Advancing Kidney Assessments for Transplants with AI-driven Applications

Federica Citterio | Sr Data Scientist

PHUSE EU Connect 2024

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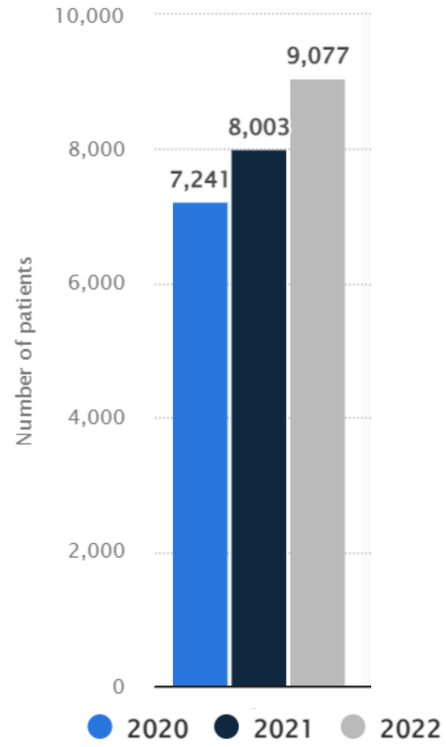
The Kidney Transplant Challenge in the UK

The challenge



- Demand for kidney transplants is increasing
- Assessing the quality of donor kidneys is a time-consuming task that requires huge domain expertise
- Kidneys form older donors are declined due to lack of evaluation

44%
of older donors' kidneys discarded

<4 hours
Window to perform analysis

only 30
pathologists in the UK can do the analysis

The need

Build a system that can support the pathologist in quantifying the degree of chronic injury of a kidney

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Improving Patient Outcomes and Cost Efficiency

Improved decision making

- Quantify and create uniform standards
- More accurate, reliable and efficient

Increased transplant rate

- Increase the number of viable kidneys, particularly from older donors

Enhanced quality of life

- Reduce waiting time for transplant
- Ensure high quality of transplanted kidneys

Cost savings for NHS

- Improve efficiency of transplant process
- Decrease dialysis cost

120 Extra kidneys transplanted each year in the UK

£3.5m Saving for the health system per year

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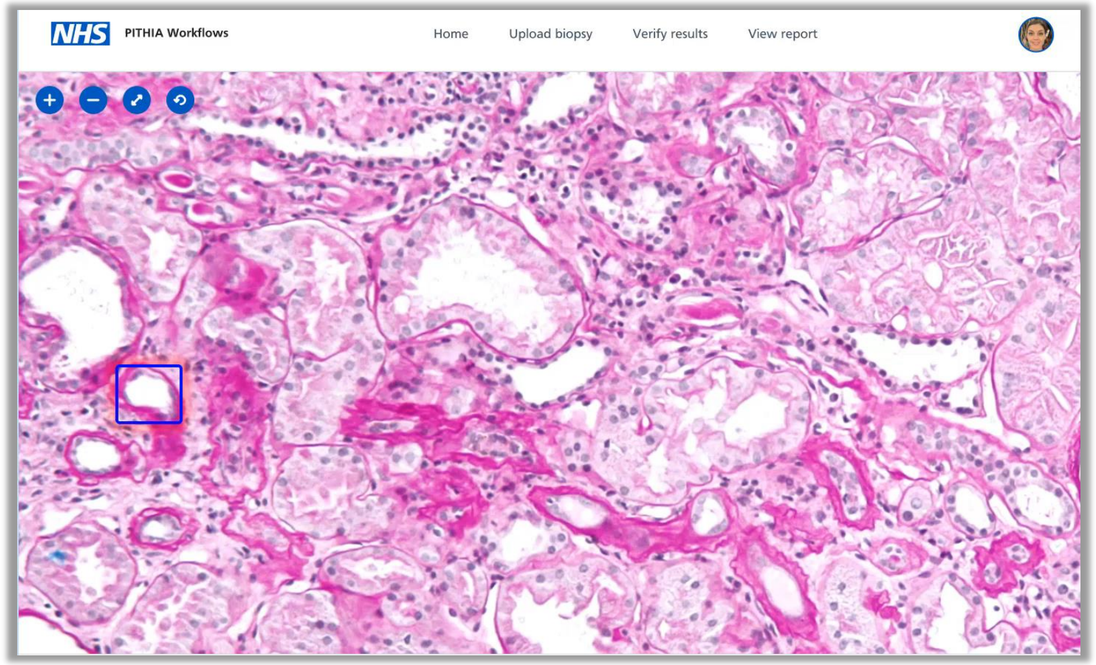
Histopathologist Analysis

Remuzzi Score



GLOMERULI *(G)*

Number of glomeruli	
Number of globally sclerosed glomeruli	
Percentage globally sclerosed*	

Remuzzi Grade *(G)*

0 - 2%	0	☐
3 - <20%	1	☐
20 - 50%	2	☐
>50%	3	☐

TUBULAR ATROPHY *(TA)*

Please indicate % TA		*Complete if % TA is in this category*
<5%	☐	
5-15%	☐	
15-25%	☐	<20% ☐
25-35%	☐	>20% ☐
35-45%	☐	
45-55%	☐	<50% ☐
55-65%	☐	>50% ☐
65-75%	☐	
>75	☐	

Remuzzi Grade *(TA)*

0 - 5%	0	☐
6 - <20%	1	☐
20 - 50%	2	☐
>50%	3	☐

INTERSTITIAL FIBROSIS *(IF)*

Please indicate % IF		*Complete if % IF is in this category*
<5%	☐	
5-15%	☐	
15-25%	☐	<20% ☐
25-35%	☐	>20% ☐
35-45%	☐	
45-55%	☐	<50% ☐
55-65%	☐	>50% ☐
65-75%	☐	
>75	☐	

Remuzzi Grade *(IF)*

0 - 5%	0	☐
6 - <20%	1	☐
20 - 50%	2	☐
>50%	3	☐

ARTERIES *(A)*

Number of arteries	

NOTE: Score based on arteries only. If severe arteriolar changes then mention as other adverse feature in comments.

Remuzzi Grade *(A)*

Normal	0	☐
Wall thickness less than (<) lumen diameter	1	☐
Wall thickness equal or slightly greater than (>) lumen diameter	2	☐
Wall thickness much greater than (>) lumen diameter	3	☐

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AI in Decision Making

How do we get it right?

AI Models

Accurate, reliable and scalable

Application

Well-designed, and easy-to-use

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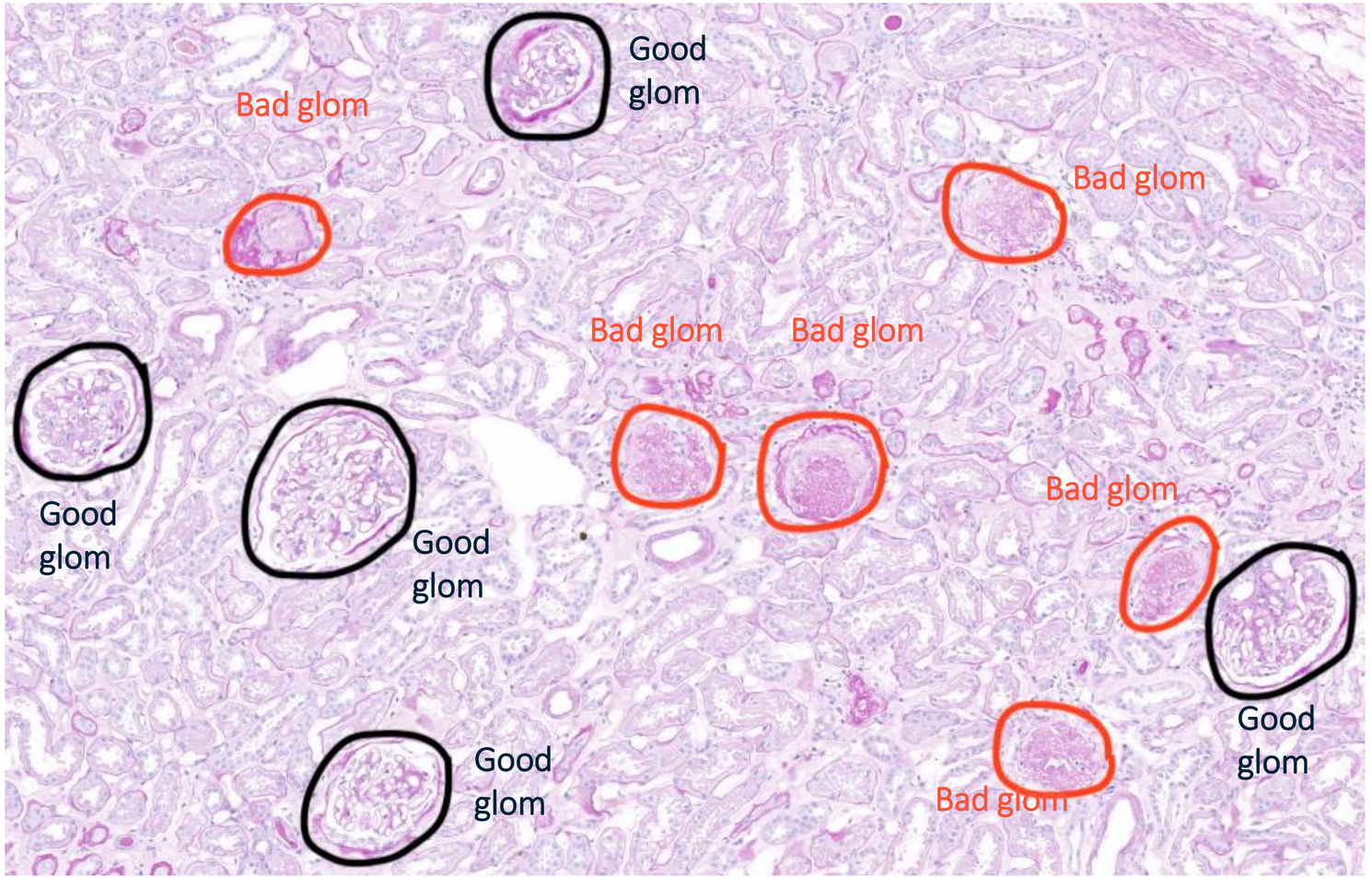
Identify and Classify Specific Structures

Glomerular Global Sclerosis



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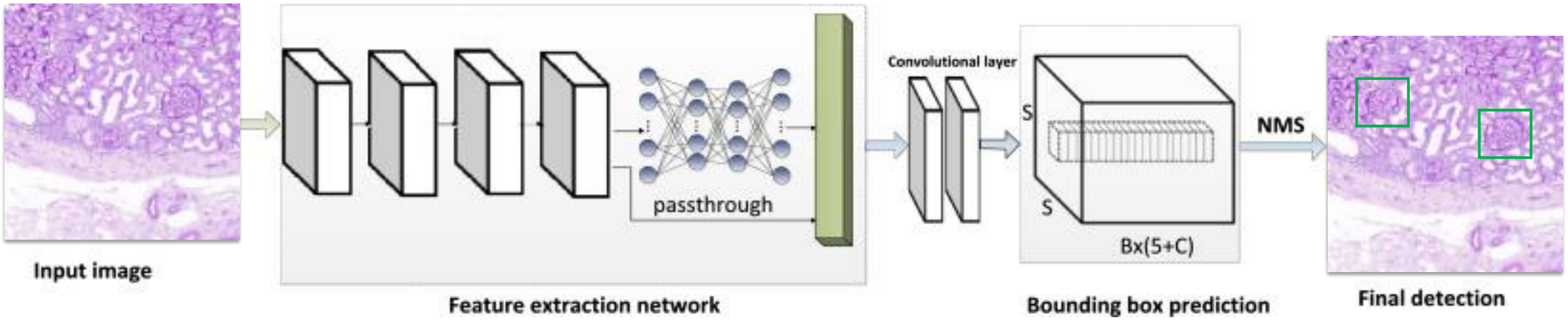
Object Detection Model



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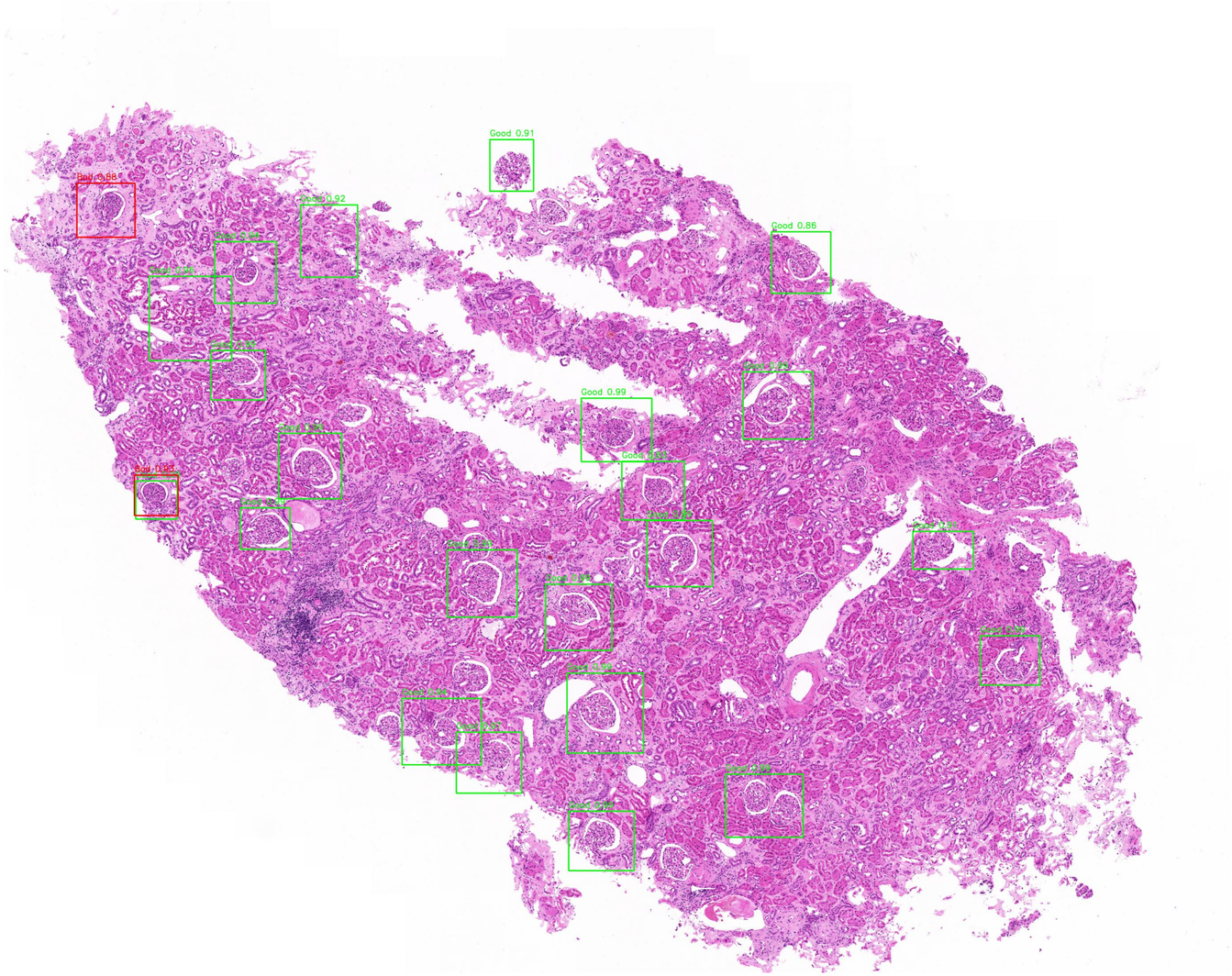
Glomerular Global Sclerosis Evaluation



Object Detected

Not Sclerosed Gloms	Sclerosed Gloms
22	1

4% Sclerosed Gloms

Remuzzi Score: **1**

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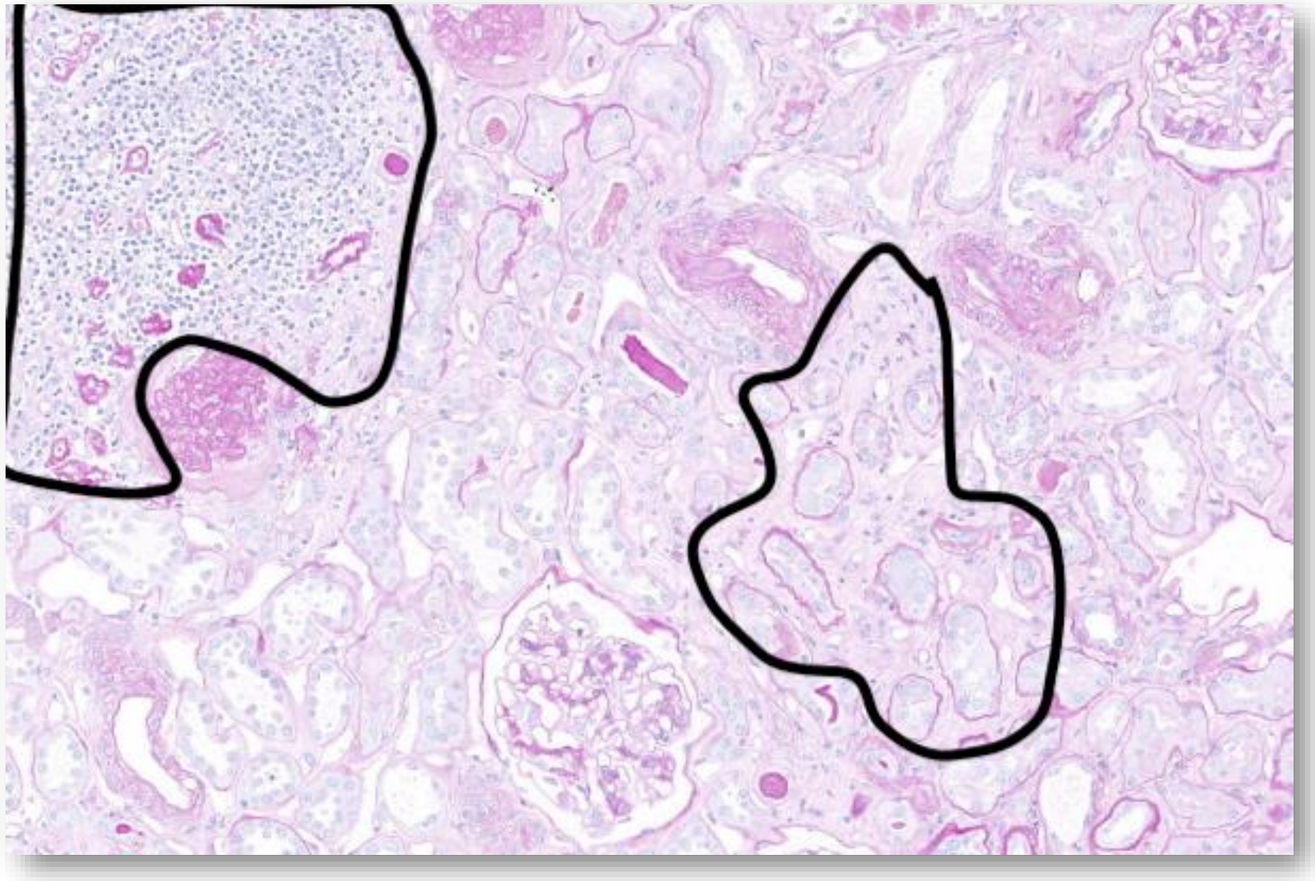
Identify Specific Areas

Interstitial Fibrosis and Tubular Atrophy - IFTA



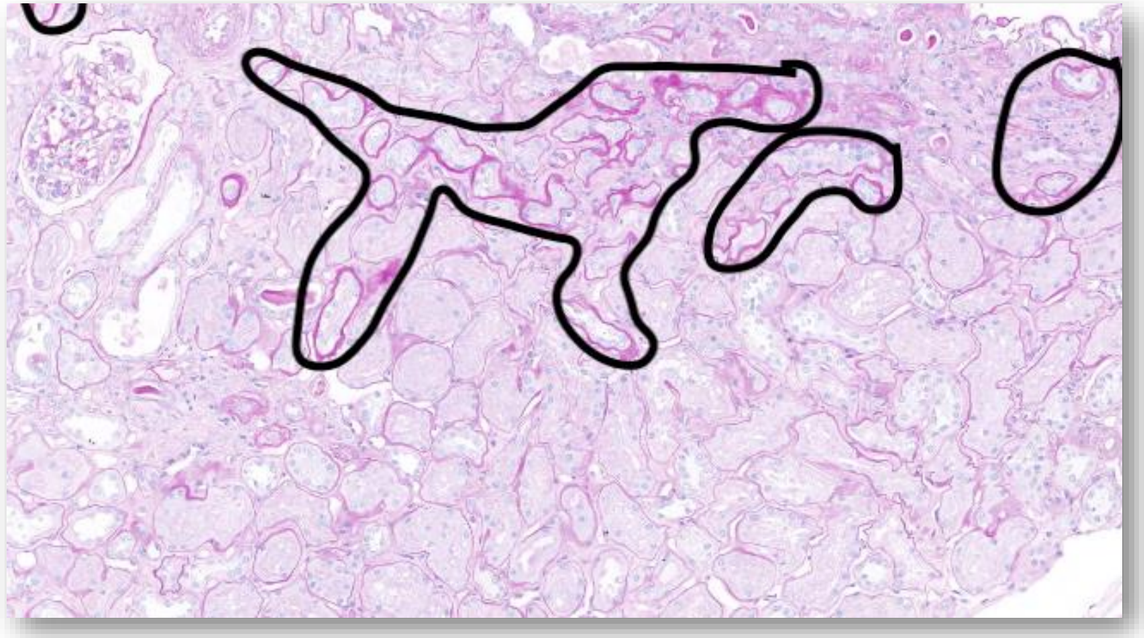


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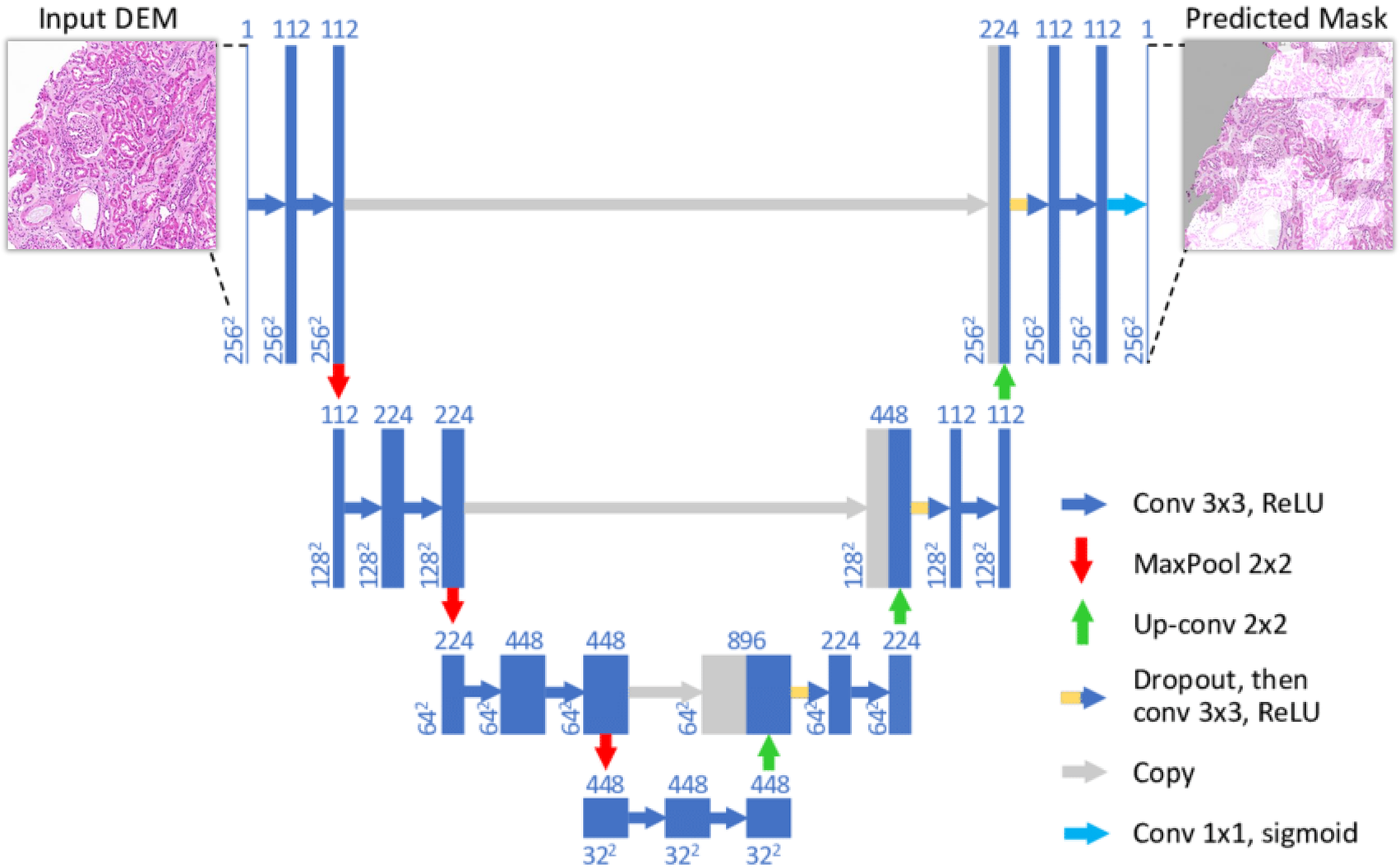
Image Segmentation Model



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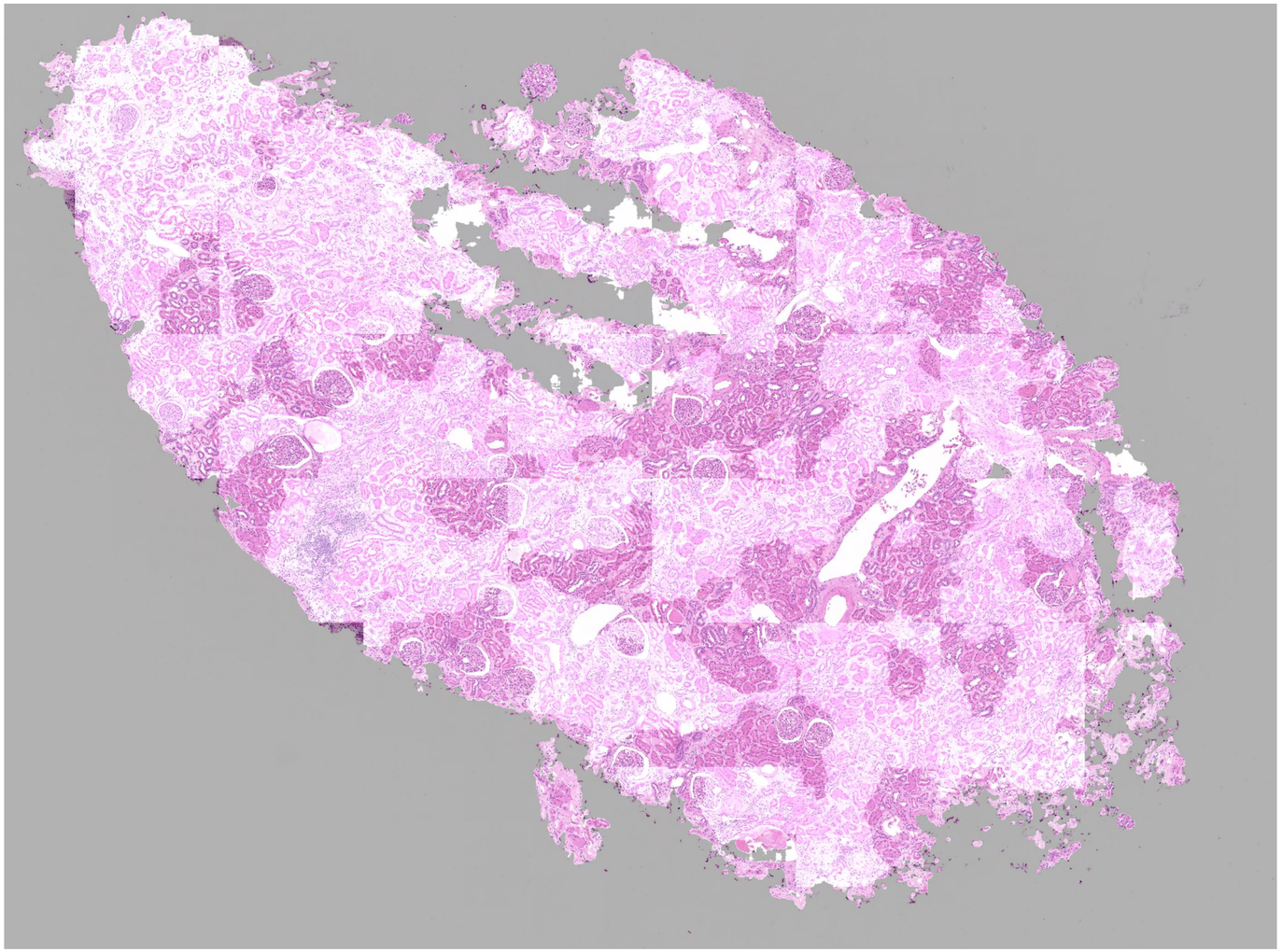
IFTA Evaluation



Estimated Areas in Pixels

IFTA Area	Normal Area
1’136’651	748’013

60% IFTA

Remuzzi Score: **3**

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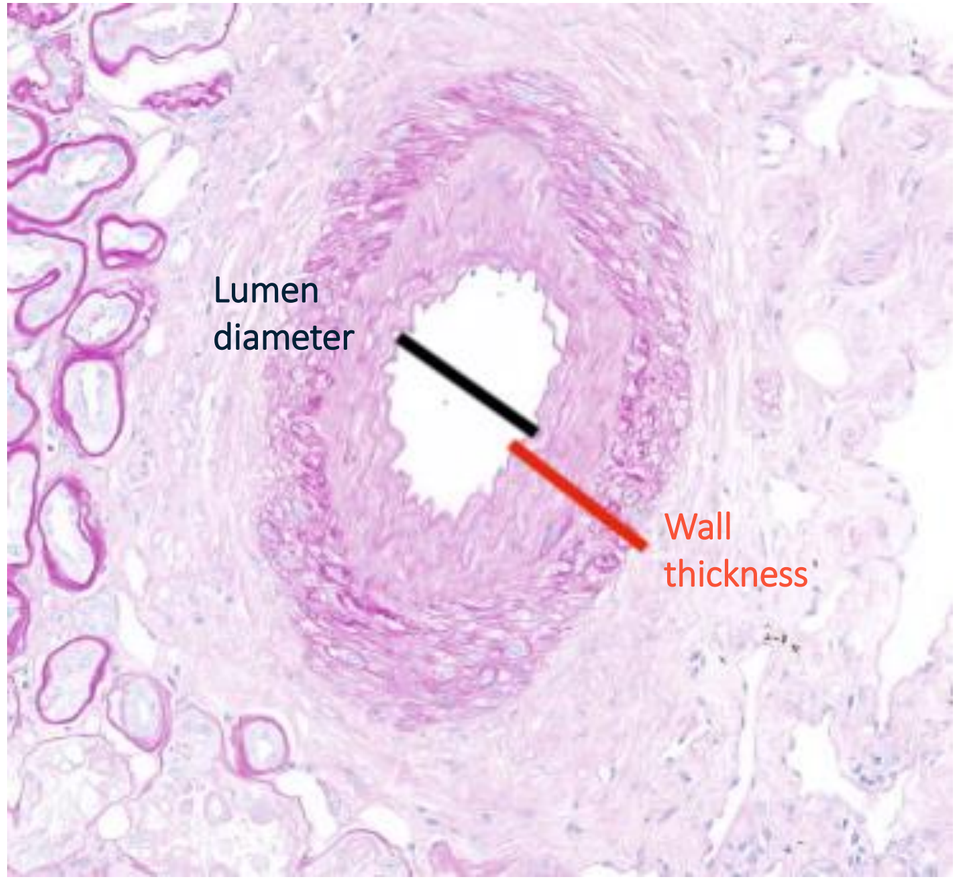
Quantify and Measure

Arterial Narrowing



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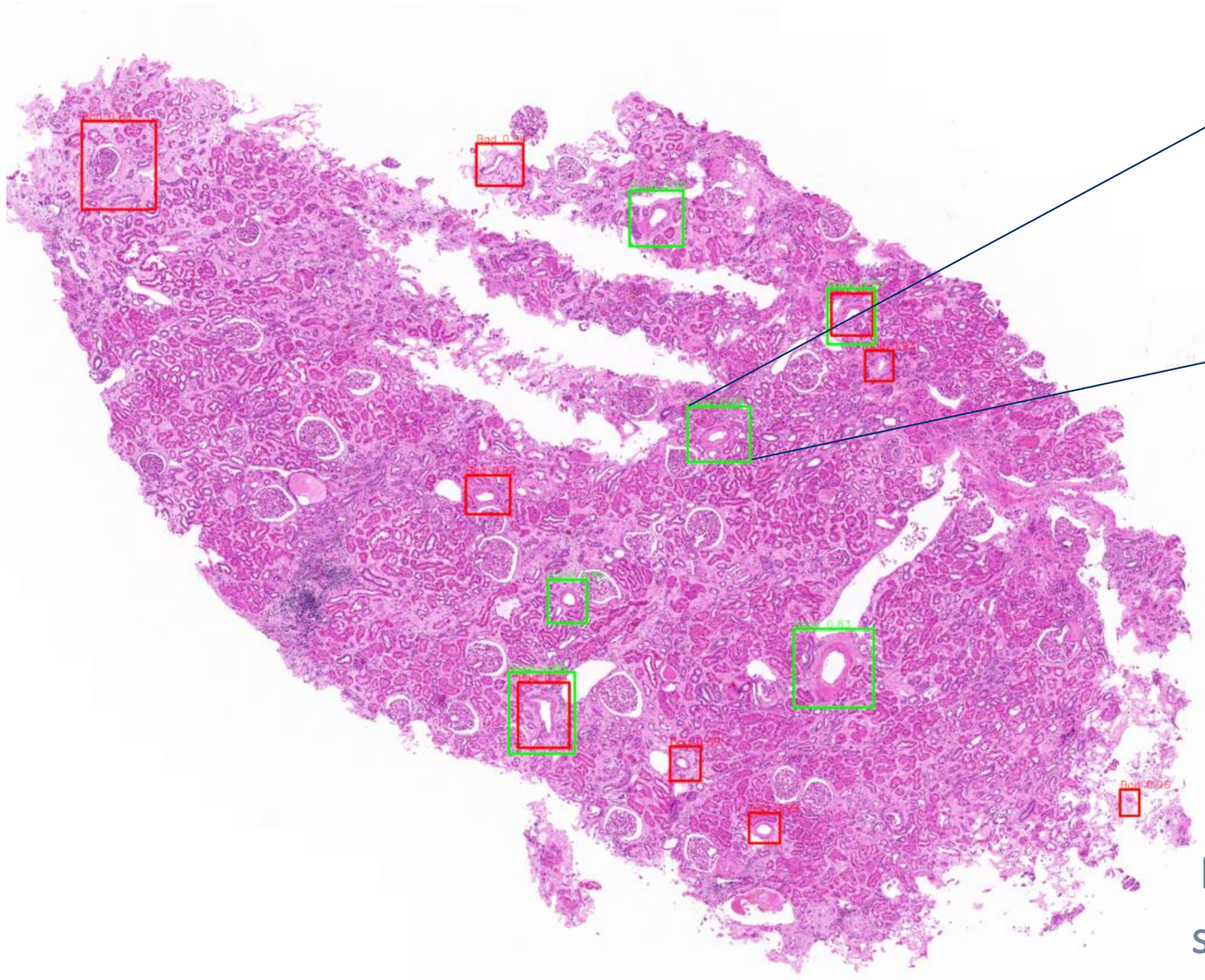
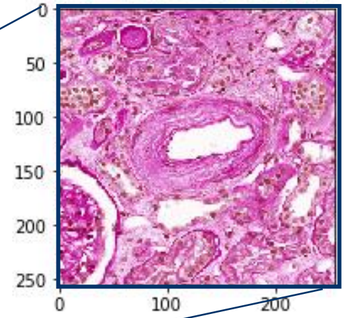
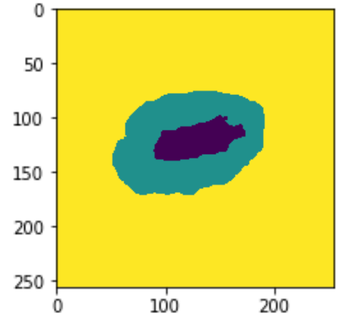
Arterial Narrowing Evaluation



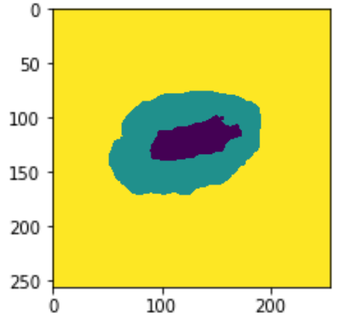
Input Image



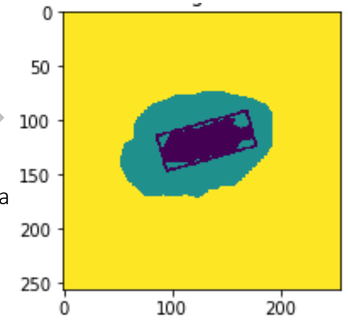
Output Mask



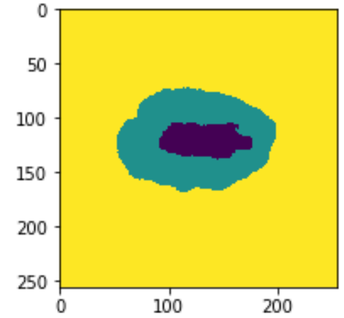
Post Processing



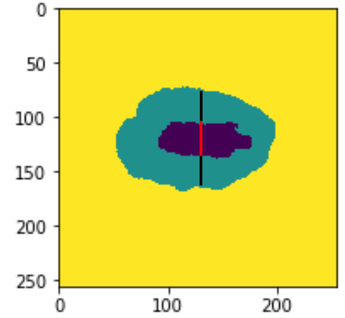
Identify lumen area



Rotate image appropriately



Calculate diameters



Remuzzi score = 2

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Key Application Building Blocks

Apps

Tools for expediting building and hosting user interfaces

Functions

Tools for hosting business logic, AI models and algorithms

Storage

Tools for designing data structures, storing data and accessing files

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Apps View All (3)

Create App

Insurance risk mitigation
Updated: 09/08/2023
Creator: Kenny.Jones@sas.com

Fraud detection
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com

Patient portal
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com

Functions View All (9)

Create Function

REMEX8
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com
Draft

Loan amortization
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com
Staged

SLCSP cost
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com
Draft

Patient Sentiment
Updated: 09/07/2023
Creator: Kenny.Jones@sas.com
Draft

Schemas View All (9)

Create Schema

nhs-kidney-app [Administrator]
Create SAS App
SAS® App Factory

Augmenting Human Possibilities with AI

- Replicate the spirit of human judgement
- Approach allows clinicians to "trust, but verify“
- Trustworthy AI is a complex problem!

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