

The future of pathology

Phil Quirke

Yorkshire Cancer Research Centenary

Professor of Pathology

University of Leeds



2008

Contents

- Pathology data
- Value of large pathology datasets
- Pathology in a digital world
- Clinical trials as a test bed for NCIN?
- International collaborations

Importance of pathology data

- Quality control of pathology
- Quality control of surgery
- Quality control radiology
- Evaluation of prognostic & predictive factors
- Evaluation of effect of screening programmes
- Stratification of patients for comparison of treatments/outcomes between clinicians

Problems

- Text based reporting
- No automatic submission
- Minimum datasets not being used/returned
- Needs official policy that is audited
- National software system – regular updates and retro proofed

Opportunities

-  **NCIN**
national cancer intelligence network
Using information to improve quality & choice
- RCPATH minimum datasets
- NHS
- Digital pathology
- Unique opportunity to be the best in the world



Standards and Minimum Datasets for Reporting Common Cancers

Minimum dataset for colorectal cancer histopathology reports

The Royal College of Pathologists

July 1998

Departmental
Reference
Copy
(CPA-Set)

APPENDIX C PROFORMA FOR COLORECTAL CANCER RESECTIONS

Surname: Forenames: Date of birth:
Hospital: Hospital no: NHS no:
Date of receipt: Date of reporting: Report no:
Pathologist: Surgeon: Sex:

Specimen type: Total colectomy / Right hemicolectomy / Left hemicolectomy / Sigmoid colectomy / Anterior resection /
Abdominoperineal excision / Other (state)

Gross description

Site of tumour:
Maximum tumour diameter: mm
Distance of tumour to nearest cut end: mm
Tumour perforation (pT4) Yes ☐ No ☐
If yes, perforation is serosal ☐ retro/intra peritoneal ☐
For rectal tumours:
Relation of tumour to peritoneal reflection (tick one):
Above ☐ Anterior ☐ Below ☐
Plane of surgical excision (tick one):
Mesorectal fascia ☐
Intramural ☐
Muscularis propria ☐
For abdominoperineal resection specimens:
Distance of tumour from dentate line: mm

Histology

Type
Adenocarcinoma Yes ☐ No ☐
If No, other type:

Differentiation by predominant area

Well / moderate ☐ Poor ☐

Local invasion

No carcinoma identified (pT0) ☐
Submucosa (pT1) ☐
Muscularis propria (pT2) ☐
Beyond muscularis propria (pT3) ☐
Tumour invades adjacent organs (pT4a) ☐
AND/OR
Tumour cells have breached the serosa (pT4b) ☐
Maximum distance of spread beyond muscularis propria: mm

Response to neoadjuvant therapy

Neoadjuvant therapy given Yes ☐ No ☐ NK ☐
If yes:
No residual tumour cells / mucus lakes only ☐
Minimal residual tumour ☐
No marked regression ☐

Tumour involvement of margins

	N/A	Yes	No
Doughnuts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Margin (cut end)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Non-peritonealised circumferential margin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Histological measurement from tumour to non-peritonealised margin: mm			

Metastatic spread

No of lymph nodes present:
No of involved lymph nodes:
(pN1 = 1-3 nodes, pN2 = 4+ nodes involved)
Highest node involved (Dukes C2) Yes ☐ No ☐
Extramural venous invasion Yes ☐ No ☐
Histologically confirmed distant metastases (pM1):
Yes ☐ No ☐ If yes, site:

Background abnormalities: Yes ☐ No ☐

If yes, type: (state as appropriate)
Adenoma(s) (state number):
Familial adenomatous polyposis / Ulcerative colitis /
Crohn's disease / Diverticulosis / Synchronous carcinoma(s)
(complete a separate form for each cancer)
Other:

Pathological staging

Complete resection at all surgical margins

Yes (R0) ☐ No (R1 or R2) ☐

TNM (8th edition)

(y) pT (y) pN (y) pM

Dukes
Dukes A ☐ (Tumour limited to wall, nodes negative)
Dukes B ☐ (Tumour beyond M. propria, nodes negative)
Dukes C1 ☐ (Nodes positive and apical node negative)
Dukes C2 ☐ (Apical node involved)

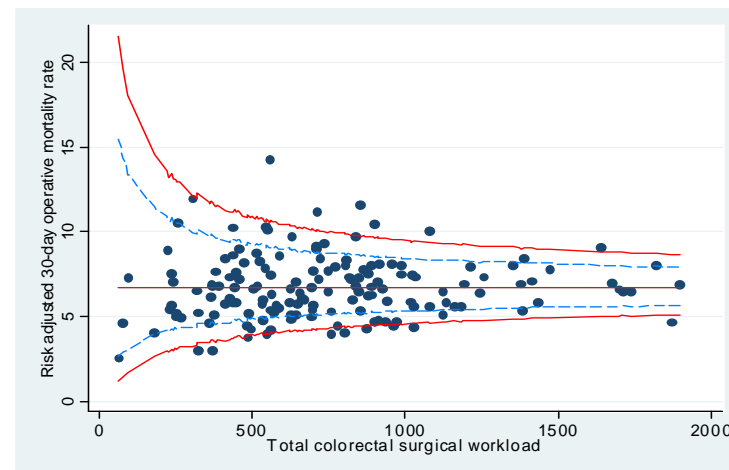
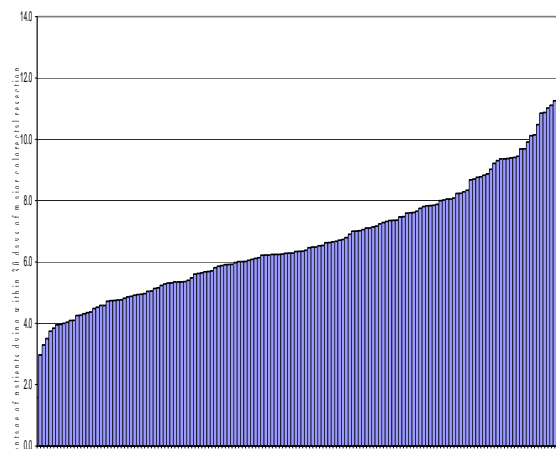
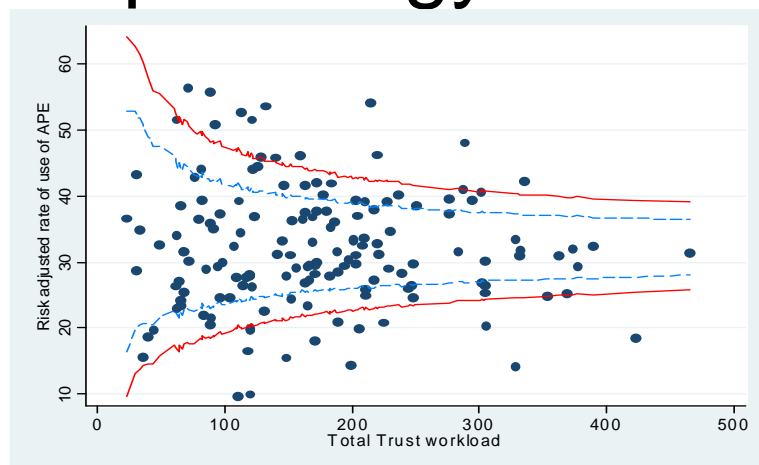
Signature: Date: SNOMED Codes T: / M:

Examples

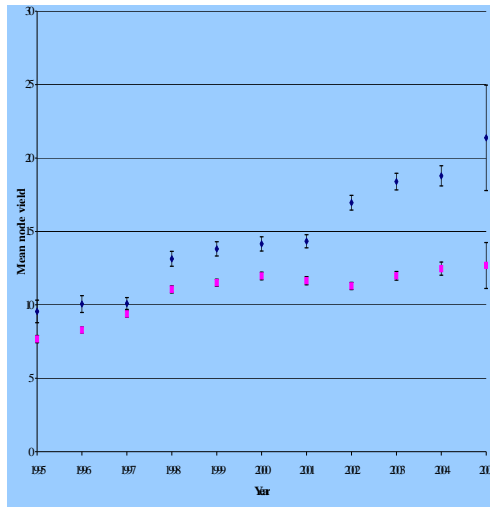
Unacceptable variation in abdominoperineal excision rates for rectal cancer: time to intervene?

E Morris,^{1,2} P Quirke,² J D Thomas,^{1,2} L Fairley,⁴ B Cottier,³ D Forman^{1,4}

- APE & operative mortality - correction for pathology data



Lymph node yields in a population



Lymph node yield over time

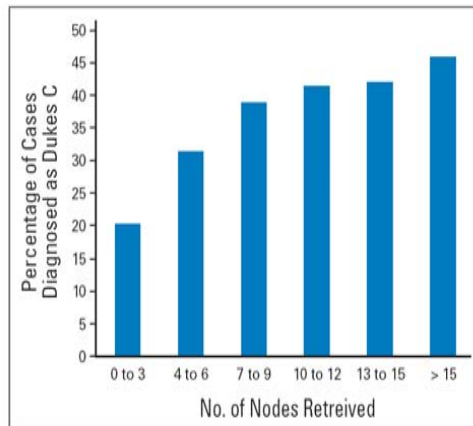


Fig 1. Percentage of cases diagnosed as stage III in relation to the number of nodes retrieved.

% cases diagnosed Stage III/Dukes C
by lymph node yield in Yorkshire

Characteristic	Odds Ratio	95% CI	P
Age, per year	0.98	0.98 to 0.99	< .01
Sex			
Male	1.00		
Female	1.19	1.07 to 1.33	< .01
Maximum tumour diameter, per cm	1.05	1.03 to 1.06	< .01
Local invasion			
T1	1.00		
T2	1.81	1.30 to 2.51	< .01
T3	3.49	2.58 to 4.71	< .01
T4	3.03	2.20 to 4.76	< .01
Unknown	1.54	0.71 to 3.35	.28
No. of positive nodes, per node	1.15	1.13 to 1.18	< .01
Year of diagnosis, per year	1.17	1.14 to 1.19	< .01
Pathologist			
General	1.00		
MDT	2.16	1.93 to 2.41	< .01
Surgeon			
General	1.00		
MDT	1.40	1.24 to 1.58	< .01

Abbreviation: MDT, multidisciplinary team.

Multivariate analysis of factors affecting nodal yield

VOLUME 25 • NUMBER 18 • JUNE 20, 2007

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

Identifying Stage III Colorectal Cancer Patients: The Influence of the Patient, Surgeon, and Pathologist

Eva Judith Ann Morris, Nicola Joanne Maughan, David Forman, and Philip Quirke

Stage II high risk features

Who to treat with adjuvant therapy in Dukes B/stage II colorectal cancer? The need for high quality pathology

Eva J A Morris, Nicola J Maughan, David Forman, Philip Quirke



This paper is freely available online under the BMJ Journals unlocked scheme, see <http://gut.bmj.com/info/unlocked.dtl>

Gut 2007;56:1419-1425. doi: 10.1136/gut.2006.116830

Factor	Category	Yorkshire (rectal)			
		survival	95% CI	X ²	p value
Extent of spread beyond muscularis propria	<3mm	76.3	70.3 -81.3		
	3 to 5 mm	69.1	55.9 -79.2		
	>5mm	54.1	42.9 -64.0	26.2 (4)	<0.00 01
	Not reported T3	73.5	61.3 -82.4		
	Not reported T4	44.8	31.7 -57.0		
Peritoneal involvement	Absent	71.4	66.7 -75.6		
	Present	39.1	24.4 -53.5	24.1 (2)	<0.00 01
	Not reported	63.7	51.1 -73.8		
Venous invasion	Not evident	70.2	65.4 -74.4		
	Present	53.0	40.7 -63.9	15.0 (2)	0.0006
	Not reported	70.1	51.5 -82.7		
Margin involvement	Not involved	71.9	67.3 -76.0		
	Present	48.0	36.6 -58.5	15.1 (2)	0.0005
	Not reported	59.8	33.6 -78.5		
Tumour perforation	Absent	77.0	68.6 -83.4		
	Present	52.8	28.9 -72.0	6.28 (2)	0.0434
	Not reported	65.4	60.2 -70.1		
Dukes C - one positive node		57.4	50.1 -63.9		

New prognostic tests

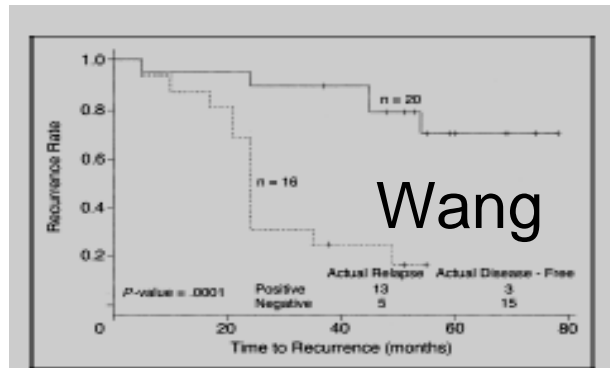
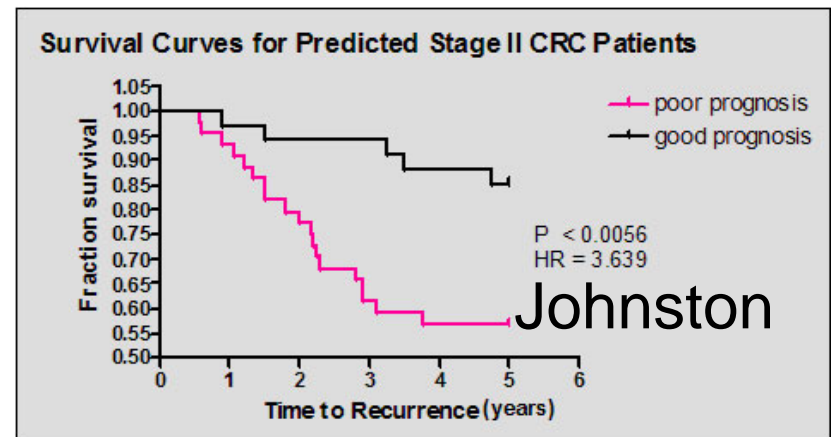
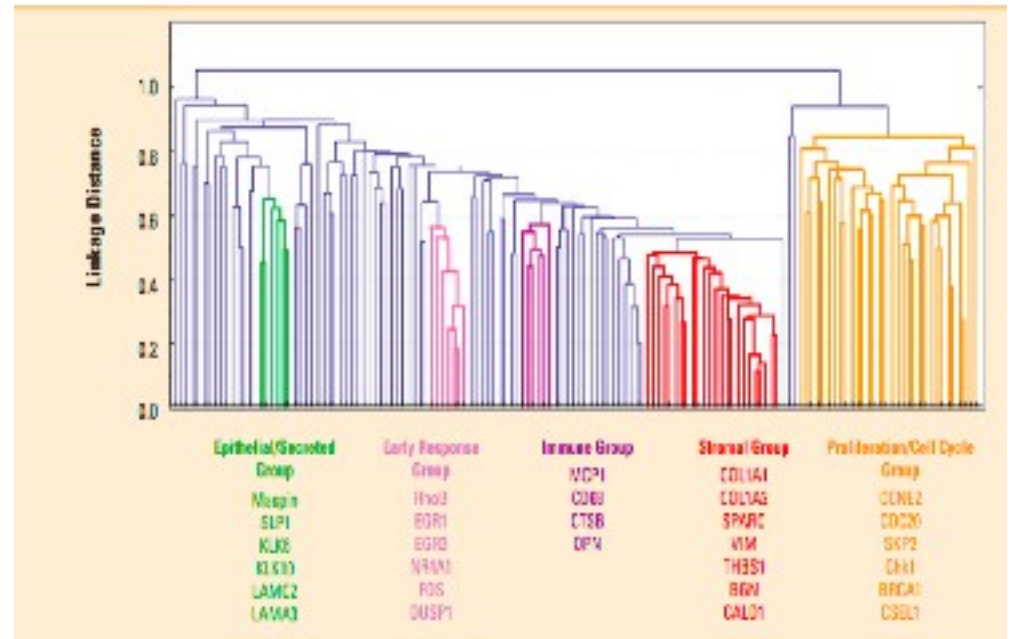
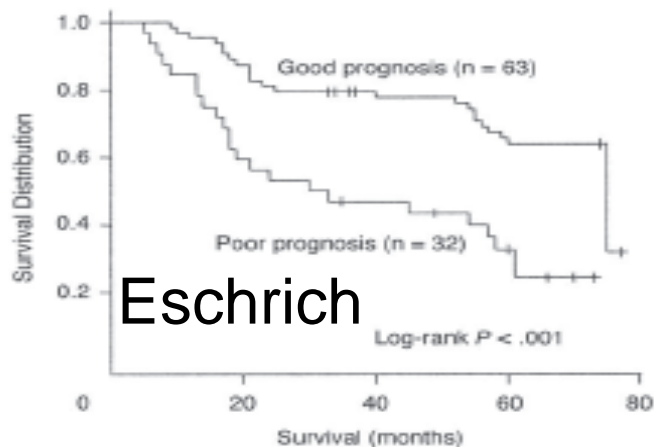
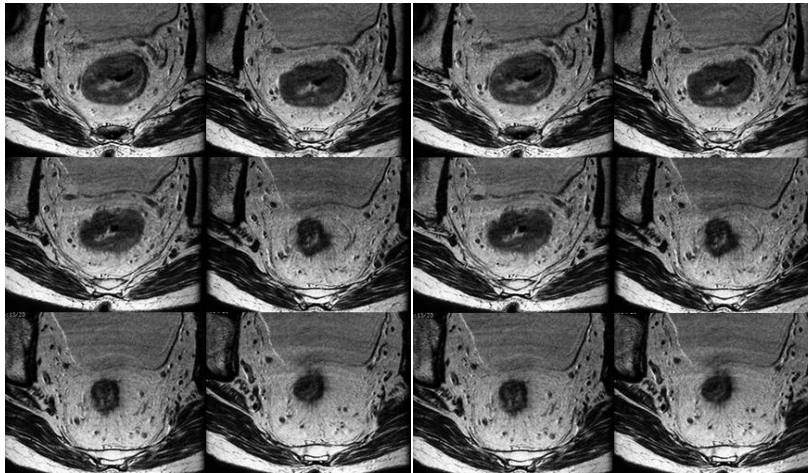
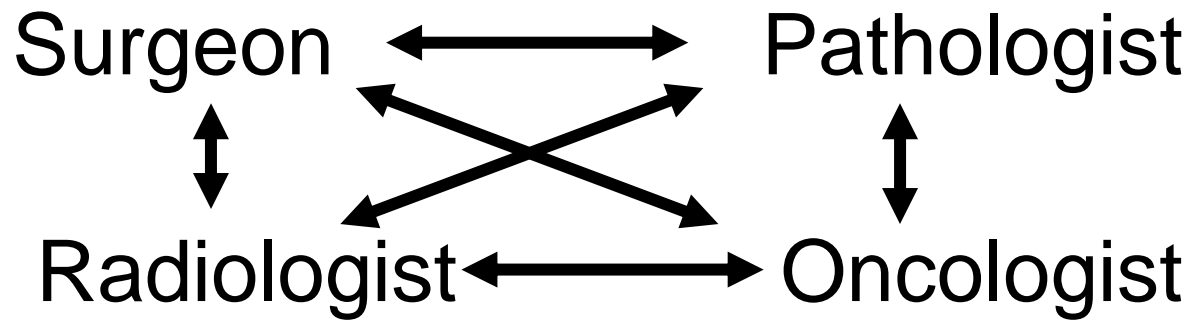


Fig 4. Kaplan-Meier curve and log-rank test of 36 independent patients. The risk of recurrence for each patient was assessed based on the 23-gene signature, and the threshold was determined by the training set. The high- and low-risk groups differ significantly ($P = .0001$).





MRI images for potentially clear radiological CRM

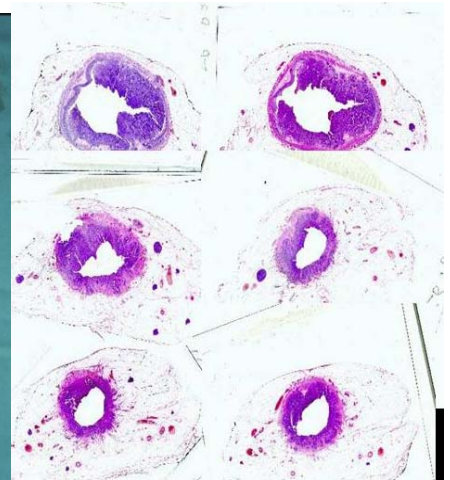
Pre neoadjuvant Post neoadjuvant



Resected specimen for actual surgical plane



Macro slices for surgical plane, CRM and radiology audit

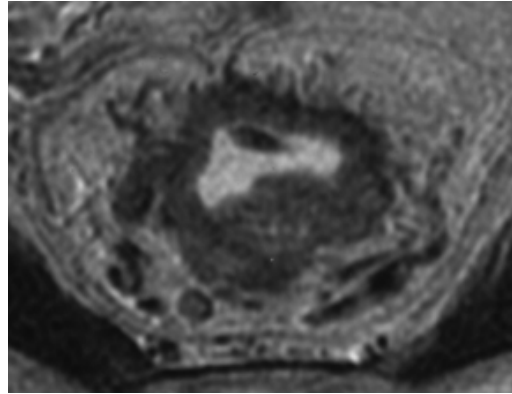


Stained microscopic slices for CRM and high risk features

Current digital information

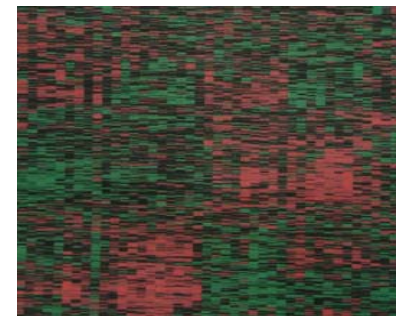
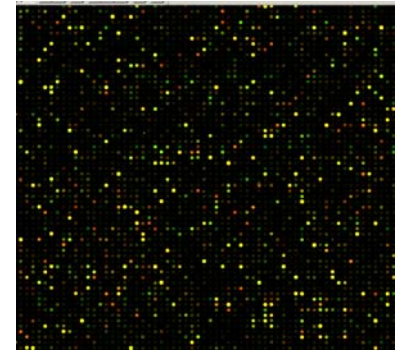
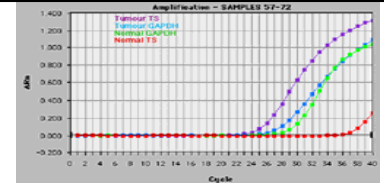
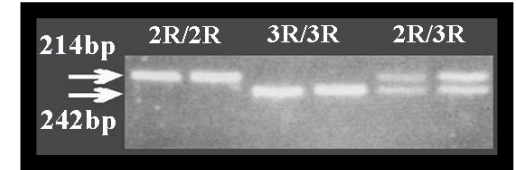


Patient records



Radiology

DNA and RNA data



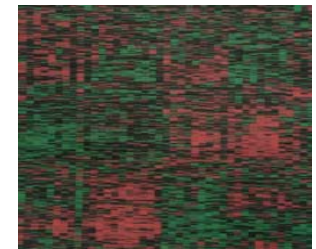
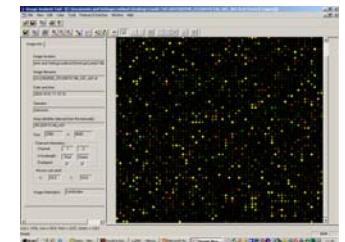
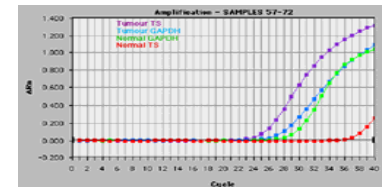
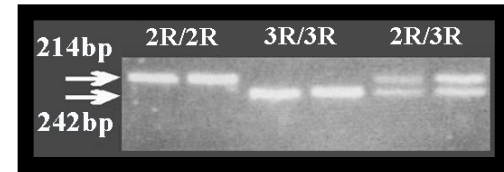
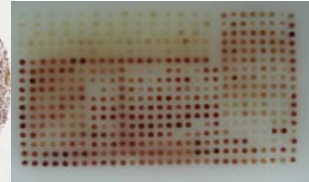
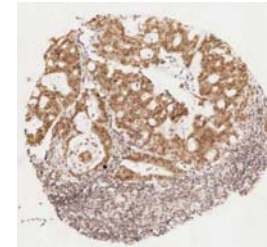
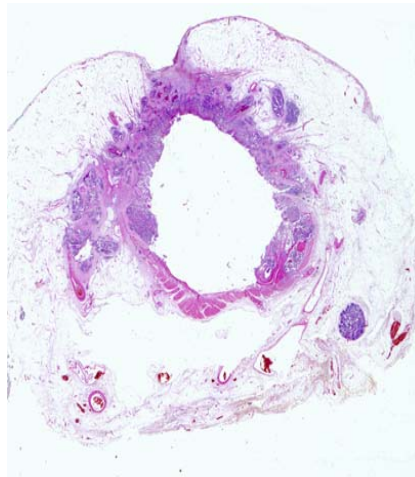
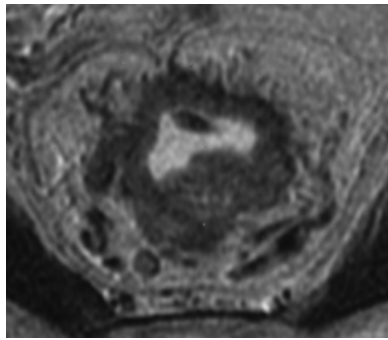
Linking for trials – NCRI demonstrator

Patient ---- radiology ---- pathology ---- biology

HES/Registry

Clinical trials

Local data



Why digital pathology?

- Advantages of microscopy
- PLUS
 - Permanent record
 - Always available
 - Viewed anywhere
 - Further digital manipulation
 - Image analysis
 - 3D
 - Integration with other digital data
- Disadvantages
 - User interface
 - Data storage
 - Networks
 - Pathologists



HOME PAGE

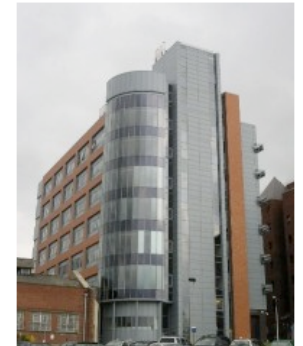
[Home](#)[Public](#)[Teaching](#)[Diagnosis](#)[EQA](#)[Tissue bank](#)

Virtual pathology at the University of Leeds

Virtual slides can be made available for **commercial users**. For details please [email](#) with your requirements. All slides on this site are the property of the University of Leeds and no commercial use is sanctioned without prior permission.

Available on this site are the following:

- [Virtual slides of common human cancers](#). These may be of interest to cancer patients or individuals studying cancer at any level.
- Our [slide database](#) of educational slides available for viewing.
- [Undergraduate](#) and [postgraduate](#) teaching packages.
- National external quality assurance schemes for [renal](#), [liver](#), [gastrointestinal](#) and [haematological malignancies](#).
- [Leeds Gift Tissue Bank](#) site. View cases that have been added to this [tissue bank](#).
- National Cancer Research Institute [clinical trial demonstrator](#) linking radiology with pathology.
- [Clinical trials](#) running from Leeds. [Classic trial pathology and macros](#).



JIF Building SJUH

Site [privacy statement](#). Comments or suggestions to the [web editor](#). [Help](#) and [FAQs](#).



Pathology & Tumour Biology
Leeds Institute of Molecular Medicine
University of Leeds



MRC CLASSICC


http://www.virtualpathology.leeds.ac.uk/classic/classic_display.php?number=01010

Discount ho...dahotel.com Outlook Web...ecure Login How do I fin...sity Library INBOX :: INBOX Connect

Clinical Trials - Classic

http://www.virtualpathology.leeds.ac.uk/classic/Macro_classic.php?slides=01010

classic/cases/01010



01010

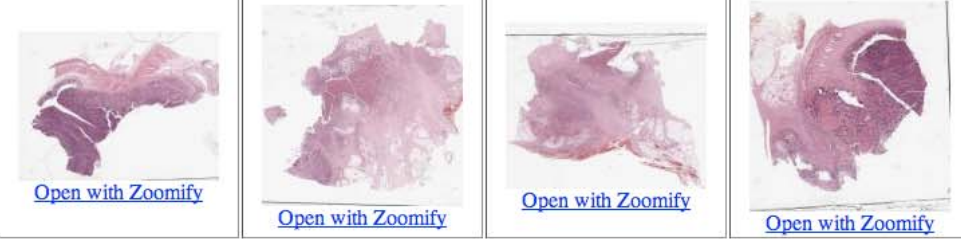
01010

01010

http://www.virtualpathology.leeds.ac.uk/classic/...classic.php?slides=Clinical_Trials/CLASSIC/01010

Clinical_Trials/CLASSIC/01010

**Please note: DO NOT CLICK "Return from image display" in the virtual slide window.
Click "X" at top right to close the window.**



[Open with Zoomify](#)

[Open with Zoomify](#)

[Open with Zoomify](#)

[Open with Zoomify](#)

Untitled

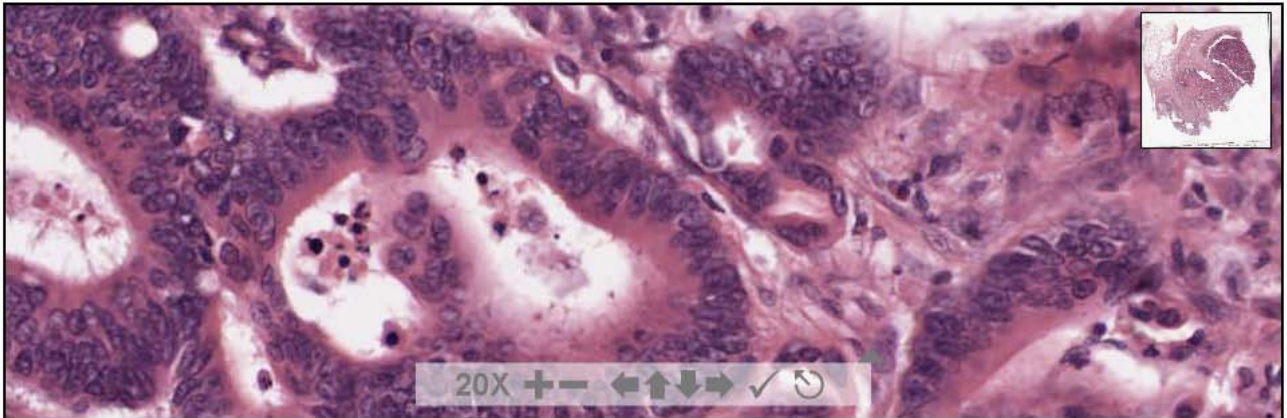
Aperio Web Viewer: /Clinical_Trials/CLASSIC/01010/3550.svs

3550.svs


42021 x 44010 size 5.17GB mag 20X

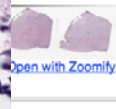
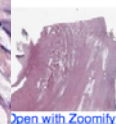
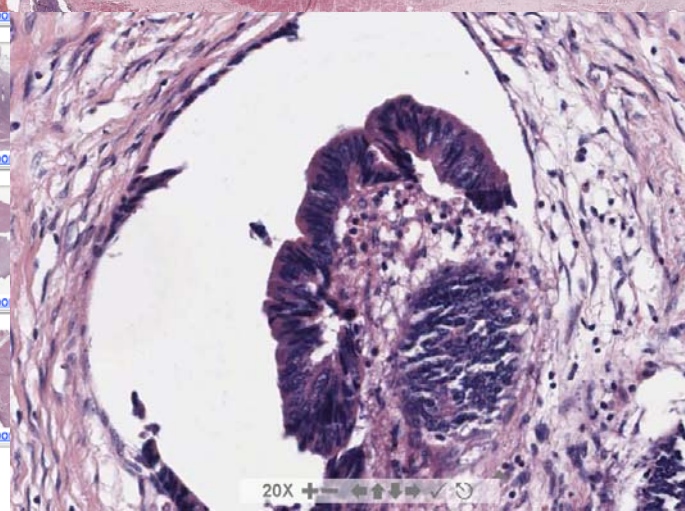
Return from image display

info help

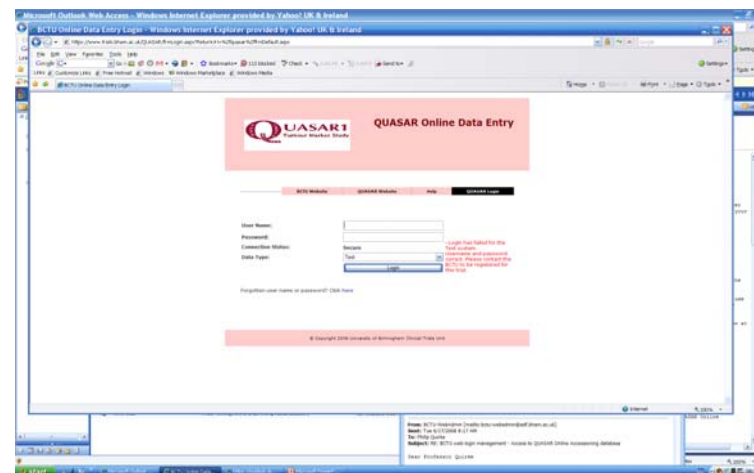
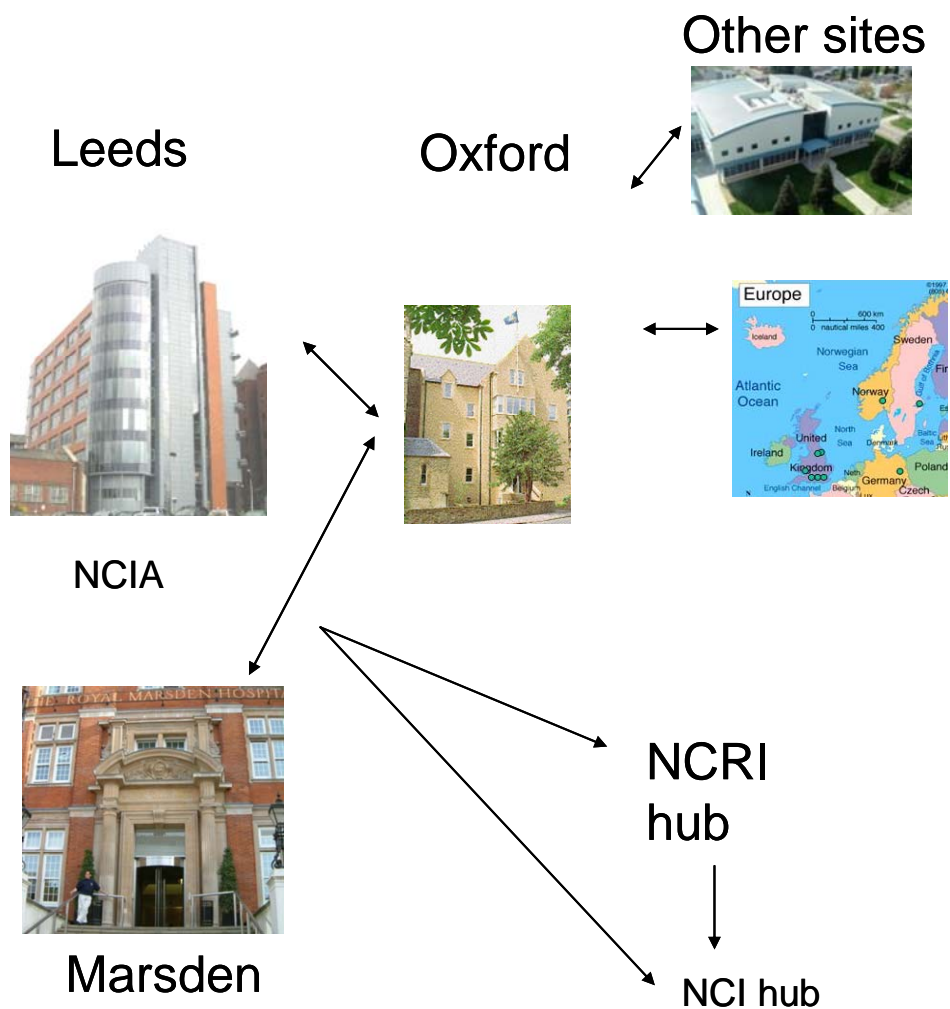


20X + - < > < > < > < >





Newer developments



National Cancer Institute
Imaging Archive node only
one outside USA

CaBig collaboration with Ohio
Grid analysis of neuroblastomas

Nijmegen- Sweden testing of
TNM4/5/6 on Clasicc

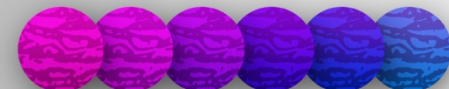
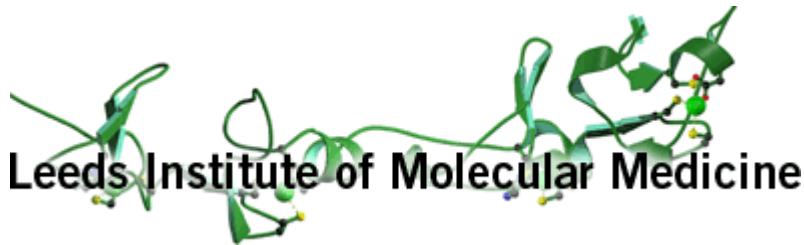
Summary

Pathology datasets are essential for modern cancer care

Unique opportunity to become world leading

Additional benefit of digital technology

Trials can act as test bed for data integration



Thanks to:

- NHS
- NCRI, CRUK, MRC
- Darren Treanor, Martin Waterhouse and Fraser Lewis
- Eva Morris, David Forman, Brian Cottier
- Gina Brown and Mike Brady
- Clinical trials groups