Statistical Advice
- Research participants – Radiographers & Radiologists

Questions?

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