**Synoptic medical kidney biopsy reporting and automated coding for data upload to central registries**

! - Important to involve stakeholders at all levels of design and testing.

Aims/motivations/Impact:

1. Improve quality and consistency of report writing for individual patients and clinician treatment decisions.
   * Guide pathologists with Minimal dataset requirement, correct use of terminology etc.
   * Stakeholders = renal pathologists. Involve via e.g. UK Renal Pathology Network.
   * Output = plain text to copy and paste into LIMS.
2. Improved population level data (local population e.g. North West London for trends in disease, and National population to compare centre practice
   * data for quality improvement) through automated and reliable renal registry data extraction from reports and upload to central registry: items in standardised report translate to automated codelist for each biopsy report.
   * Output = .csv file, for local and national usage.
   * Stakeholders e.g. Renal Units, national renal practice bodies (NHS England), UK Kidney Association/Renal Registry.
3. Research ready (accurate; granular)
   * Data for multimodal AI applications in renal pathology. Need for good quality, consistent terminology and structured data to improve model training, for future use with other data such as matched digital images or clinical data.

Scoping the field – Commercial

Companies already in existence providing solutions - ?few

Important to use the standard format (FHIR/HL7) so that each lab can choose their own company provided and still be able to use the standard form that might be agreed by a pathology organization.

mTuitive. <https://www.mtuitive.com/>.

* very cancer focussed
* but “Professional associations have established requirements for cancer reports—but the standards for non‐cancer pathology reporting remain less defined. mTuitive works diligently with its users and other domain experts to ensure that the reports for these cases adhere to the specific standards of your institution. “ and kidney transplant biopsy is listed
* ?flexible? – “You can customize existing reports, create brand new algorithms, and adapt the best practices/requirements for reporting into dynamic algorithms “
* Not sure it automatically creates a .csv file from your input?

Tiro.Health.

* Build your own standard report
* You can dictate liberally (semi-structured/key words) and it automatically fills in fields of the form; not sure the other systems do this
* Nice contacts: "Koen Van Damme" [<koen.vandamme@tiro.health](mailto:%3ckoen.vandamme@tiro.health)> "Andries Clinckaert" <andries.clinckaert@tiro.health>

Celerato. <https://www.celerato.ch/en>

Useful diagram from their website:

A screenshot of a computer

AI-generated content may be incorrect.

Scoping the field – Research

Amelie Dendooven/Sabine Leh

Many renal pathologists use an Access database “form” to standardise reporting e.g. Vanessa Bijol, Shana Coley.

Call meeting with Amelie early August or on the way to Aachen/ ? get funding from all 3 companies for a project manager/medical writer to produce a form for renal pathology that all of them could use in their system? RCpath support?

Methods

Any report created must be FHIR compatible.

Amelie suggests to start by creating a consensus document that is a list of items and terminology that would need to go in to the standardised report. Create a form like ICCR forms for cancer, for native and transplant biopsies. Fields can be core (need to be filled) or non-core (don’t need to be filled). And there is some scope for adapting the text as needed.

Commercial solutions can be integrated into LIMS, no need for copy/paste.

*Note 04/07/2025: could link with Roman/Peter Boor effort to define things for segmentation?*

Proof of principle that it works would be a good start, to then get buy in from stakeholders to mandate its use, which would then ensure it is enforced.

Business case (to make lab managers purchase it) includes proof that it saves consultant pathologist time (measure %) – cost per annum will end up being trivial compared to that cost.

For example, Tiro: ~ 12K euros/annum for 10 consultants workload.

DESIGN

On the left, data that is input.

On the right, what we need to produce:

1. Clinical diagnostic report, that will be copied into the LIMS and signed out, for individual patient treatment decision making. The report should contain as a minimum a number of required standardised data (e.g. # glomeruli, % tubular atrophy/interstitial fibrosis, Banff lesion scores etc) +/- additional data that depend on the nature of the case, but should also to some degree be standardised (e.g. standard terminology used). The use of standard terminology is also useful for development of ML from clinical diagnostic reports.
2. A set of data including codes (standardised) for local, national and international population level registry of diseases.

INPUT OUTPUT

Clinical Report for sign out in Copath

Report templates (Native & Transplant)

Standard Terminology Items and Definitions

Database entry with codes

Sentence “bank”

Code list

Shorthand report items

Database entry list

Two Examples of shorthand

It would be useful to have a proforma with items in red to remind me of what to write down where in shorthand in (black) – but items in red ignored when compiling report automatically

Example 1:

NHS

234 4567 2345

HN

31098674

NS

25-67890

Name

Smith

Coder

CR

Consent

PISv.8

Date of biopsy

12/07/2025

LM

CM

C2M1

Glom

31

Gs7

Ss1\_NOS

Mm 1

Mc 1

G 2

Cg 1

TI

ATI micro

IFTA 20

CTCI1

T1

I1\_I-IFTA3

TI2

Ves

A3

2IL\_1Ar

Cv2

Caa0

V0

Ah1

Ptc1

IHC

C4d0

SV40\_0

EM

EM0

IFFR

FR\_0

CONCLUSION

BL

MVI+

MildIFTA

COMMENT

MVI+

DP

Example 2

NHS

987 6543 2109

HN

31045678

NS

25-54321

Name

Patel

Coder

AS

Consent

U

Date of biopsy

13/07/2025

LM

C

C2

Glom

10

Gs1

Ss0

G 0

Cg 0

TI

ATI micro

IFTA 10

CTCI1

T0

I0\_I-IFTA1

TI0

Ves

A1

1IL\_0Ar

Cv1

Caa0

V0

Ah0

Ptc0

IHC

C4d0

SV40\_0

EM

EM0

IFFR

FR0

CONCLUSION

ATI\_micro

COMMENT

ATI\_micro

DP

Report for example 1

NHS number: 234 4567 2345

Hospital number: 31098674

NS number: NS25-67890

Name: Smith

A. LIGHT MICROSCOPY

The sample consists of cortex and medulla.

There are 2 samples of cortex and 1 sample of medulla.

GLOMERULI

Total number of glomeruli: 31

Number of globally sclerosed glomeruli: 7

One glomerulus shows segmental sclerosis (NOS).

There is a mild increase in mesangial matrix.

There is a mild increase in mesangial cellularity.

There is moderate glomerulitis (g2).

A few segmental capillary wall double contours are seen (cg1b).

TUBULOINTERSTITIUM

There is mild acute tubular injury.

Tubular atrophy/interstitial fibrosis (nearest 10%): 20% (ct1, ci1)

Mild tubulitis is present in >1 focus of non-severely atrophic tubules (t1).

There is a chronic interstitial inflammatory infiltrate, that affects 10-25% of non-scarred cortex and >50% of scarred cortex (i1, i-IFTA3).

Total cortical interstitial inflammation amount to 25-50% of cortex (ti2).

BLOOD VESSELS

Three arteries are present in the sampled kidney.

Two are interlobular, 1 is arcuate.

Arteries show moderate fibrointimal thickening (cv2).

No features of chronic allograft arteriopathy are present.

No endarteritis (v0).

Mild arteriolar hyalinosis (ah1).

Peritubular capillary inflammation with a maximum of 3-4 cells is present in >10% of cortical peritubular capillaries (ptc1).

IMMUNOHISTOCHEMISTRY

C4d: negative (C4d0)

SV40: negative

B.ELECTRON MICROSCOPY

Ultrastructural examination was not performed.

CONCLUSION

Transplant kidney biopsy:

Borderline for T cell-mediated rejection

Microcirculation inflammation present, C4d-negative, DSA-negative

Mild interstitial fibrosis/tubular atrophy

COMMENT

MVI above the histological threshold, without circulating DSA and with negative C4d staining in peritubular capillaries has been observed in patients with normal or abnormal kidney function. This is a purely descriptive phenotype, and the cause remains unclear. Further research is necessary to determine the prevalence, the causes and related biological processes and best treatment for this pattern. These cases may represent alloreactive T cell mediated responses; autoreactive or alloreactive non-HLA antibodies; primary NK cell activation through missing self; viral infection; other mechanisms of innate immune activation; ischemia reperfusion injury, etc.

This case was reported using the Digital Pathology Whole Slide Acquisition. The laboratory is not UKAS accredited for this test.

Report for example 2

NHS number: 987 6543 2109

Hospital number: 31045678

NS number: NS25-54321

Name: Patel

A. LIGHT MICROSCOPY

The sample consists of cortex only.

There are 2 samples of cortex.

GLOMERULI

Total number of glomeruli: 10

Number of globally sclerosed glomeruli: 1

No segmental sclerosis is seen.

There is no glomerulitis.

No capillary wall double contours are seen on light microscopy (cg0).

TUBULOINTERSTITIUM

There acute tubular injury with tubular epithelial cell cytoplasmic microvacuolation.

Tubular atrophy/interstitial fibrosis (nearest 10%): 10% (ct1, ci1)

Tubulitis is not present in >1 focus of non-severely atrophic tubules (t0).

There is a chronic interstitial inflammatory infiltrate, that affects <10% of non-scarred cortex and 10-25% of scarred cortex (i0, i-IFTA1).

Total cortical interstitial inflammation amount to 25-50% of cortex (ti2).

BLOOD VESSELS

One artery is present in the sampled kidney (interlobular).

Arteries show mild fibrointimal thickening (cv1).

No features of chronic allograft arteriopathy are present.

No endarteritis (v0).

No arteriolar hyalinosis (ah0).

Peritubular capillary inflammation is present in <10% of cortical peritubular capillaries (ptc0).

IMMUNOHISTOCHEMISTRY

C4d: negative (C4d0)

SV40: negative

B.ELECTRON MICROSCOPY

Ultrastructural examination was not performed.

C.IMMUNOFLUORESCENCE (frozen tissue sample)

Frozen sampled received but not examined.

CONCLUSION

Acute tubular injury with tubular epithelial cell cytoplasmic microvacuolation.

COMMENT

Tubular epithelial microvacuolation is not specific but has been described in acute CNI toxicity. Other associations include IVIG, plasma expanders and radiolabeled contrast media.

This case was reported using the Digital Pathology Whole Slide Acquisition. The laboratory is not UKAS accredited for this test.

The report can then be copied and pasted into copath but beware!

Report needs to NOT be formatted, not Word:

Please see the list of characters illegal in CoPath, according to the advice of Sunquest Support

The use of these characters will compromise the integrity of reports. Can we remind all not to use these.

•             (x0D) Segment separator

•             | Field separator, aka pipe

•             ^ Component separator, aka hat

•             & Sub-component separator

•             ~ Field repeat separator

•             \ Escape character

•             [ ] brackets

•             **¨**Umlaut

•             Word functions that create issues, such as smart quotes (they show in HL7 message as a 3 and 4, disrupting the meaning)

Two examples of database entry : see excel spreadsheet

Future Vision

Individual patient:

Standardised Clinical Report for clinical decision-making

Clinical Info (blood, urine, serology, presentation, Past MH etc.)

Population Level:

Database entry with codes > UK renal registry

Medical literature updates

WSI

Pathology + Renal medicine textbook