



The Scottish Experience



Mike Black



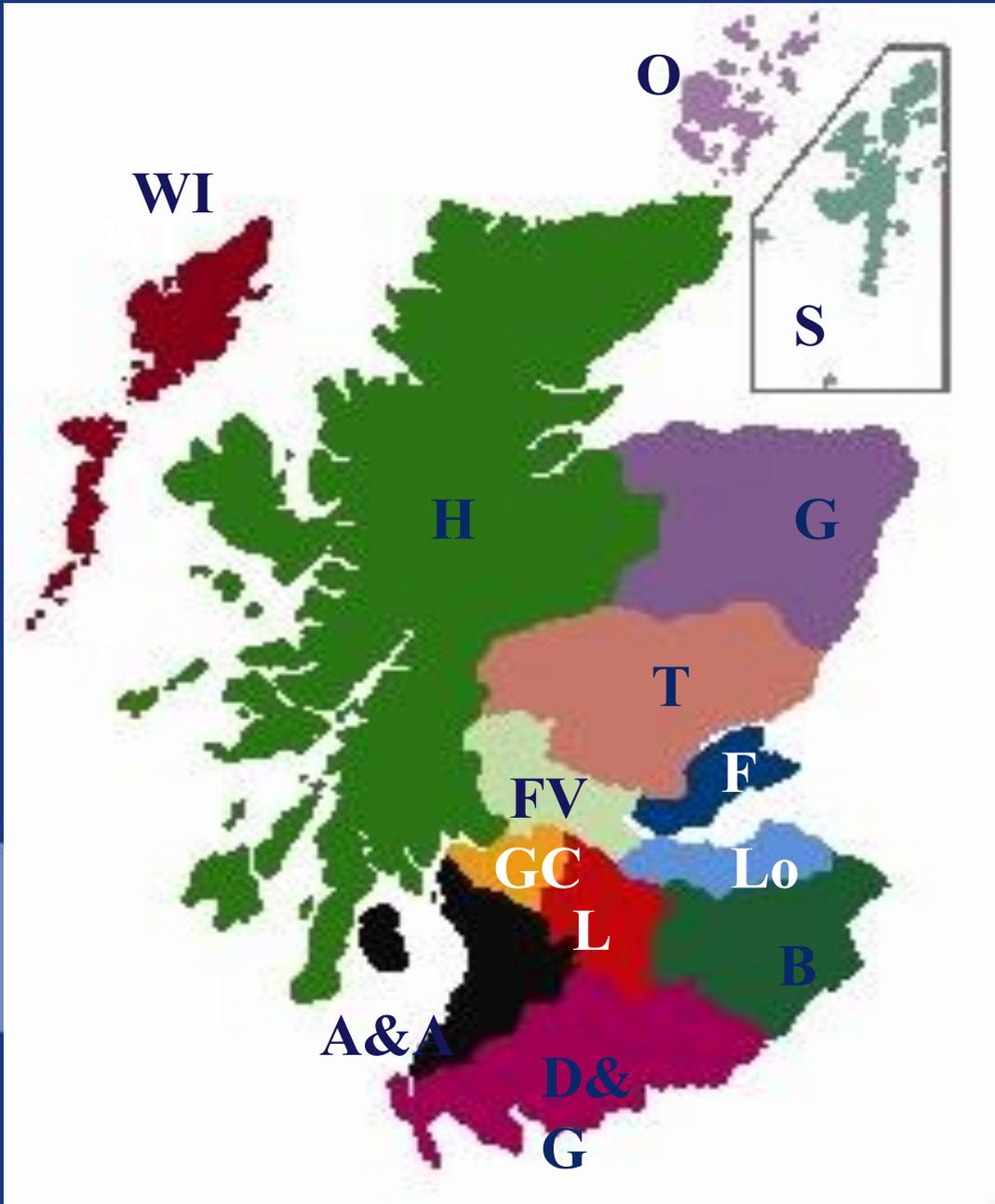
NHS
SCOTLAND



Automated Grading



- Why did we introduce it?
- What is it?
 - Integration
 - Acceptance by users
 - Governance



Ayrshire & Arran (A&A)

Borders (B)

Dumfries & Galloway (D&G)

Fife (F)

Forth Valley (FV)

Grampian (G)

Greater Glasgow & Clyde (GC)

Highland (H)

Lanarkshire (L)

Lothian (Lo)

Orkney (O)

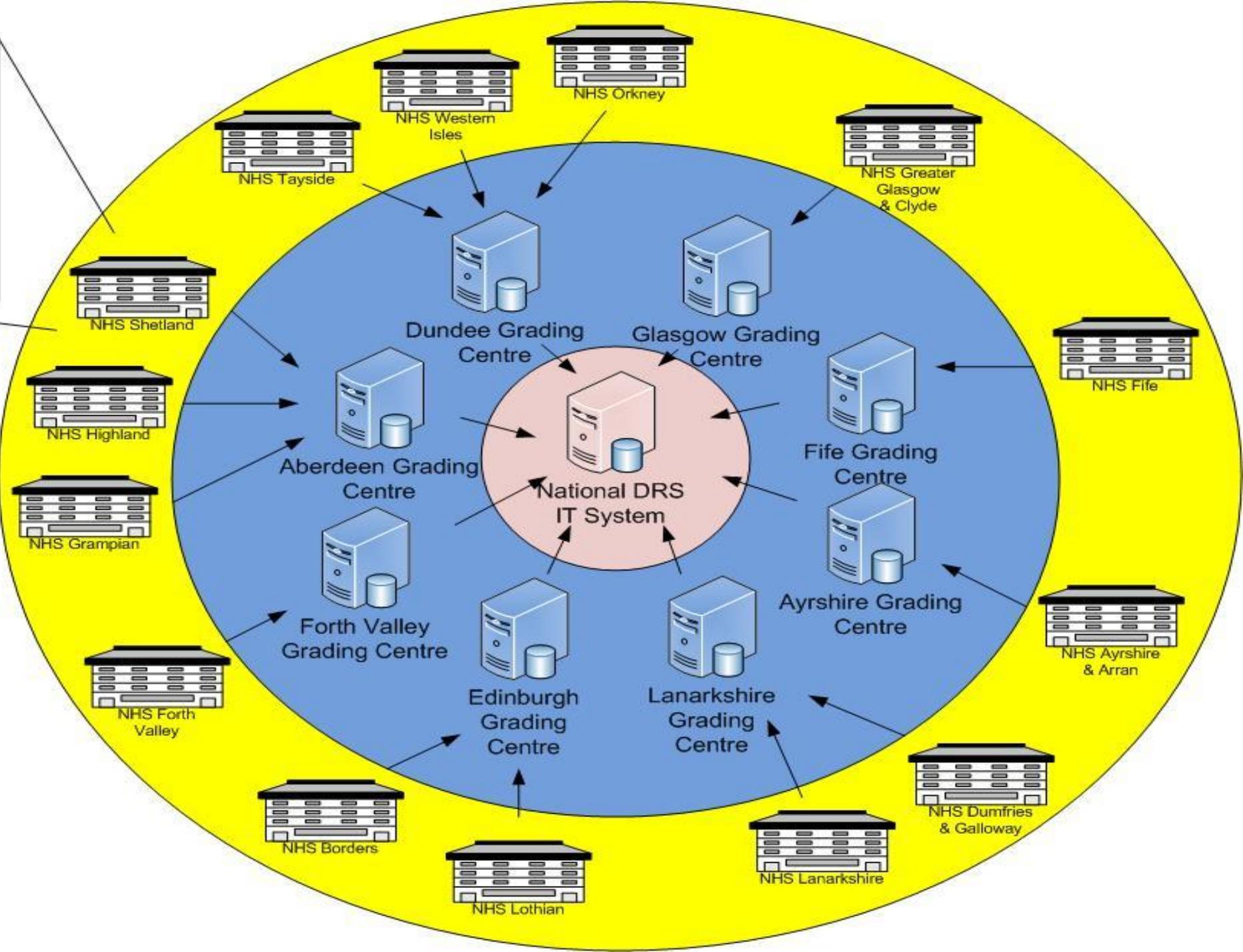
Shetland (S)

Tayside (T)

Western Isles (WI)

Web Browser Client PCs

Mobile Units



Why use it?

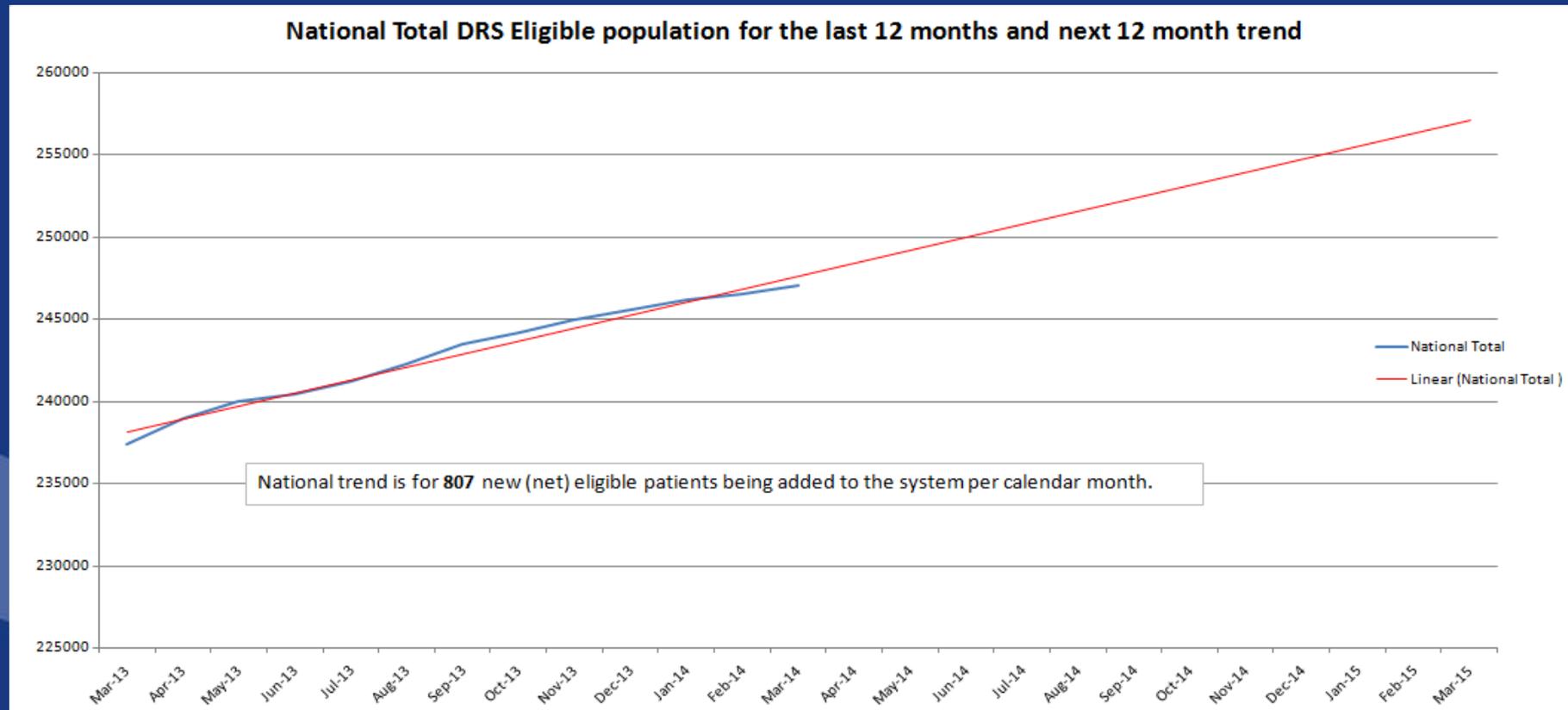


Programme in 2009

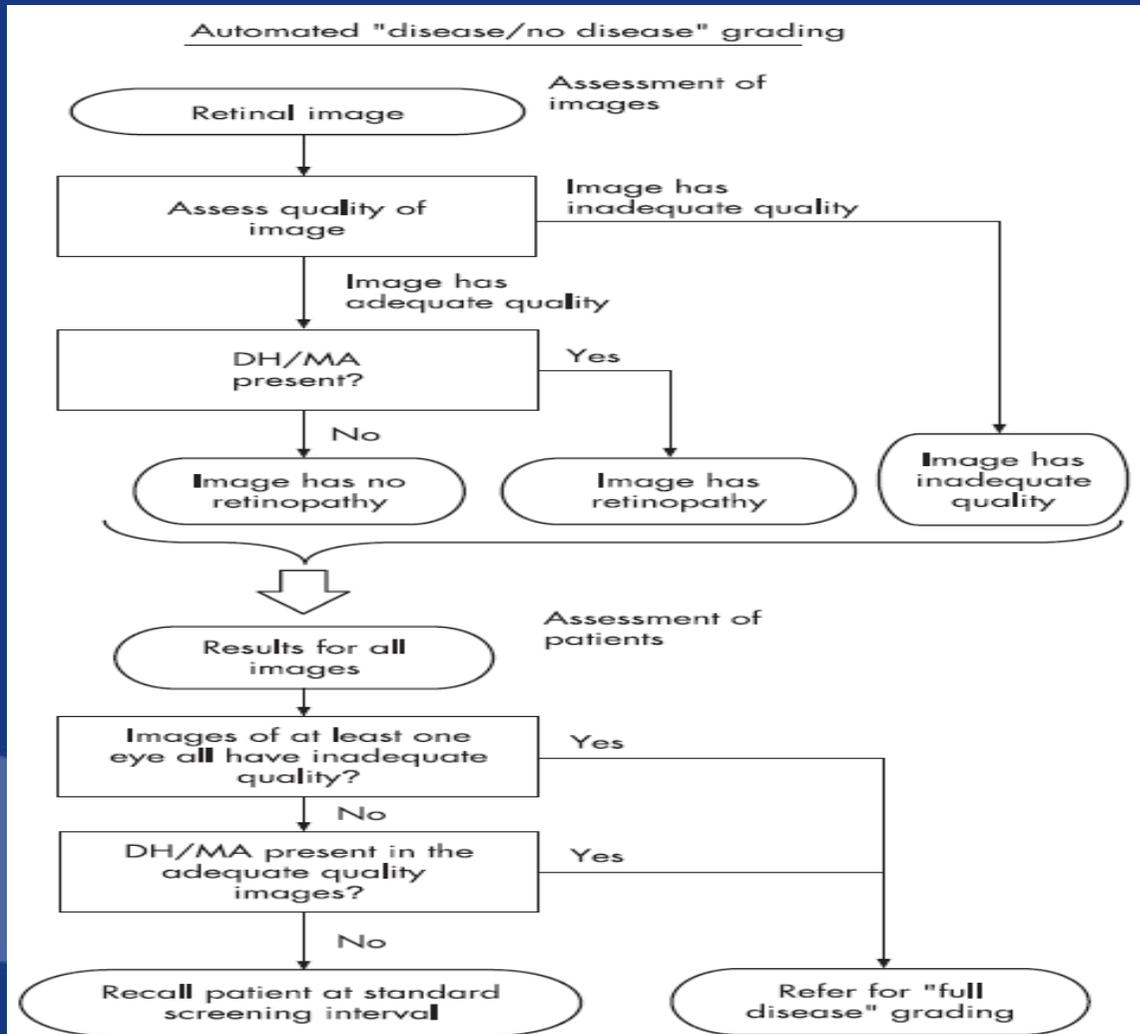
- Total diabetic population = 227,293
Eligible = 196,686
- Graders
 - 41 Level 1
 - 34 Level 2
 - 15 Level 3 – Ophthalmologists
 - Total team of 90
- Turnover of L1 graders was ~20% pa ☹️

Why use it?

- Reduces manual grading by ??
- Cost effective ??
- Resilience ??



What is automated grading?



Detects micro-aneurysms

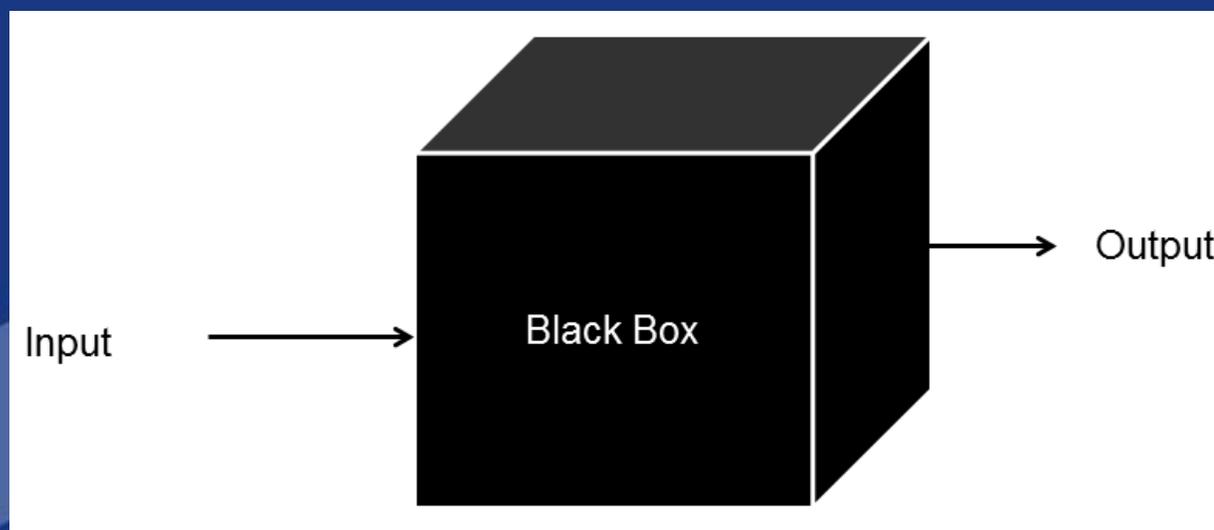
Sensitivity vs specificity

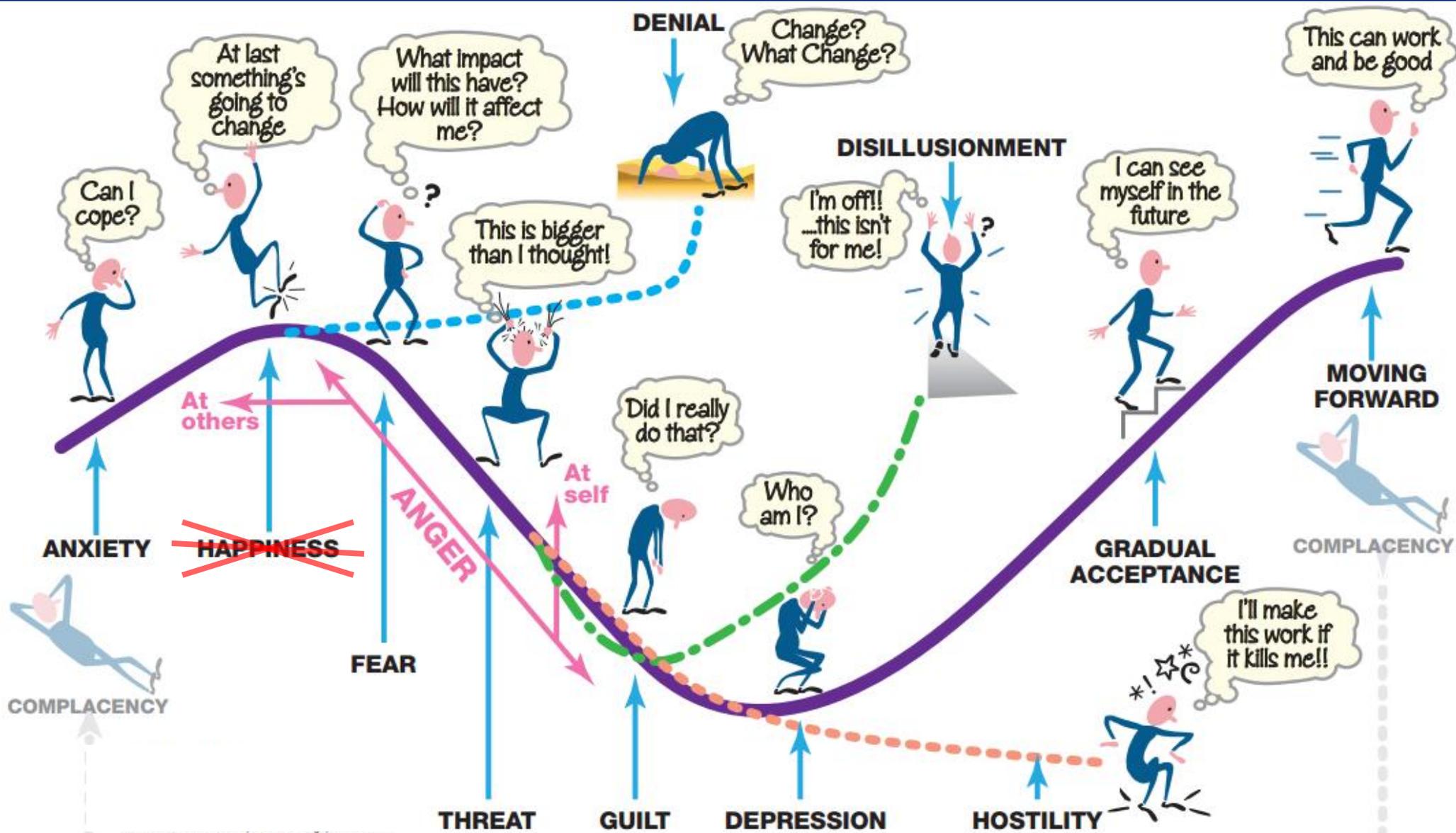
No disease

- autograder 40%
- manual grader 60%

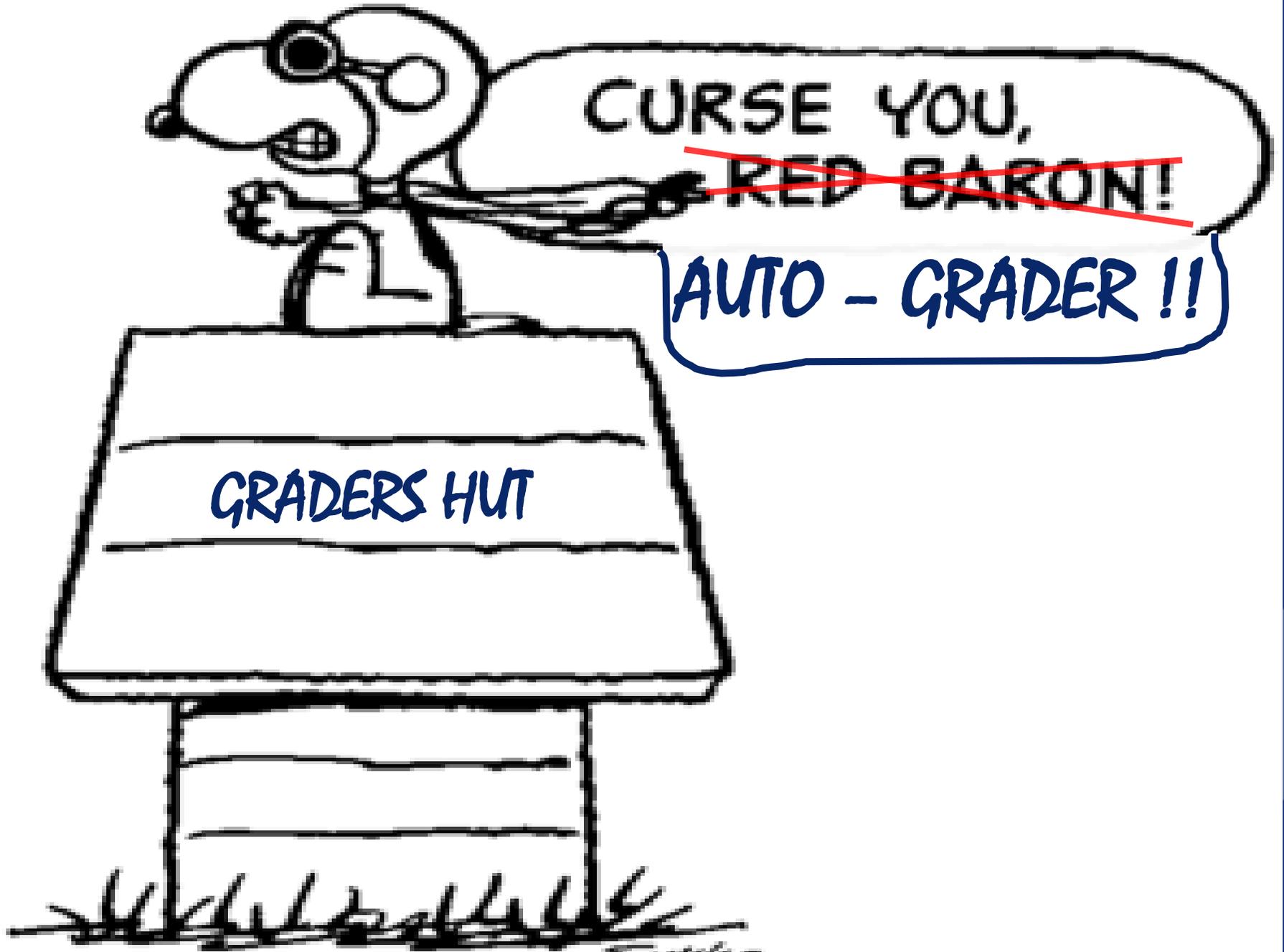
What is Automated Grading?

- Black Box solution
- Inputs
 - Unique case/image identifier
 - Retinal images
- Outputs only one of the following -
 - Technical Failure
 - No Disease Detected
 - Disease Detected





Time

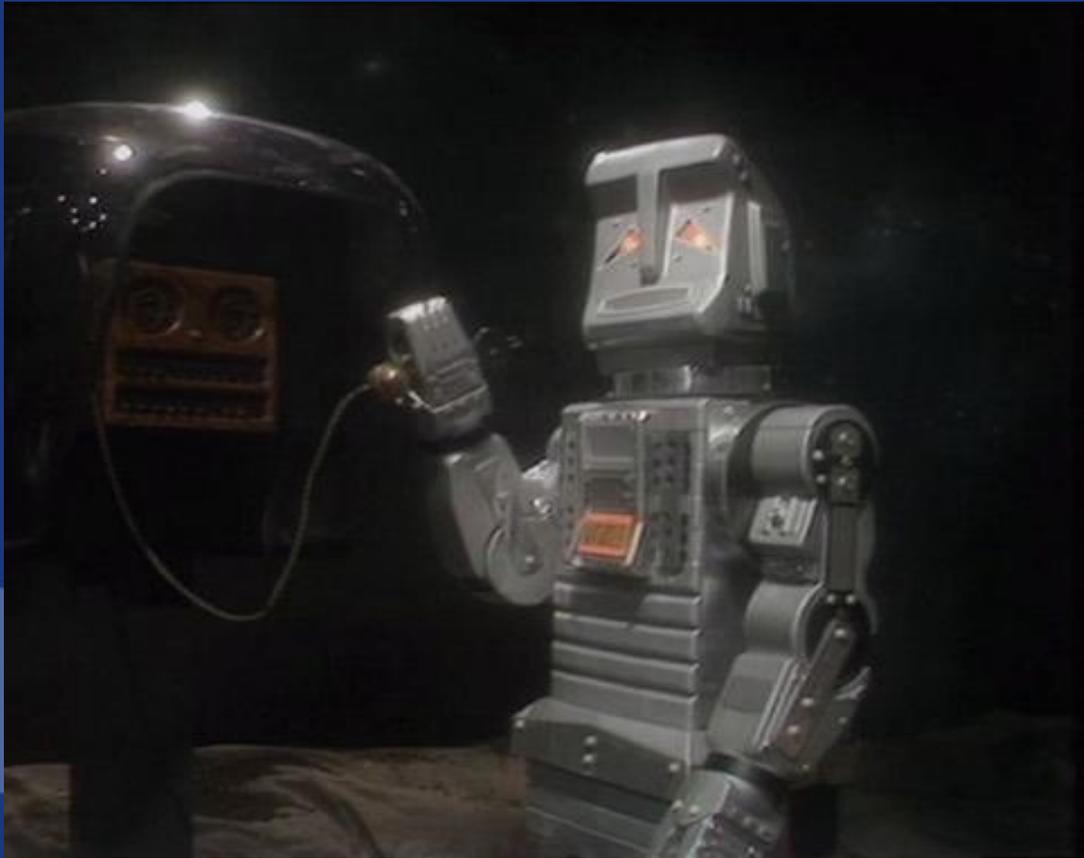


CURSE YOU,
~~RED BARON!~~

AUTO - GRADER !!

GRADERS HUT

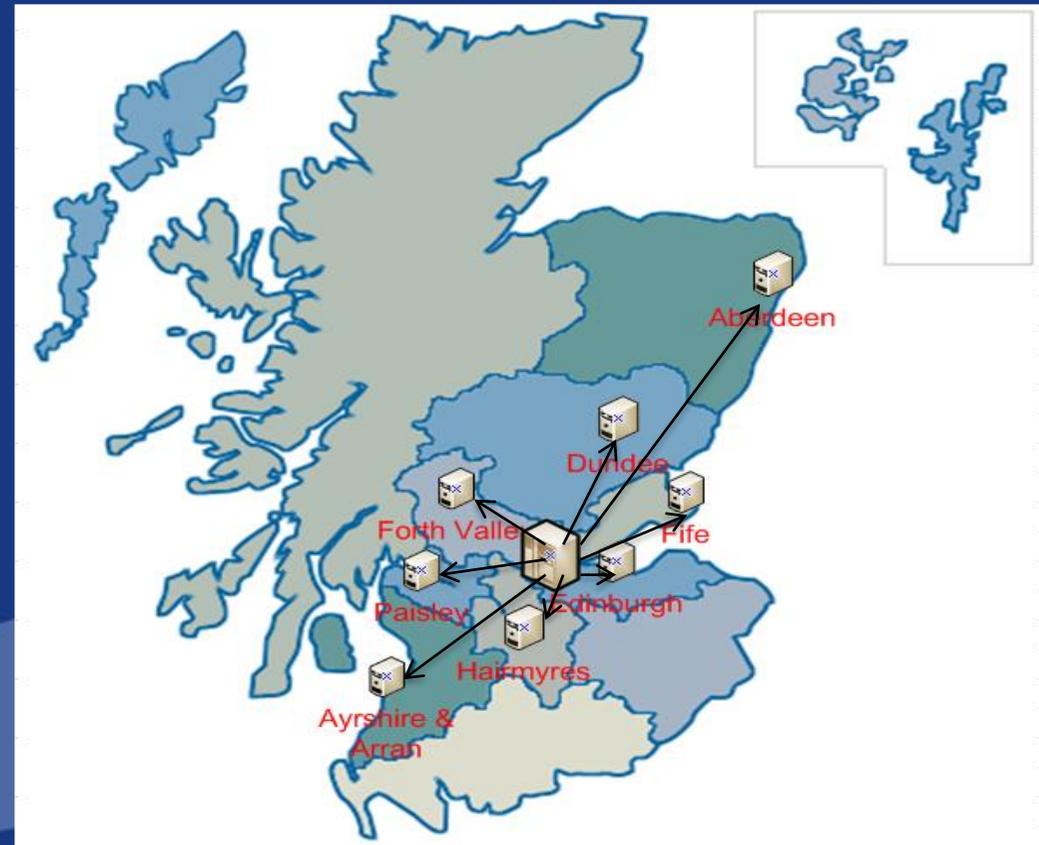
Marvin the Depressed Auto-grader



"I think you ought to know.... I'm feeling very depressednobody likes me"

How did we introduce it?

- Feature based grading programme
- Technical architecture
- Interface
- What type of grader
- Reporting?



How did we introduce it?



DRS IT System

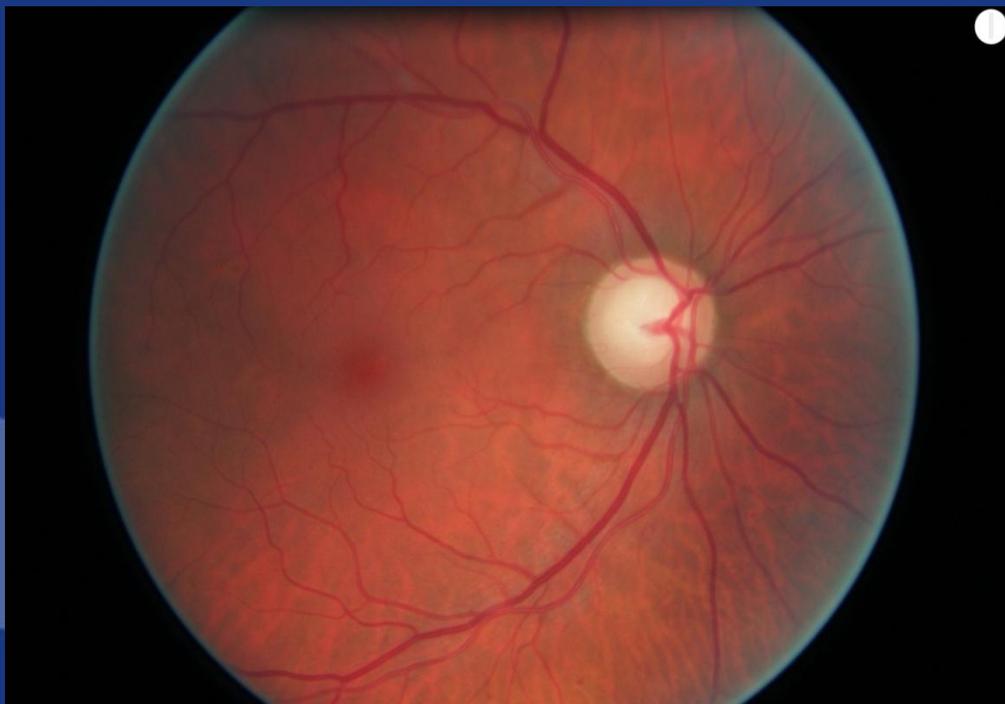
Interface

Auto-grader



iGradingM V1.0

Non DR Pathology



What is the purpose of screening?

- HTA purpose of screening
 - *“The detection of referable (potentially sight-threatening) retinopathy so that it can be treated.”*

Quality assurance

- Red flag system bypasses auto-grader
- Internal and External quality assurance

Task List			
Grading (1st Level)		▼	not started
K ◀			
		▼	Examination
<input type="checkbox"/>			T_C01-20110119-002-BELW 
<input type="checkbox"/>			S_C01-20110222-001-ADAJ 
<input type="checkbox"/>			T_C01-20110119-001-BELM 
<input type="checkbox"/>			T_C01-20110117-001-BELJ 

Source: Scottish DRS Test IT system

Leaflet for patients



Your guide to
**diabetic retinopathy
screening**



Will I still need to have a regular eye test at the optometrists?

Yes, you need to do both. Your screening photographs will either be graded by a health professional or an automated grading system to detect diabetic retinopathy but not any other eye conditions. You should continue to visit your optometrist regularly for a free eye check as well.

DIABETES UK
CARE. CONNECT. CAMPAIGN.
SCOTLAND



Internal Quality Assurance



KPI 20 – QA False Negative Rate

Human Graders = 0.45%

Auto-grader = 0.24%

Source: Scottish DRS Collaborative IT System

KPI 20: QA False Negative Rate

Grader Id	Sets of images reviewed on the QA task list	Sets of images for which the QA outcome is Refer to Ophthalmology	Percentage
	473	8	1.7%
	199	2	1.0%
	41	0	0.0%
	7	0	0.0%
	458	5	1.1%
Autograder, ABERDEEN	500	0	0.0%
Autograder, DANDG	347	0	0.0%
Autograder, DUNDEE	490	3	0.6%
Autograder, EDINBURGH	484	0	0.0%
Autograder, FIFE	501	0	0.0%
Autograder, FORTHVALLEY	500	0	0.0%
Autograder, HAIRMYRES	492	2	0.4%
Autograder, PAISLEY	527	2	0.4%
	3	0	0.0%
	96	2	2.1%
	500	3	0.6%

DRS External Quality Assurance



IQA
Agree

L3



IQA
Agree

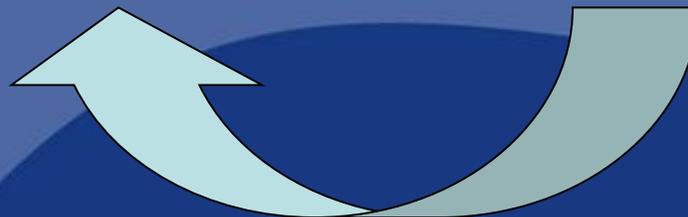
L3



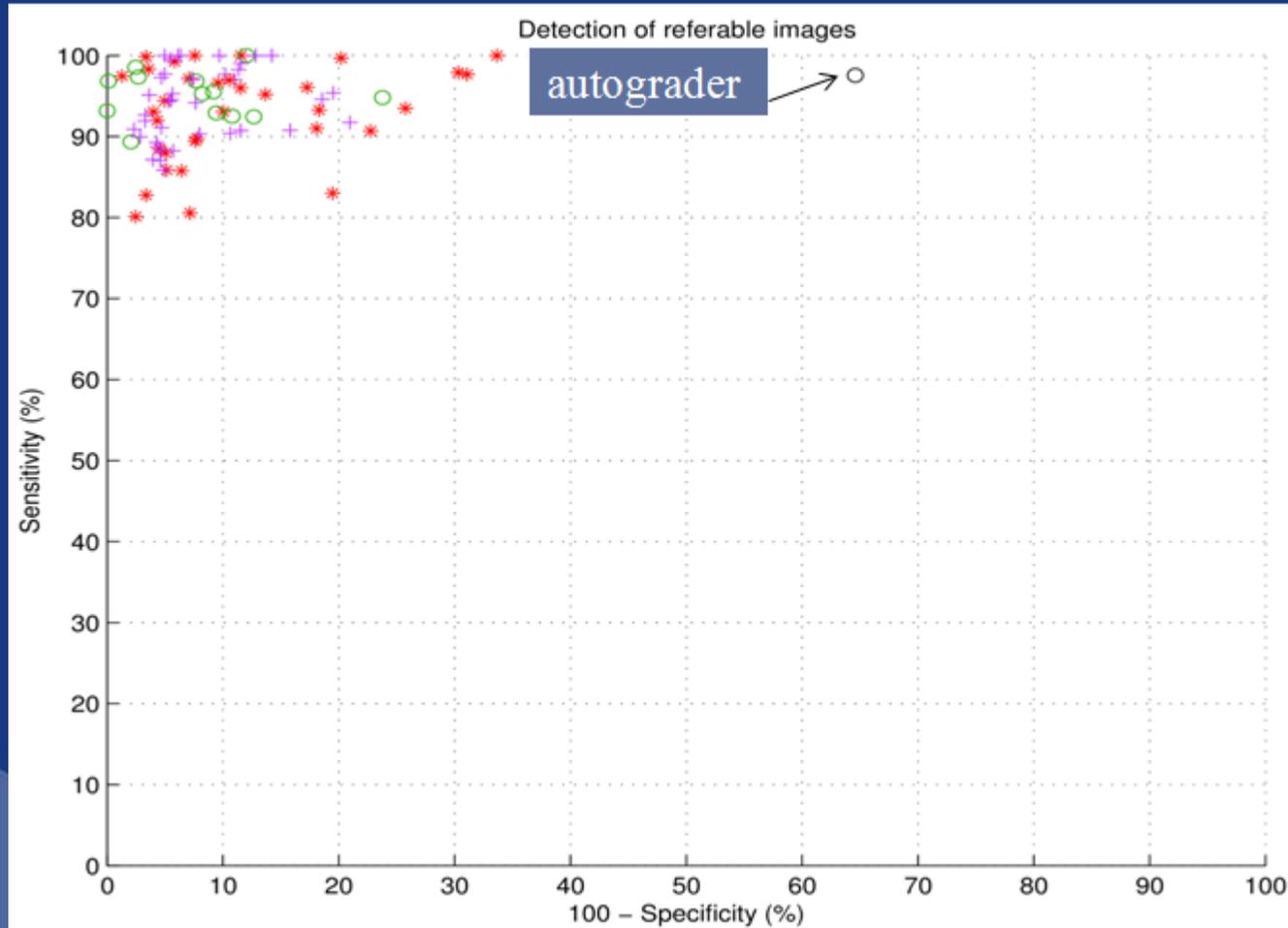
Graders Centre 1

Agree???

Graders Centre 2



External Quality Assurance



Source: Scottish DRS EQA System, Dr K.A. Goatman, University of Aberdeen

What we have learnt?



- Marvin is not an automated-grader –
 - he's a micro-aneurysm detector!
- Hard worker – 600+ patients per day
- Technical aspects need some careful thought
- Acceptance, its not a small issue
- Governance, vital for acceptance
 - Micro-Aneurysm Detector - **MAD**
 - Pre R0/M0 Filter – **PR0F**
 - Totally Obedient Moron - **TOM**
 - Archie Gemmill – **Archie Gemmill**

Programme in 2016



- Total diabetic population = **312,253** (+ 41%)
Eligible = **268,896** (+ 36%)
- Graders
 - 38 Level 1 (**-3**)
 - 37 Level 2 (**+3**)
 - 15 Level 3 – Ophthal + **L2/SLE**
 - Total team of 90 (**no change**)
- Turnover of L1 graders is now < **5%** 😊





Moving House – from Soarian to Vector - 2017

British Association of Retinal Screeners - Sept 2016

References

- Br J Ophthalmology 2010;94:1606-1610. doi:10.1136/bjo.2009.176784 – *Automated grading for Diabetic retinopathy: a large-scale audit using arbitration by clinical experts.* Alan D Fleming, Keith A Goatman, Sam Philip, Gordon J Prescott, Peter F Sharp, John A Olson
<http://www.ndrs-wp.scot.nhs.uk/wp-content/uploads/2013/04/automated-grading-for-drs-large-scale-audit.pdf>
- *Should automated grading of retinal photographs be used in the Scottish Diabetic Retinopathy Screening Service.* Prof Norman Waugh, MB ChB, DA, MRCP(UK), MPH, FRCP(Edin) FFHM.
<http://www.ndrs-wp.scot.nhs.uk/wp-content/uploads/2013/04/automated-grading-for-drs-large-scale-audit.pdf>
- Costs and consequences of automated algorithms versus manual grading for the detection of referable diabetic retinopathy. G S Scotland, P McNamee, A D Fleming, K A Goatman, S Philip, G J Prescott, P F Sharp, G J Williams, W Wykes, G P Leese, J A Olson.
<http://www.ndrs-wp.scot.nhs.uk/wp-content/uploads/2013/04/Costs-and-consequences-of-autograding.pdf>