Why do we make mistakes in morphological diagnosis – how can we improve?

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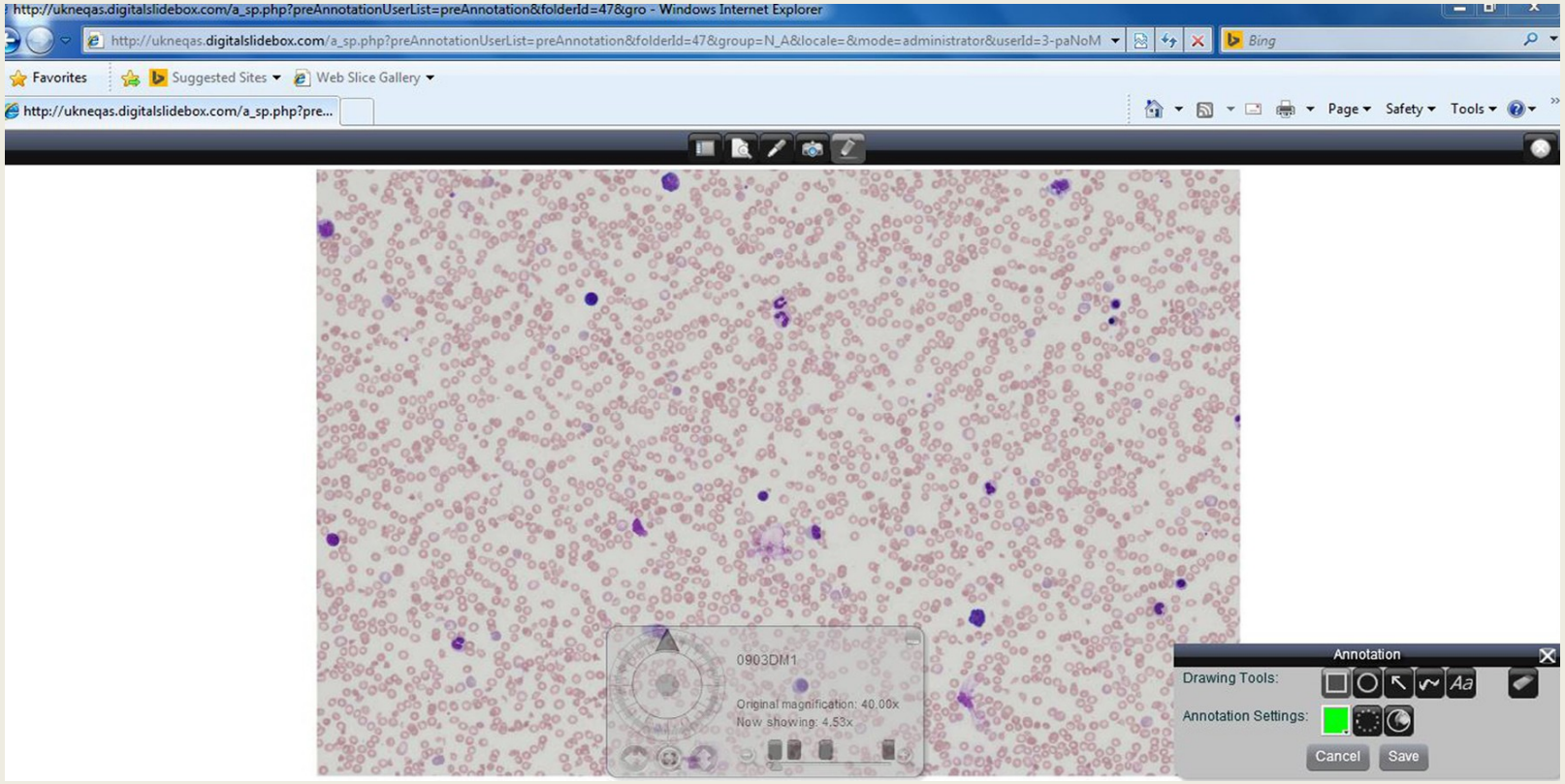
Manchester, UK

UK NEQAS(H) DM scheme



1. Select up to 5 significant morphological features from a defined list
2. Place these in priority order 1-5
3. Answer multiple choice question : “what would I do next?”
4. Offer free text opinion generally: “what is your preferred diagnosis?”

But some people get the answers wrong!

Are we really helping this group sufficiently?
Do we really know why they get things wrong?

Analysing morphology is more complex than we think

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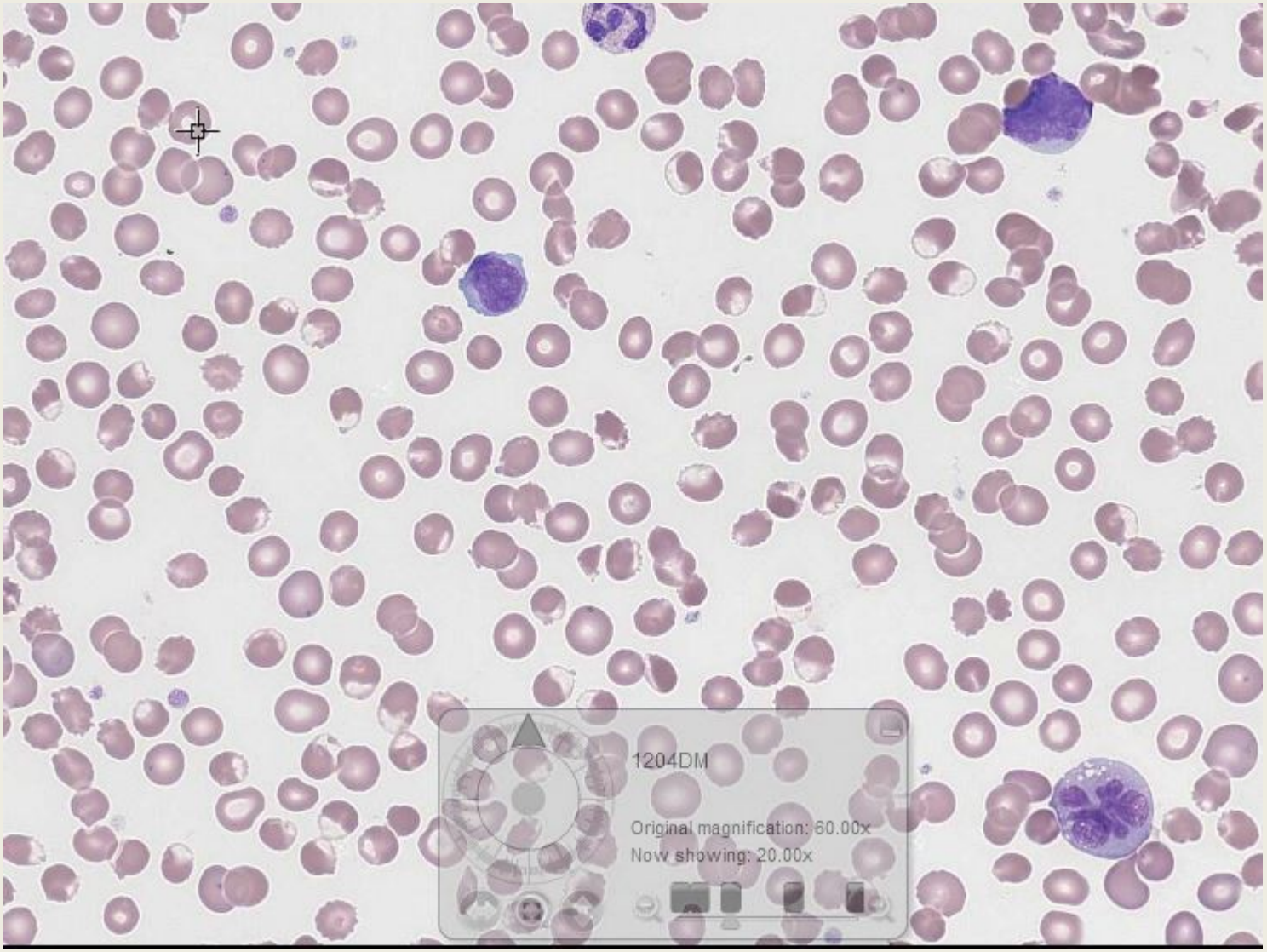

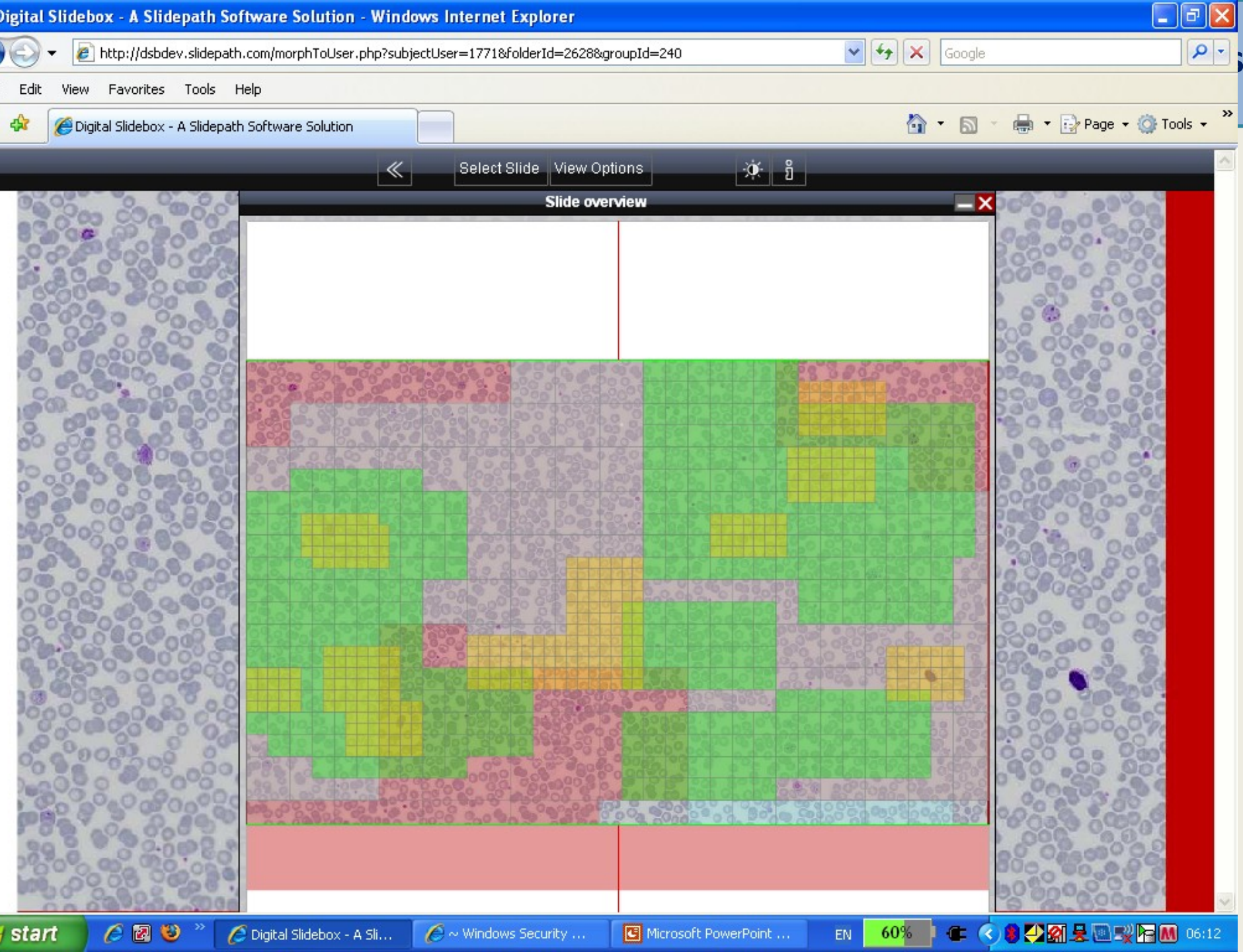
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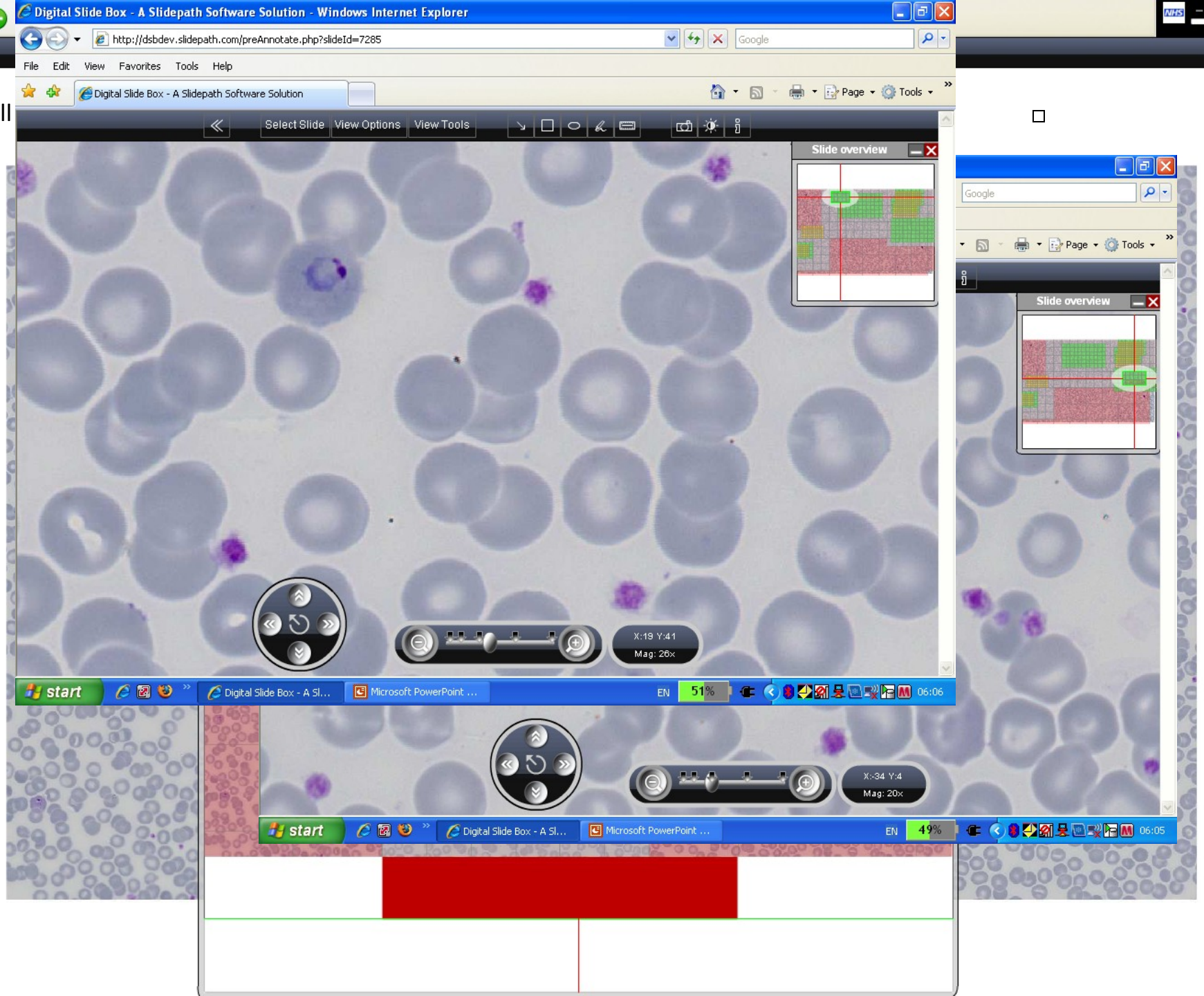
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Can we analyse our data to see why we arrive at incorrect answers?

The Heuristic Approach: “Fast and Frugal”

A model to understand how people arrive at a morphological opinion

1. Familiarity/unfamiliarity
2. Recognition
3. Classification
4. Reinforcement
5. Priority assignment
6. Interpretation
7. Action

We all use these approaches (1) .....

A simple case

We all use these approaches (2) .....

A complex case

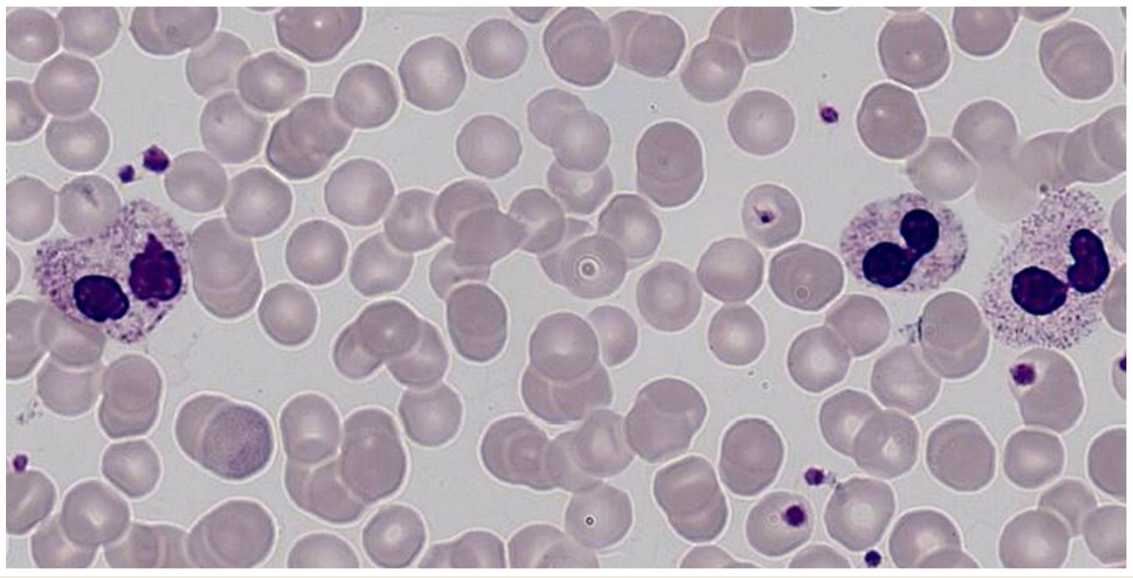
We all use these approaches (2) .....

Made the evidence fit my view = Framing effect bias
Persisted in original view = anchoring bias
Simplification = multiple alternatives bias
Stopped looking or thinking = Satisfaction of search (premature closure)

Heuristic approaches can introduce major sources of bias!

CASE 1 and 2 Simple cases

CASE 1 Inherited Pelger Huet anomaly Overview of features



A routine pre-operative blood sample reveals these features on the film.

Preferred answer:

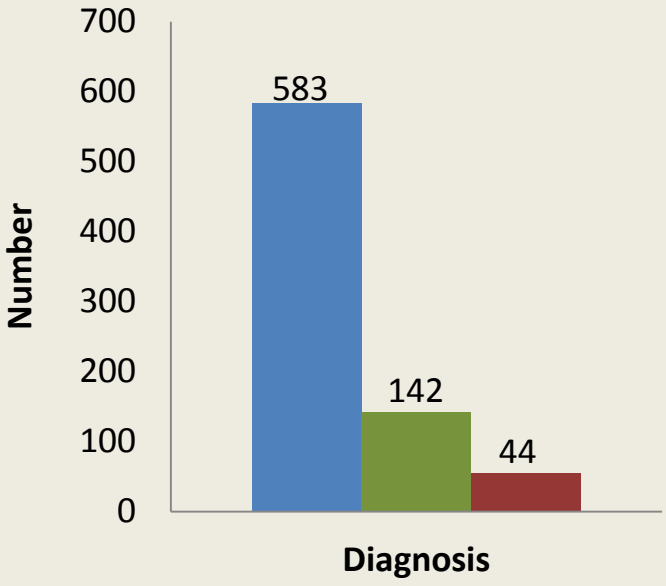
1. Pelger cells +/- other normal features
2. Pelger cells ranked most important
3. Action: low priority action
4. Diagnosis: Pelger Huet anomaly

CASE 1

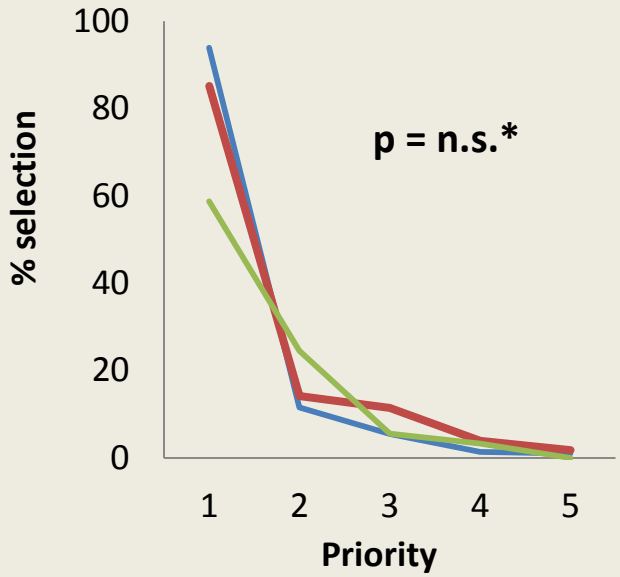
Inherited Pelger Huet anomaly
Overview of selected features

Participants completing all aspects of survey: 1029

Major distinct diagnostic groups



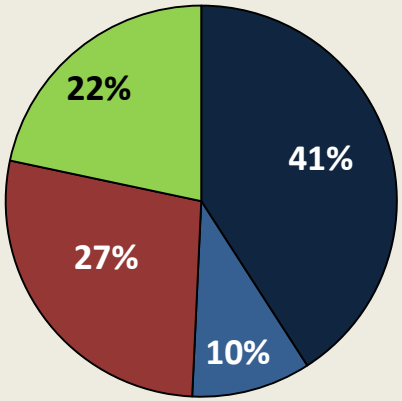
Priority given to neutrophil features



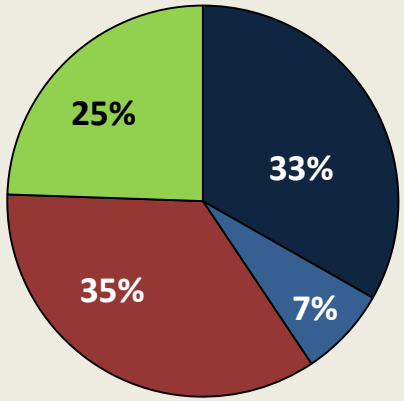
Pelger Huet anomaly Myelodysplasia Reactive changes

*Chi Square test two tailed (Fisher's exact)

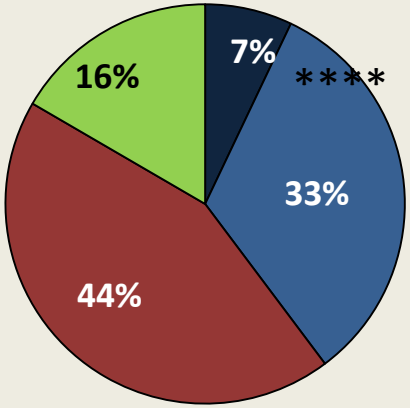
CASE 1 Selected features and final diagnosis



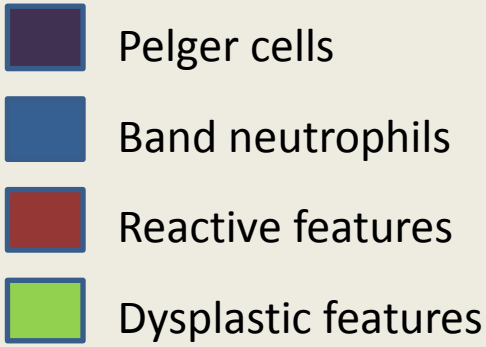
Pelger Huet



Myelodysplasia

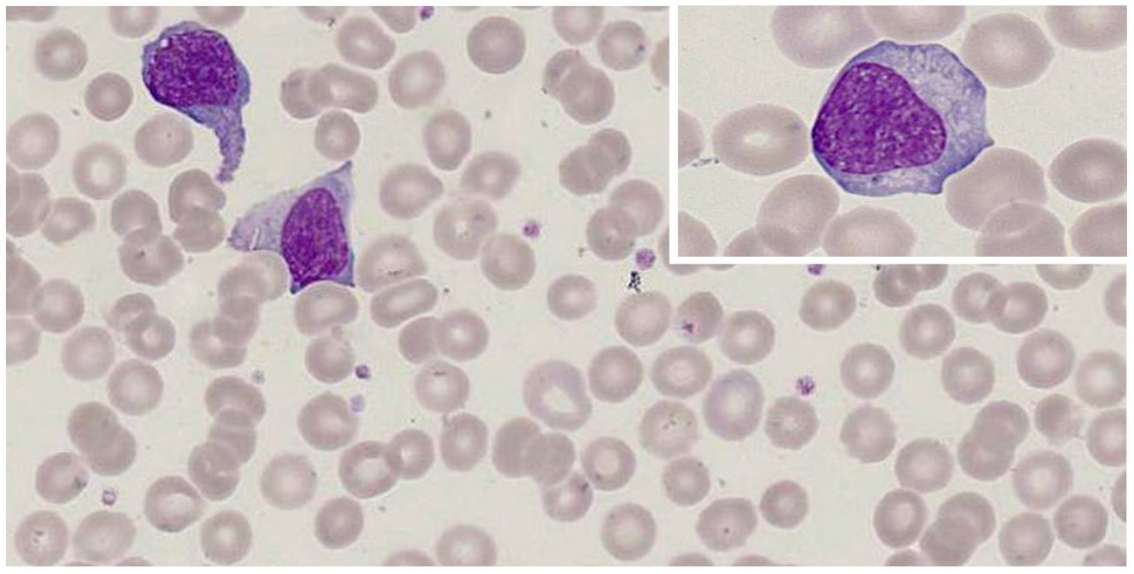


Reactive



Chi Square Test two-tailed (Fisher's exact)

CASE 2 Reactive lymphocytes in glandular fever Overview of features



A young man presenting with enlarged neck lymph nodes.

Preferred answer:

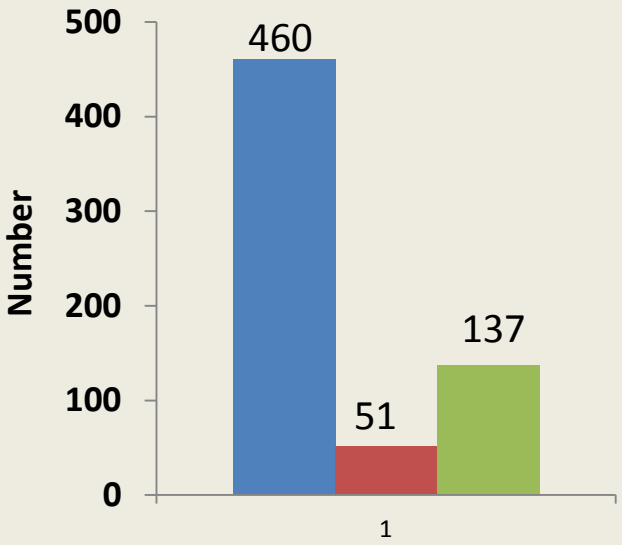
1. Reactive lymphocytes (one or more choices)
2. Reactive lymphocytes ranked most important
3. Action: low priority action
4. Diagnosis: Reactive viral (?EBV)

CASE 2

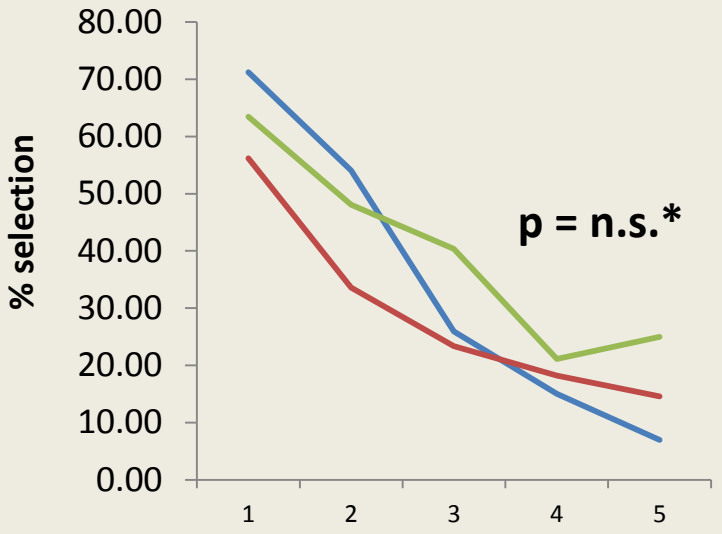
Reactive lymphocytes (glandular fever)
Overview of selected features

Participants completing all aspects of survey: 713

Distinct diagnostic groups



Priority given to lymphocyte features



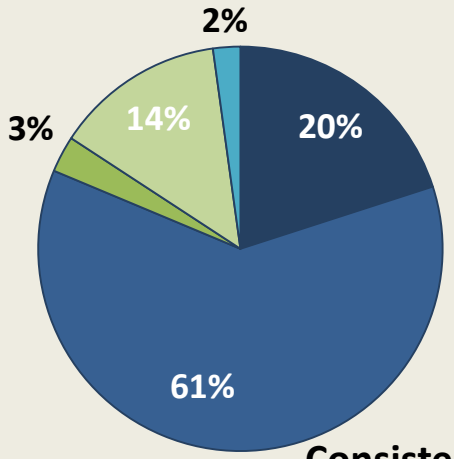
Features of viral infection

Viral infection exclude neoplasia

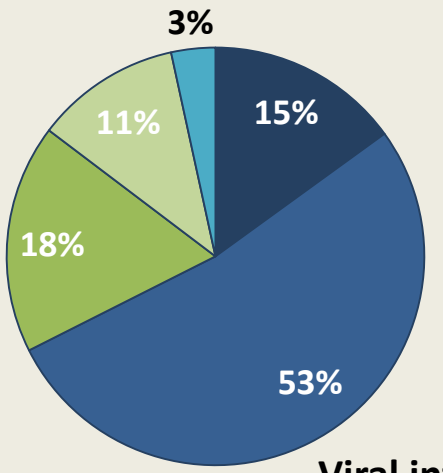
Neoplastic cells

*Chi Square test two tailed (Fisher's exact)

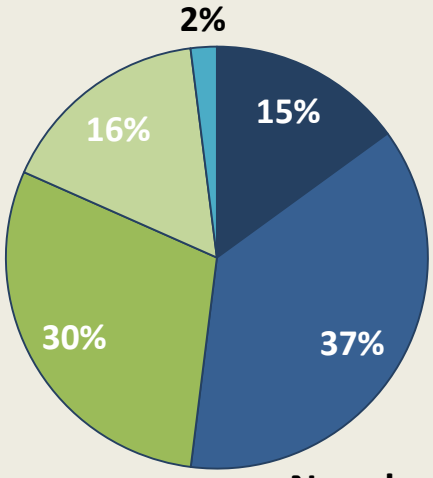
CASE 2 Selected features and final diagnosis



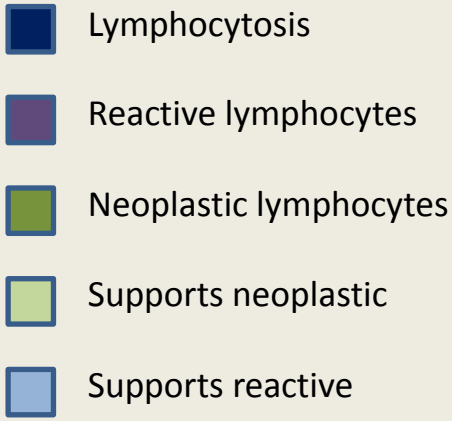
Consistent with viral infection



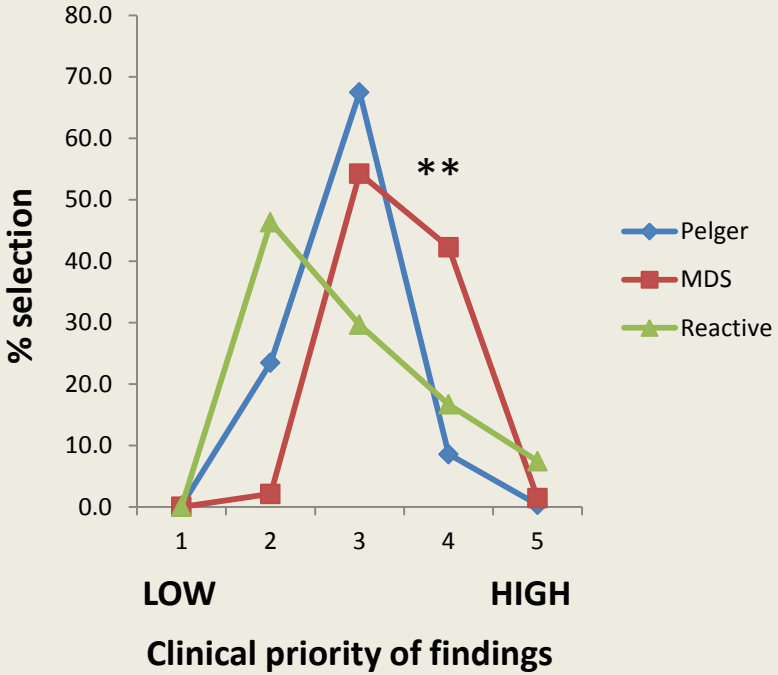
Viral infection, exclude neoplasia



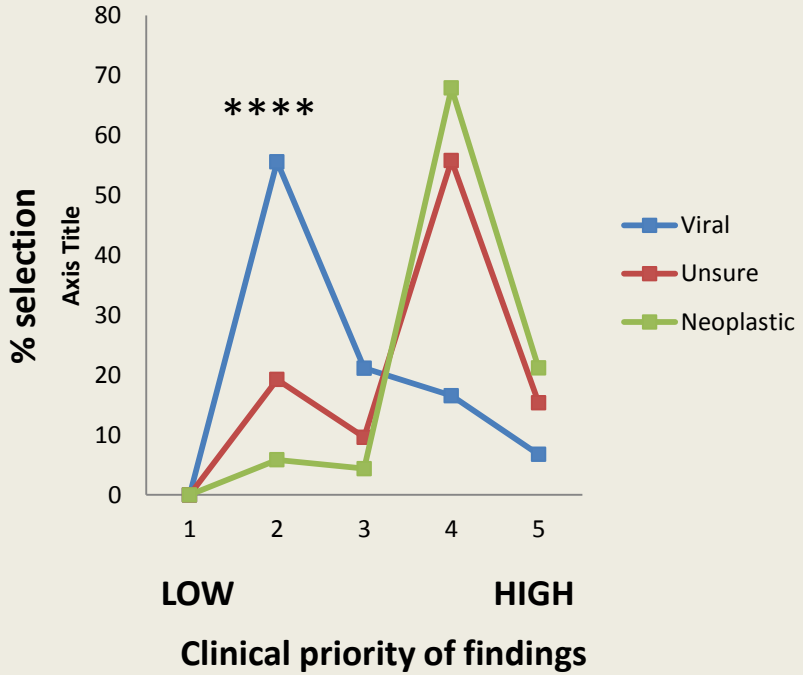
Neoplastic



CASES 1 and 2 Why be interested?



CASE 1
(Pelger Huet anomaly)



CASE 2
(Viral infection)

** p<0.001
**** p<0.00001
Mann Witney U test

CASES 1 and 2 Principle sources of error

In these cases interpretation depended predominantly on accurate assessment of a single abnormal cell

Analysis
Familiarity, recognition and prioritisation: well completed irrespective of diagnosis

MAJOR ERROR SOURCE:

Classification: recognising the abnormal cell

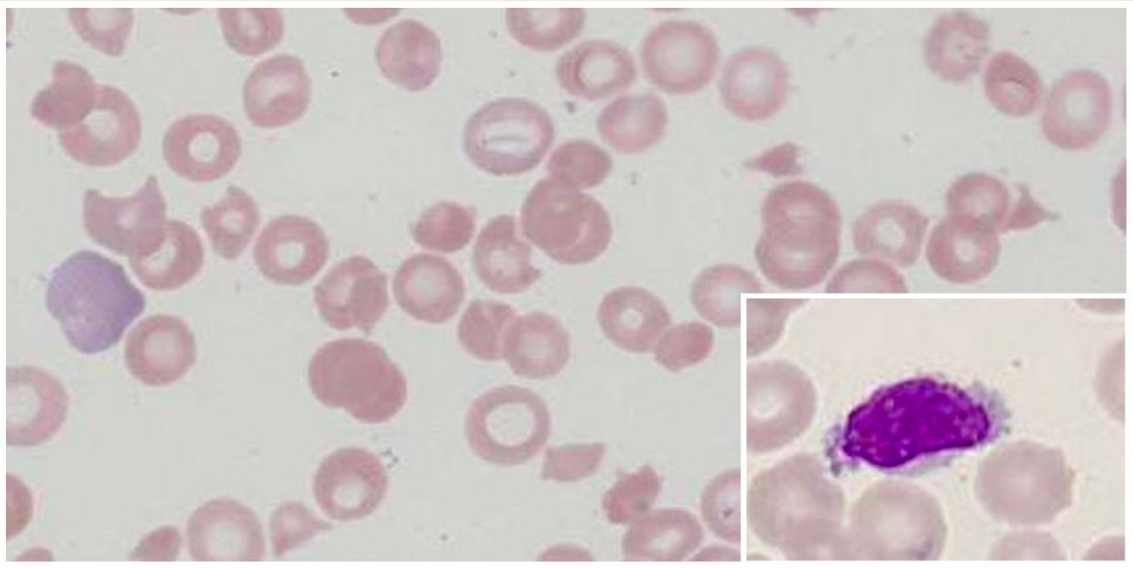
Substantial contributions:

Framing effect (overstating supportive features)
Anchorage (ignoring lack of support)

NOTE The highly significant effect on action/outcome

CASE 3 Complex morphology unifying diagnosis

CASE 3 Microangiopathic haemolysis (TTP) with acute viral infection (HIV)



A patient attending an evening clinic is unwell

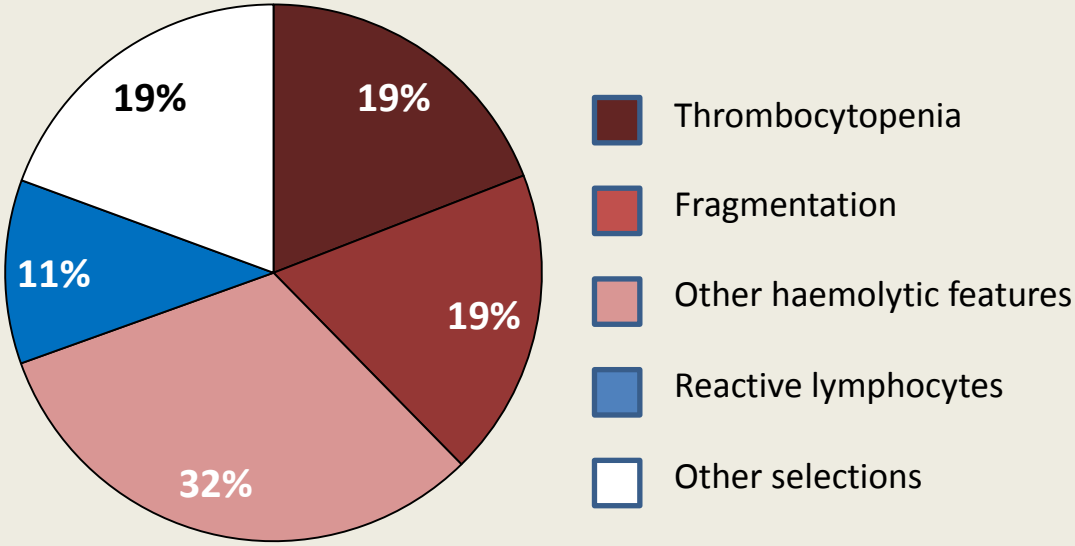
Preferred answer:

1. Thrombocytopenia, Fragmentation features, general haemolyisis features
2. Thrombocytopenia and fragmentation ranked most important, reactive lymphocytes recorded
3. Action: High priority action
4. Diagnosis: Microangiopathic haemolysis +/- viral infection

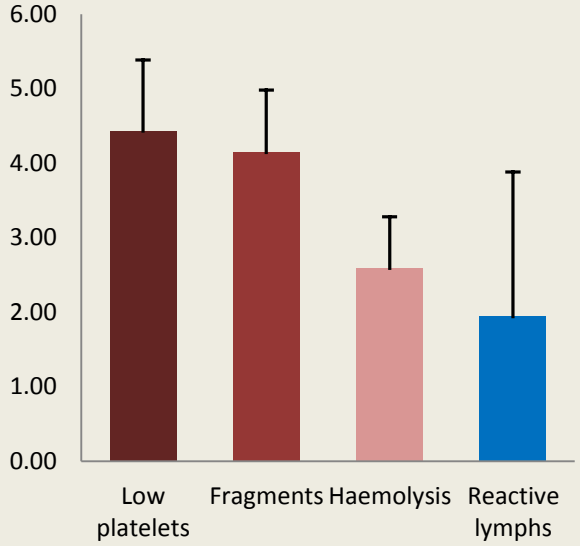
CASE 3 Thrombotic thrombocytopenic purpura with acute HIV Overview of selected features

Participants completing all aspects of survey: 751

Feature choice



Feature priority

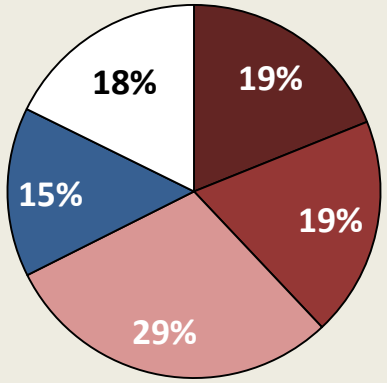


Preferred diagnosis:

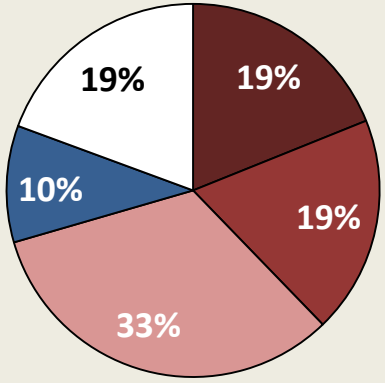
Microangiopathic haemolysis (MAHA)	381	(51%)
MAHA and viral illness	125	(16%)
Haemolysis unspecified	155	(21%)

CASE 3 Selected features and final diagnosis

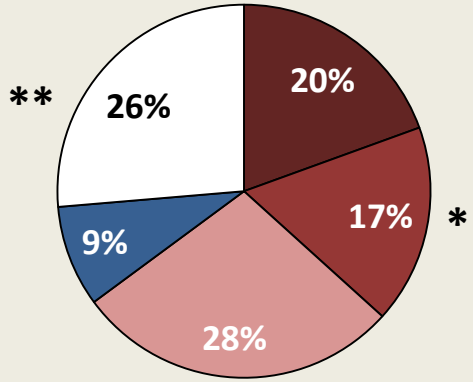
MAHA and viral illness



MAHA alone



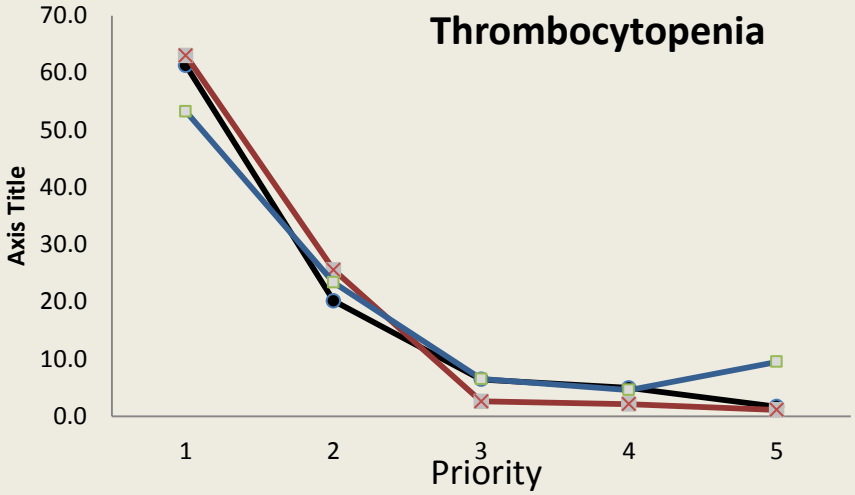
Haemolysis other

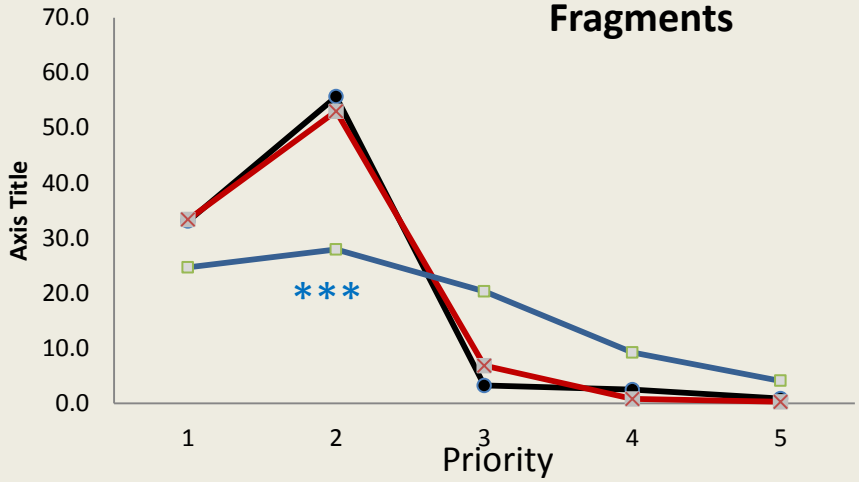


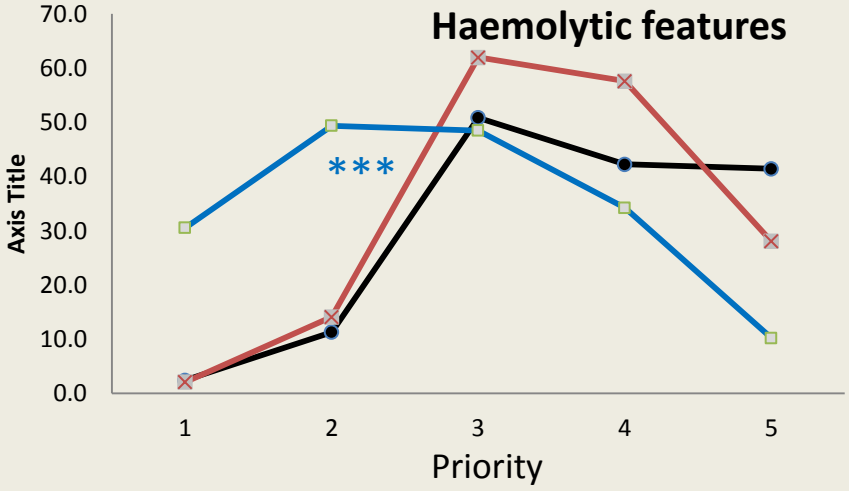
- Thrombocytopenia
- Fragmentation
- Other haemolytic features
- Reactive lymphocytes
- Other selections

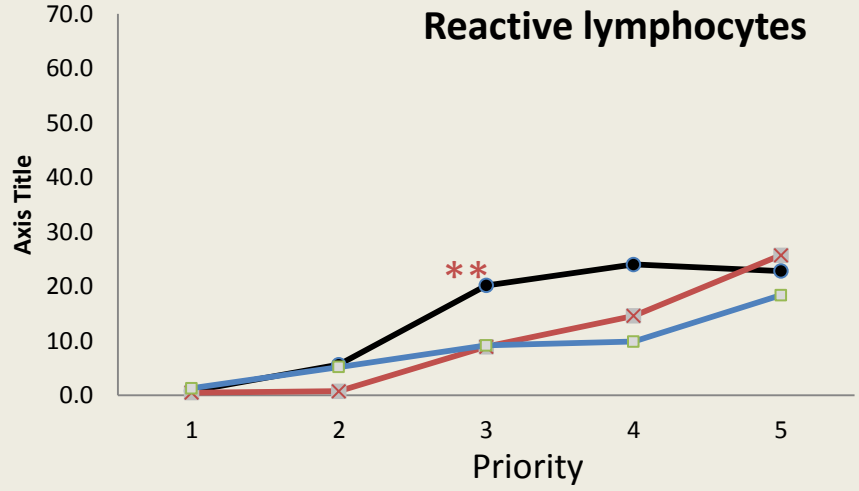
*p<0.01
** p<0.001
Chi Square test

CASE 3 Priority assigned to features according to preferred diagnosis









TTP & viral **TTP only** **Haemolysis**

** p<0.001
*** p<0.0001
Mann Witney U test

CASE 3 Elements governing diagnostic conclusion

Interpretation

Feature selection was remarkably similar **BUT** diagnosis differed

MAJOR ERROR SOURCE:

Prioritisation (confirmation bias – emphasising features that fit**)**

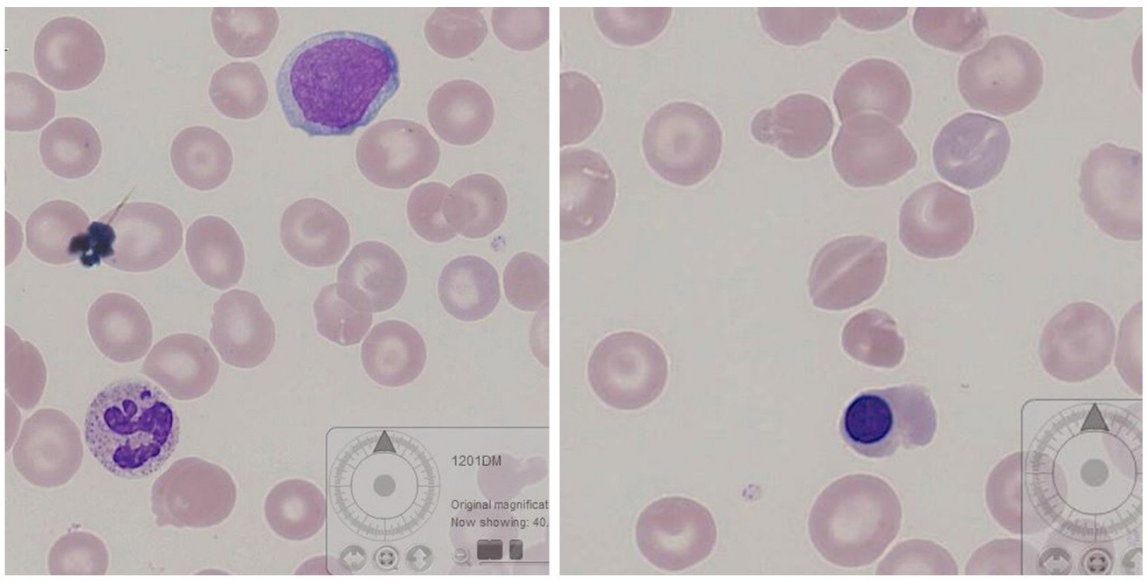
Simplification (multiple alternatives bias and elimination by aspects**)**

Possible contribution:

Premature completion (I have a diagnosis, I can finish looking)

CASE 4 Complex case – dual pathology

CASE 4 HbSC disease with acute myeloid leukaemia



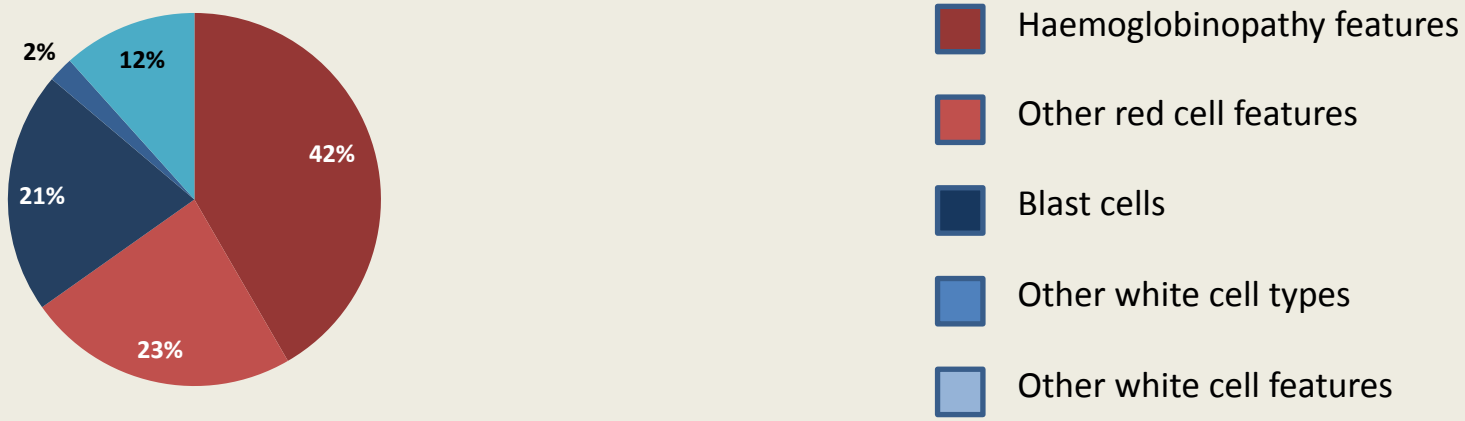
A patient under long-term follow up as an out patient clinic has changed blood count features.

Preferred answer:

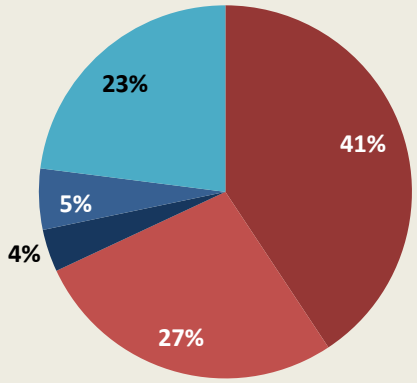
1. Blast cells and features of haemoglobinopathy (HbC or HbSC)
2. Blast cells ranked most important, red cell features recorded
3. Action: high priority action
4. Diagnosis: acute leukaemia with haemoglobinopathy

CASE 4 HbSC disease with acute myeloid leukaemia

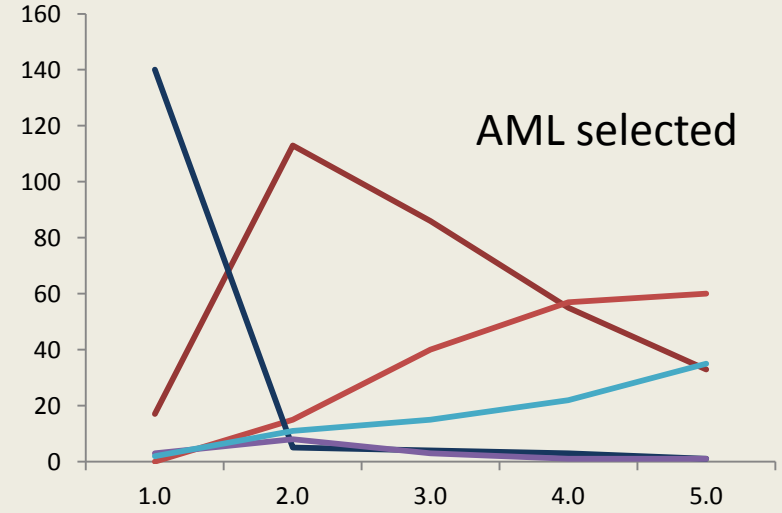
Acute myeloid leukaemia selected (n= 162)

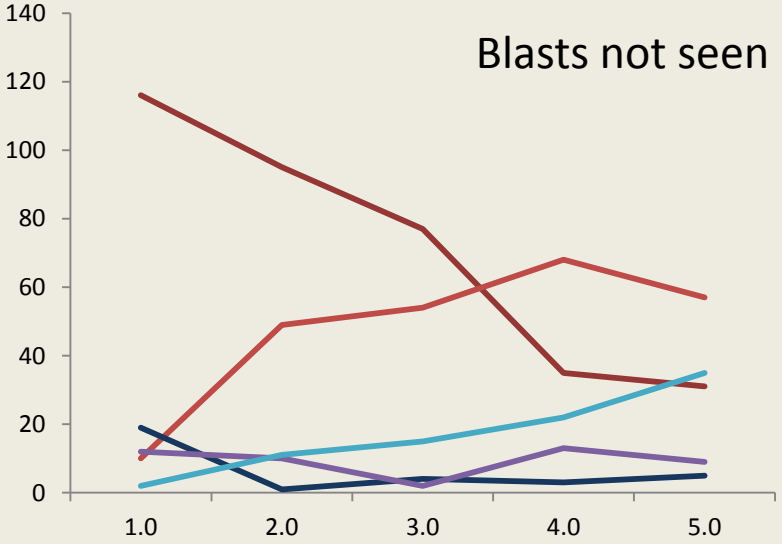


Reactive white cells selected (n= 90)



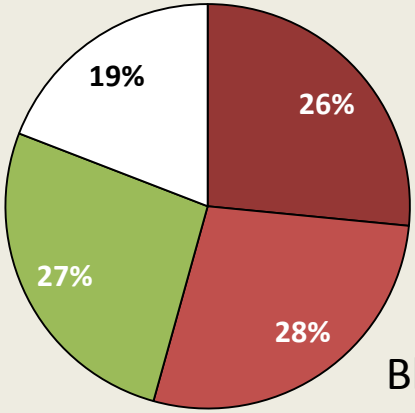
CASE 4 HbSC disease with acute myeloid leukaemia



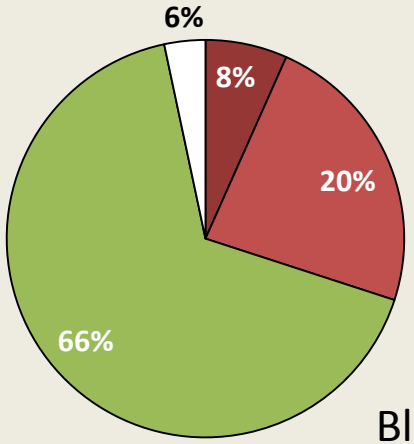


- Haemoglobinopathy features
- Other red cell features
- Blast cells
- Other white cell types
- Other white cell features

CASE 4 HbSC disease with acute myeloid leukaemia



Blast cells seen



Blast cells not seen

How did the perception of red cell and white cell findings relate to the perception of white cells?

- Haemoglobinopathy
- Thalassaemia
- Liver disease
- No additional diagnosis

CASE 4 Elements governing diagnostic conclusion

Interpretation

This did not appear to be a classification error or prioritisation error, those making an incorrect diagnosis simply failed to see the blast cells!

MAJOR ERROR SOURCE:

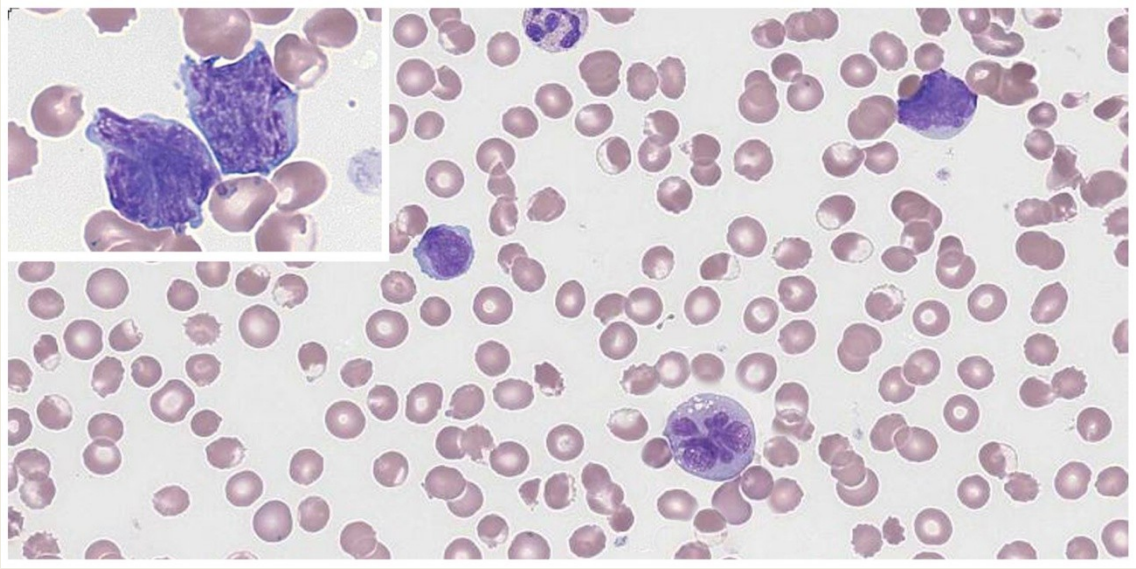
Multiple alternatives bias (simplified to exclude other important features)
Framing effect (substantial influence of other features)
Premature closure (arriving at a single diagnosis and stopped)

What are the Heuristic techniques in diagnosis

TECHNIQUE	BENEFITS	DISADVANTAGES
Availability	Applying a context can improve speed and accuracy	May reduce the detection of less common disorders
Classification	Enhances speed, improves accuracy, interpretive framework	Incorrect classification affects all subsequent action
Reinforcement (framing)	Assists interpretation and improves accuracy	May falsely reassure
Prioritisation	Simplification: helps speed and the accuracy of interpretation	If incorrect affects interpretation
Simplification	Allows rapid processing of complex datasets	If incorrect affects interpretation
Completion of search	Essential to speed	Premature completion misses diagnoses

CASE 5 Does experience help?

CASE 5 Oxidative haemolysis and Adult T-cell Leukaemia Lymphoma



An man receiving medical treatment becomes unwell.

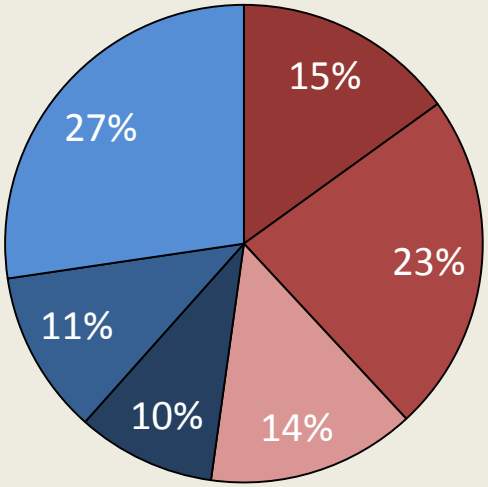
Preferred answer:

1. Oxidative haemolysis with neoplastic lymphocytes
2. Oxidative haemolysis ranked most important
3. Action: high priority action
4. Diagnosis: Oxidative haemolysis (G6PD def) plus neoplastic lymphocytes or blasts

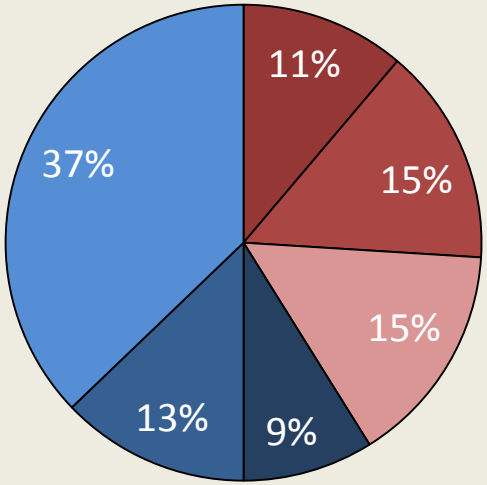
CASE 5 Oxidative haemolysis and Adult T-cell Leukaemia Lymphoma

FEATURE SELECTION

UBMS



NRBMS



Oxidative haemolysis

Other haemolysis

Other erythroid

Neoplastic lymphocytes

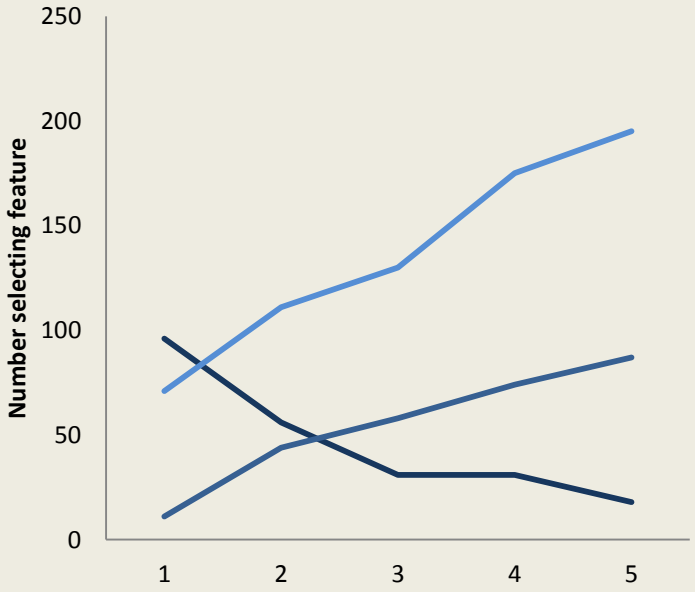
Supports neoplastic

Reactive white cell features

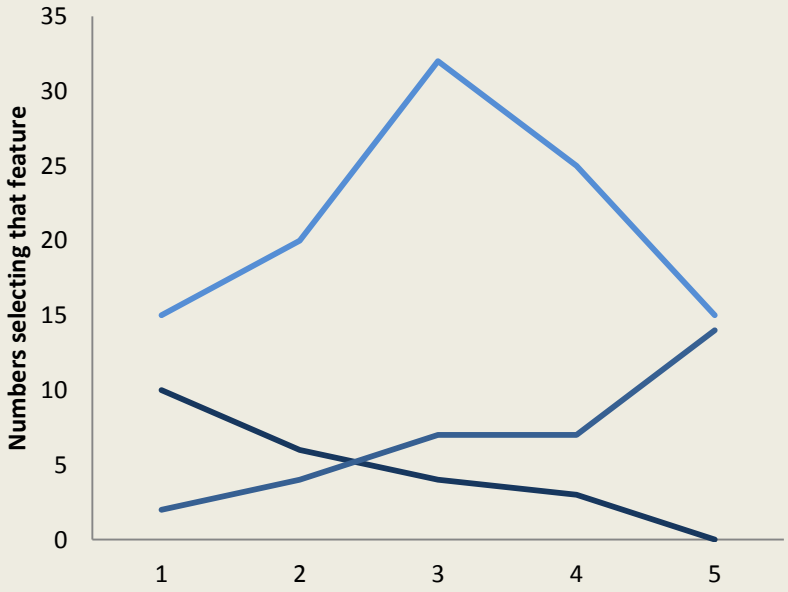
CASE 5 Oxidative haemolysis and Adult T-cell Leukaemia Lymphoma

FEATURE Prioritisation

UBMS



NRBMS



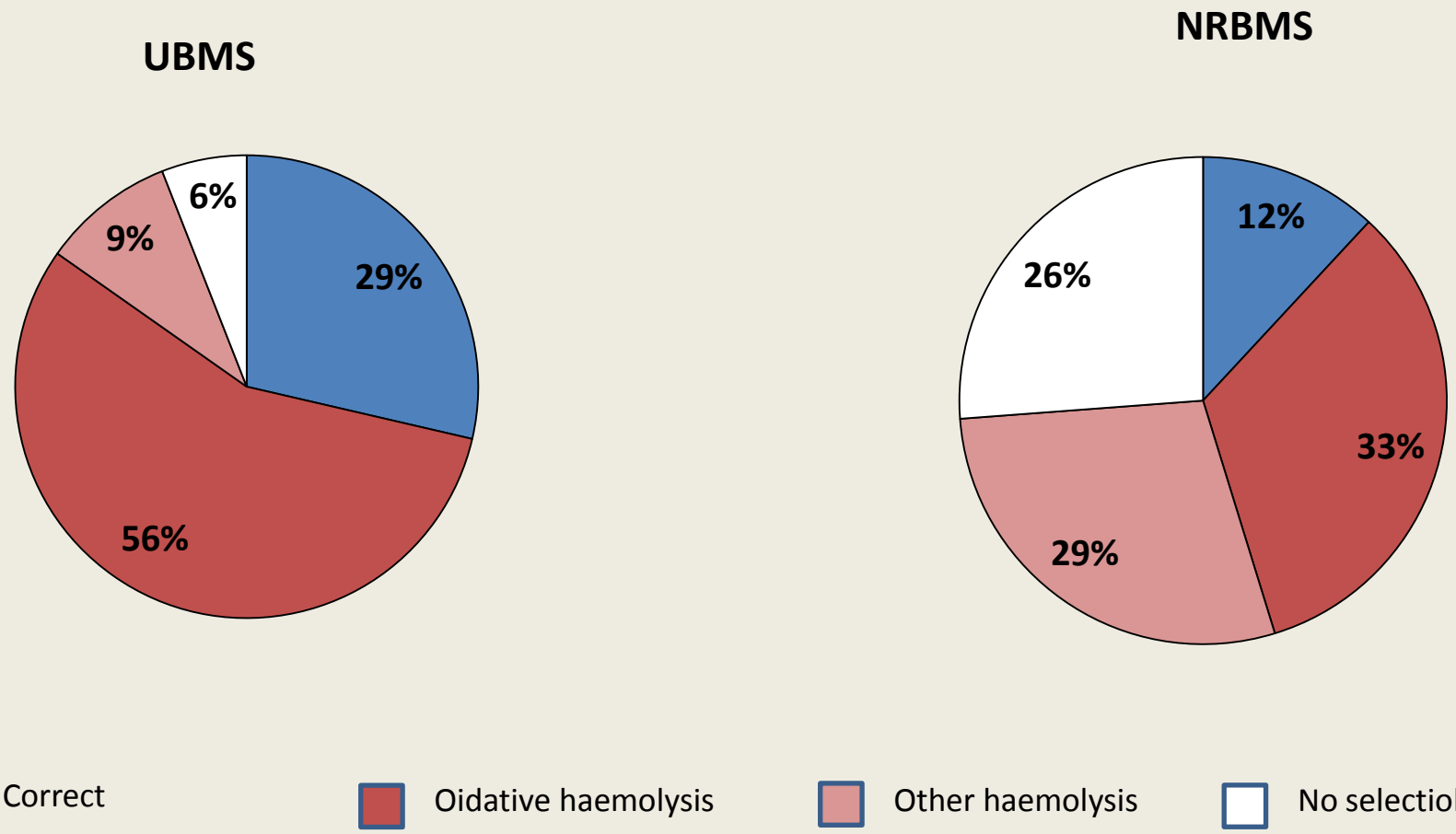
Neoplastic lymphocytes

Supports neoplastic

Reactive white cell features

CASE 5 Oxidative haemolysis and Adult T-cell Leukaemia Lymphoma

DIAGNOSIS CHOICE



Conclusions

1. The nature of errors depends significantly on the complexity of morphological features

2. In “simple” cases, where there is a single feature diagnosis depends **mainly** on the classification of that feature

3. As cases become more complex, heuristic techniques play a much greater role in interpretation **but also produce specific patters of errors**

4. Experience improves the application of these techniques (but does not eliminate errors)

5. Action may be very strongly influenced by the choices made

Strategies to improve interpretation

- AWARENESS OF SOURCES OF ERROR
- STANDARDISATION (ICSH)
- GUIDANCE ON REPORT STYLE
- ASSESSMENT: competency
- DECISION SUPPORT: tools

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Leica-SlidePath