

A novel and promising proteomic-based MALDI-MSI thyroid nodule classifier as complementary diagnostic tool in cytopathology

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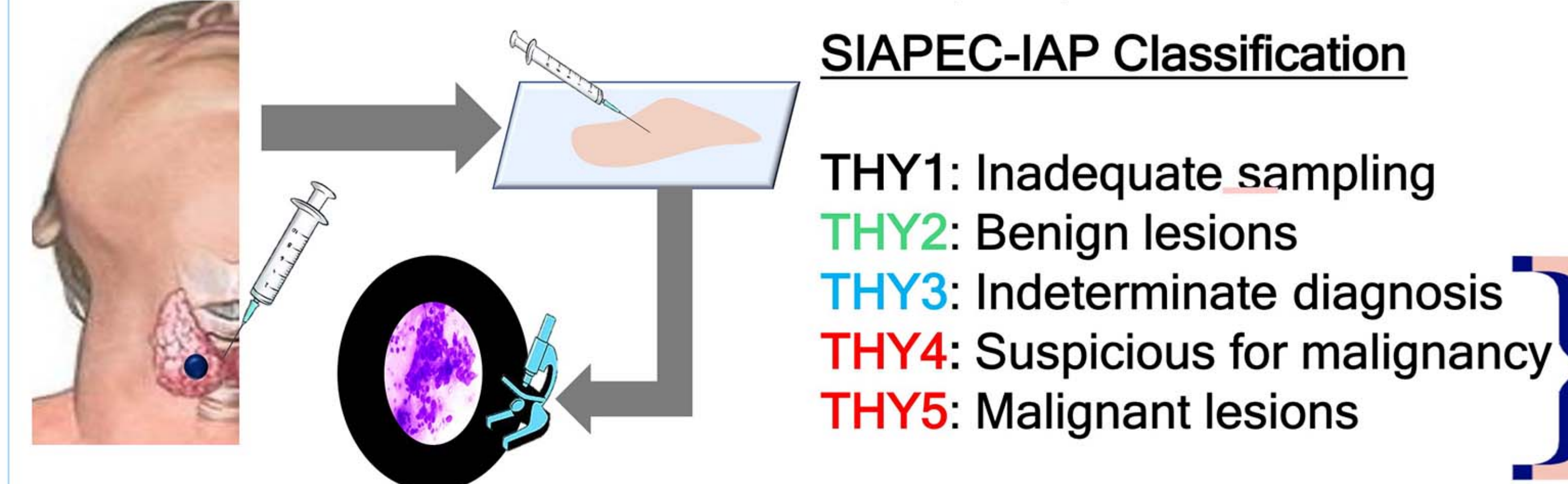
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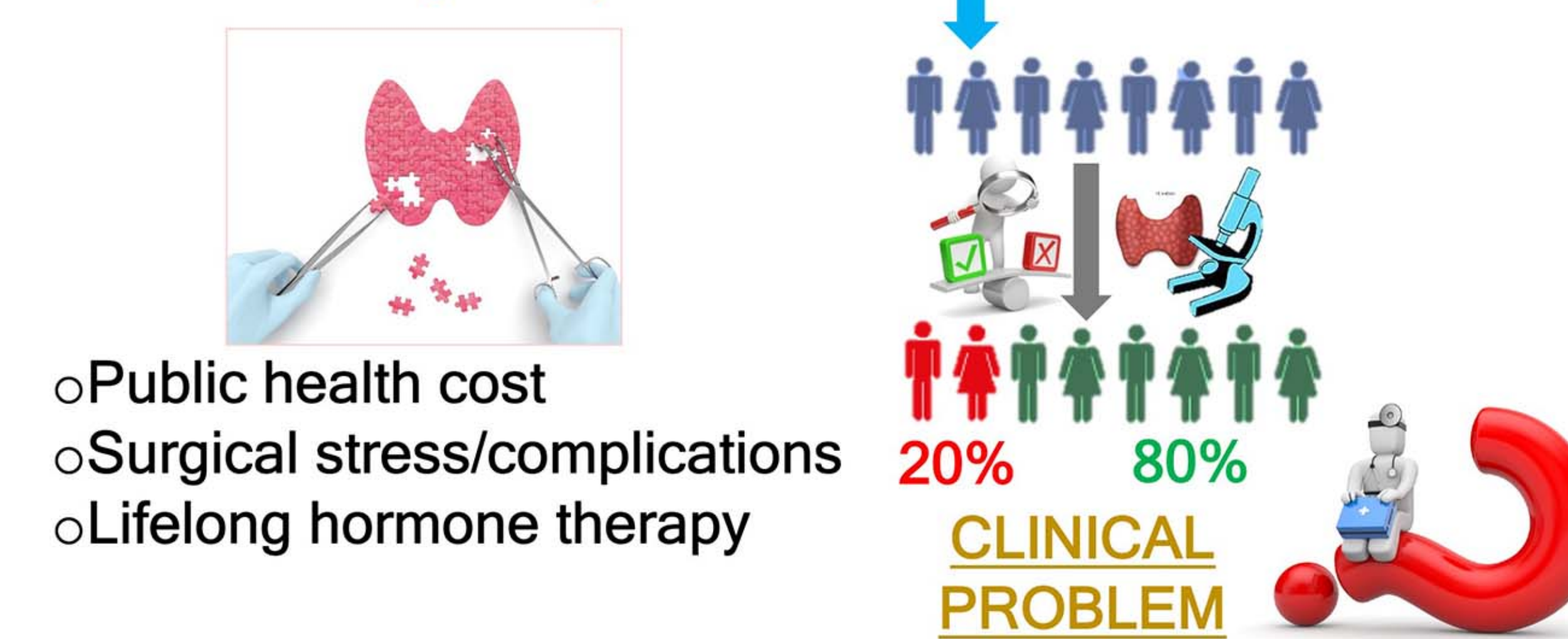
INTRODUCTION

THYROID FINE NEEDLE ASPIRATION (FNA) BIOPSY



TOTAL THYROIDECTOMY

25% FNA (THY3)



RESULTS

TRAINING: ROI

N = 9 hyperplastic patients (THY2)
N = 9 Papillary Thyroid Carcinoma patients (THY5)

Equivalent group of ROIs were generated for each patient:

- 5 groups of ROIs for THY2 (Total: 45 ROIs)
- 4 groups of ROIs for THY5 (Total: 36 ROIs)



VALIDATION

n=4 THY2; n= 1 THY3; n=1 THY4, n=4 THY5; n=1 metastatic lymph node

- Overall Average Spectrum
- Regions of Interest Spectra
- Single Spectrum: Pixel by Pixel

Pixel by pixel Images & Histograms of Frequency³

AIMS

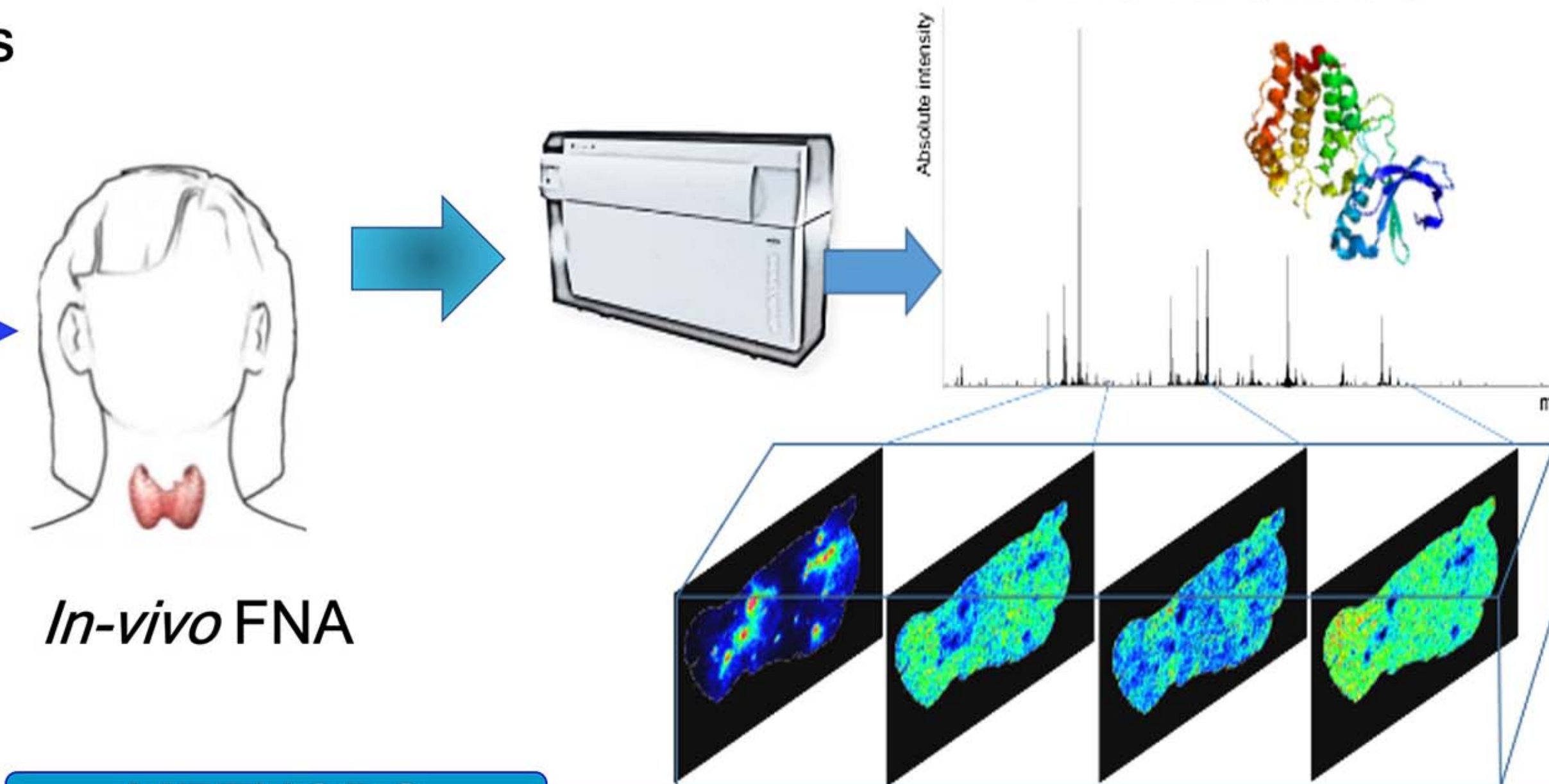
Discriminate Benign and Malignant thyroid nodules

Classify Indeterminate (THY3) nodules.

SAMPLE PREPARATION METHOD

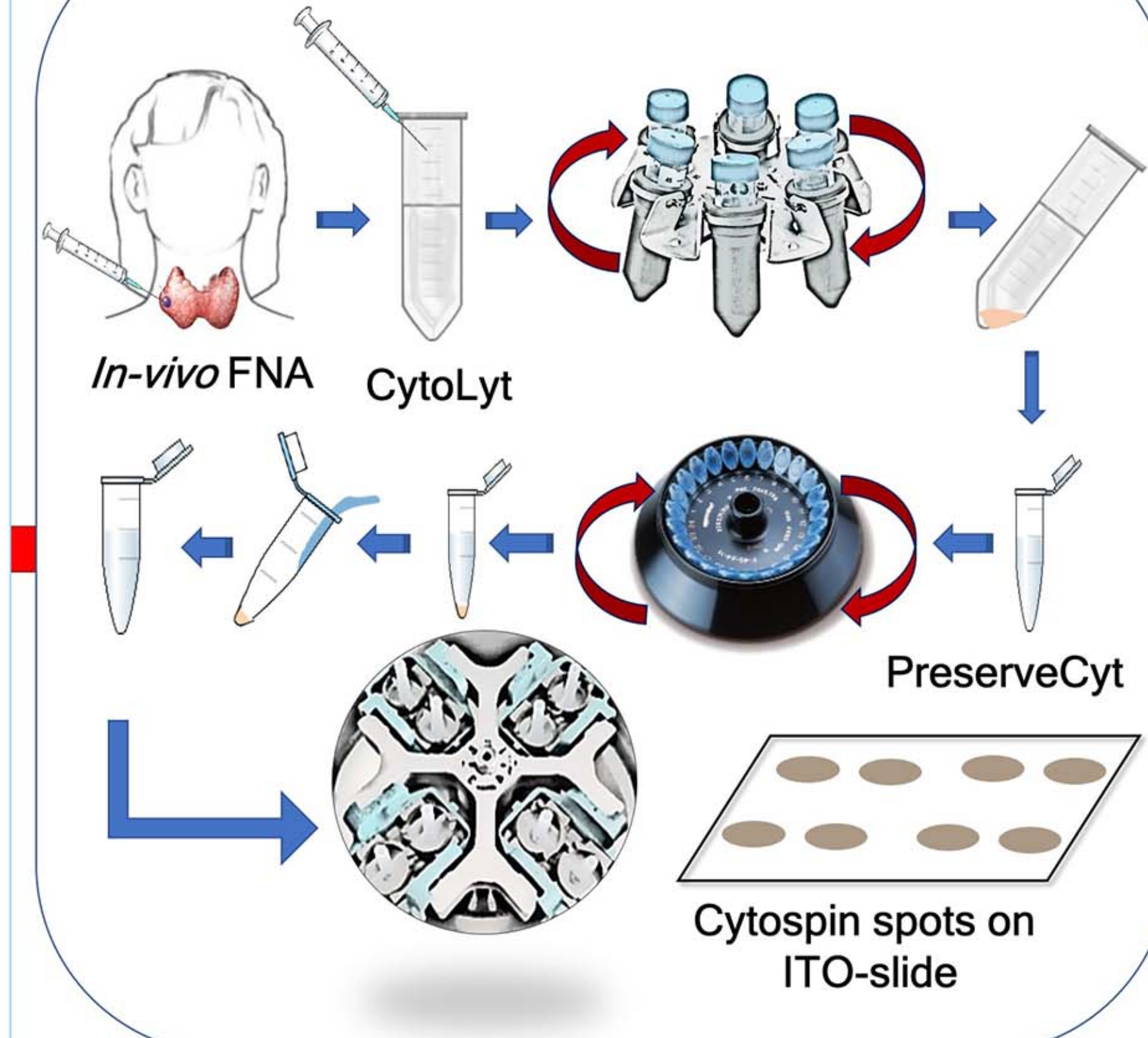
- Reproducible and Robust
- Specific and sensitive
- Transferable in different clinics

MALDI-MSI PROTEOMICS

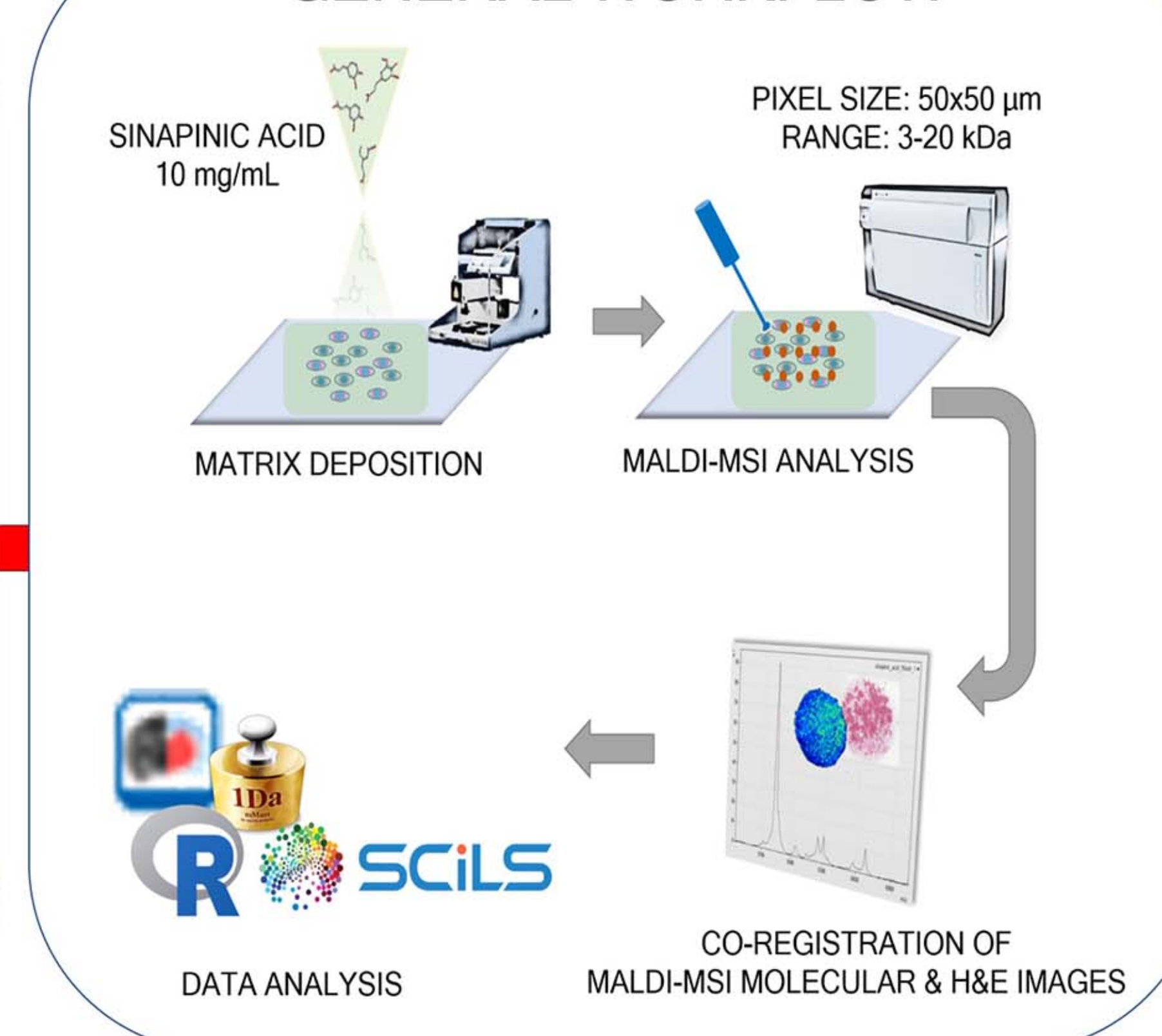


METHODS

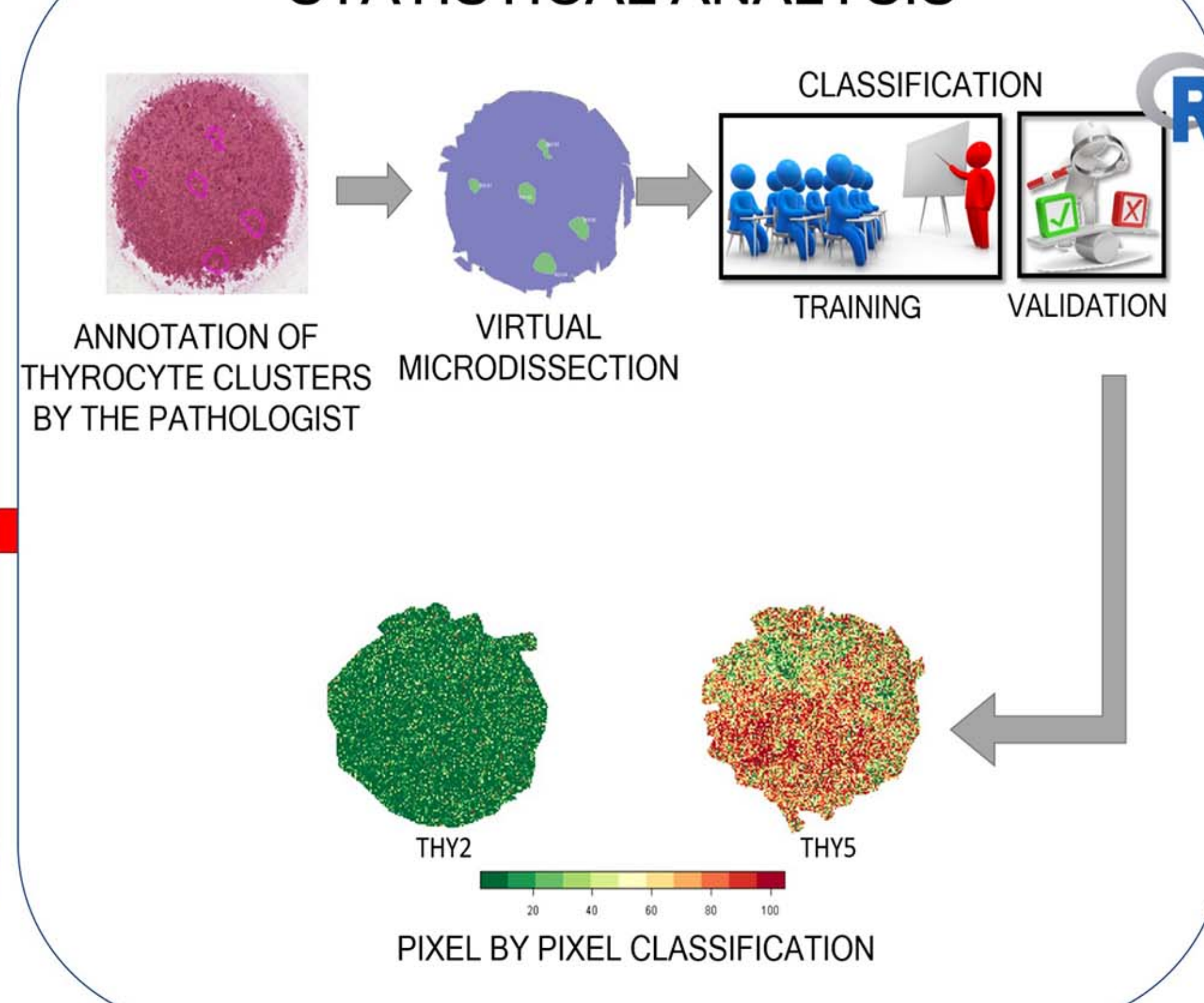
SAMPLE PREPARATION^{1,2}



GENERAL WORKFLOW



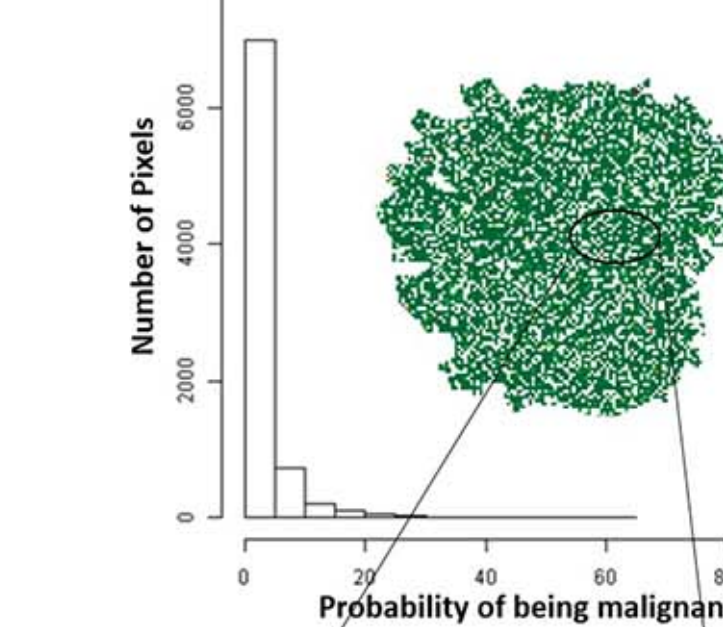
STATISTICAL ANALYSIS



BENIGN

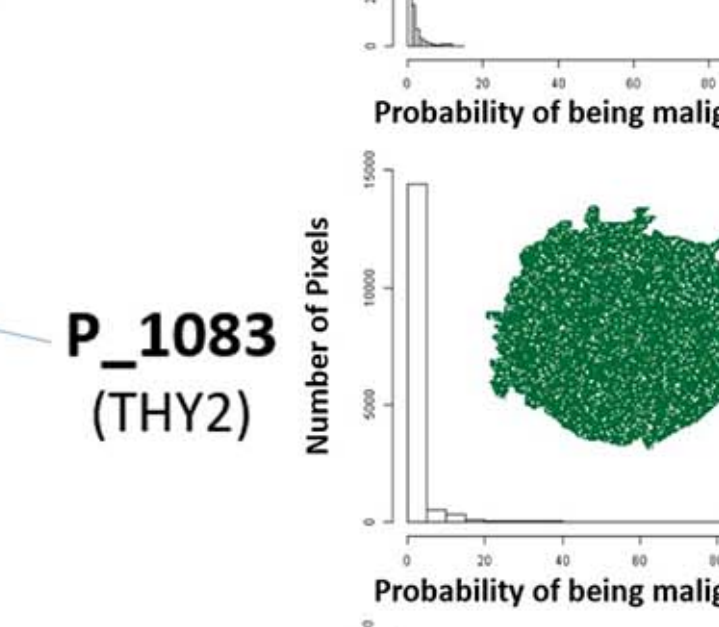
TRAINING SAMPLE

P_308 (THY2)

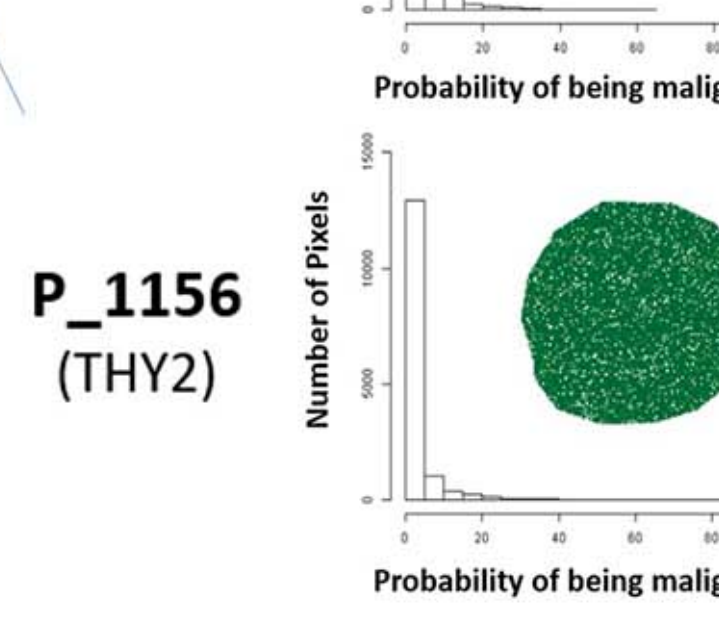


VALIDATION SAMPLES

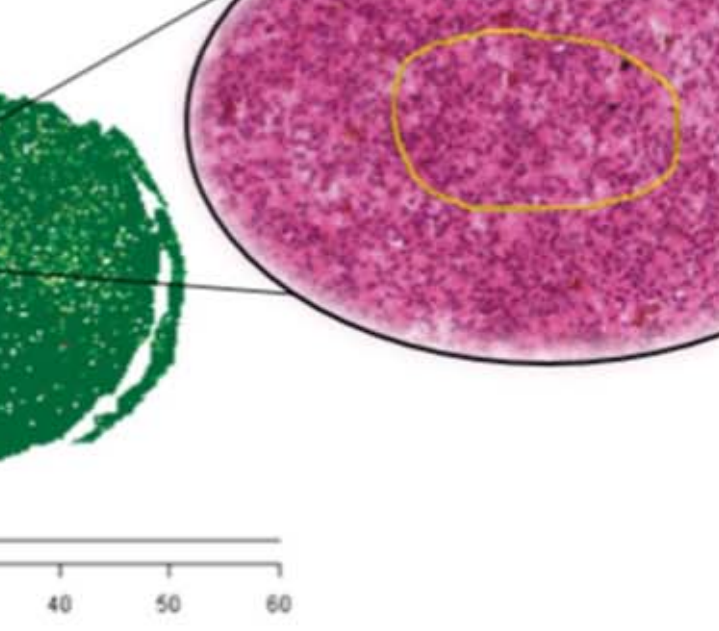
P_1081 (THY2)



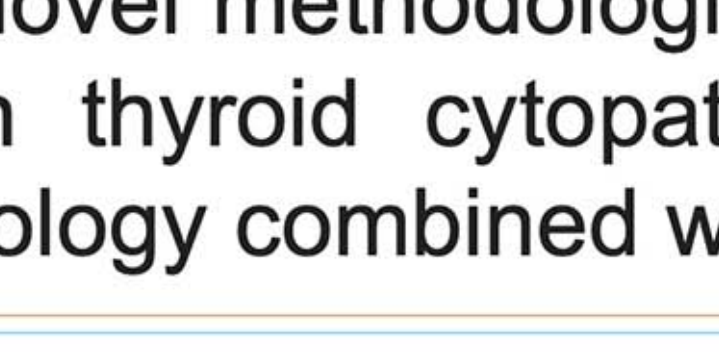
P_1083 (THY2)



P_1123 (THY2)



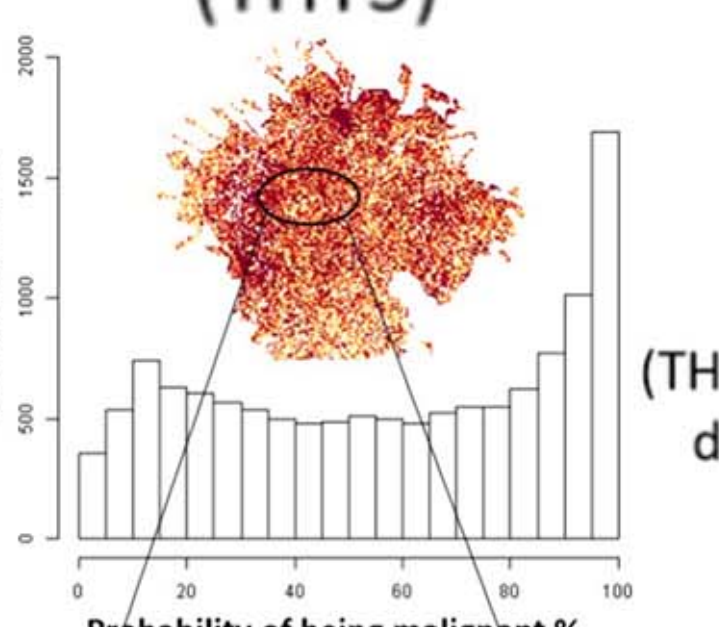
P_1156 (THY2)



MALIGNANT

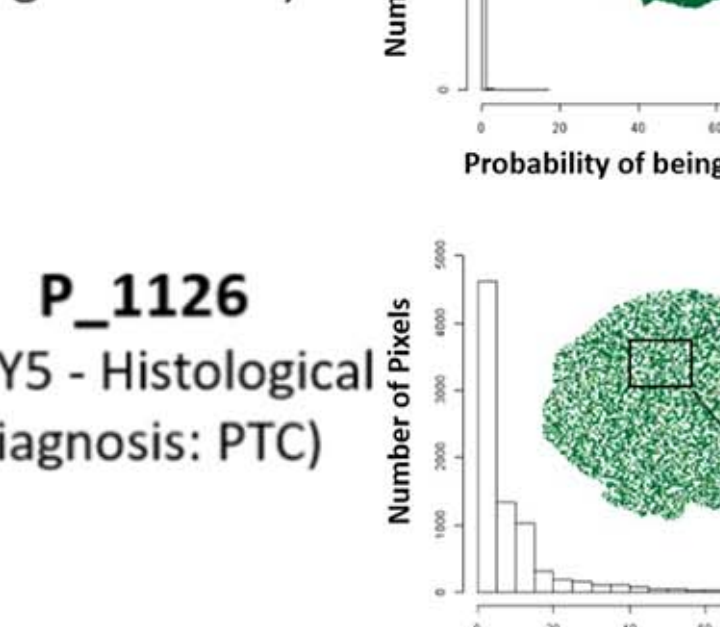
TRAINING SAMPLE

P_250 (THY5)

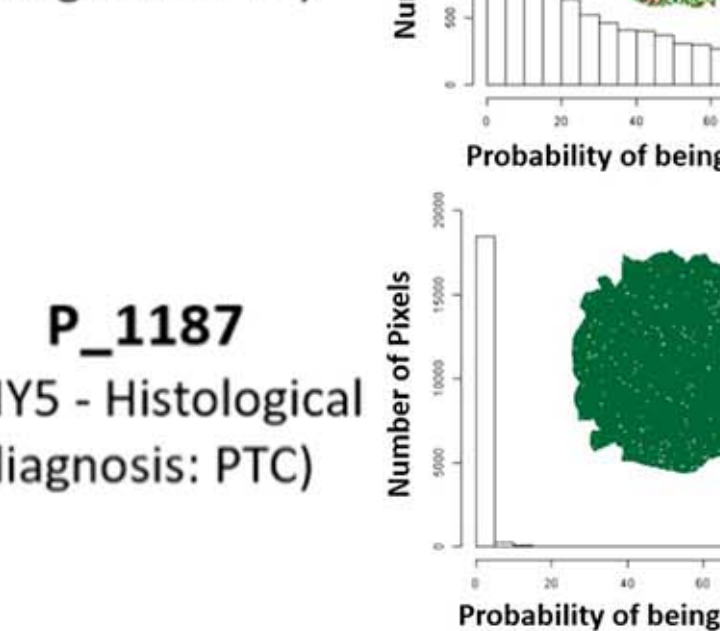


VALIDATION SAMPLES

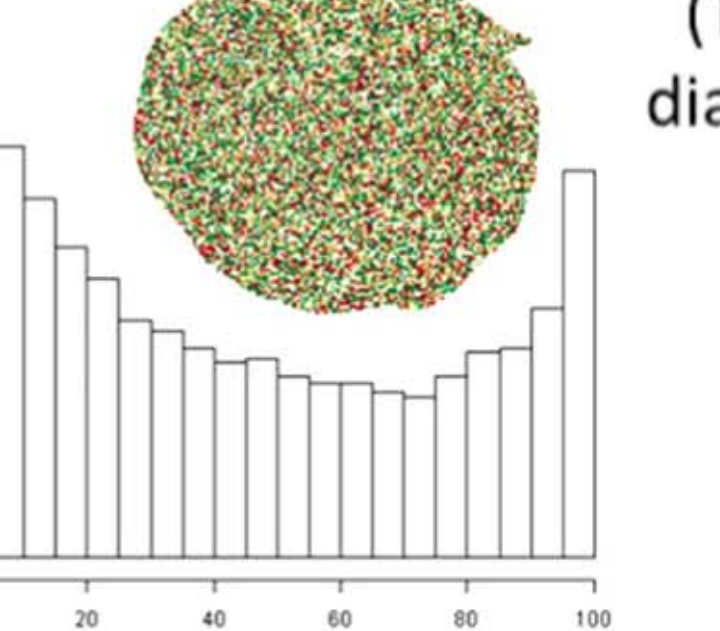
P_1084 (THY5 - Histological diagnosis: PTC)



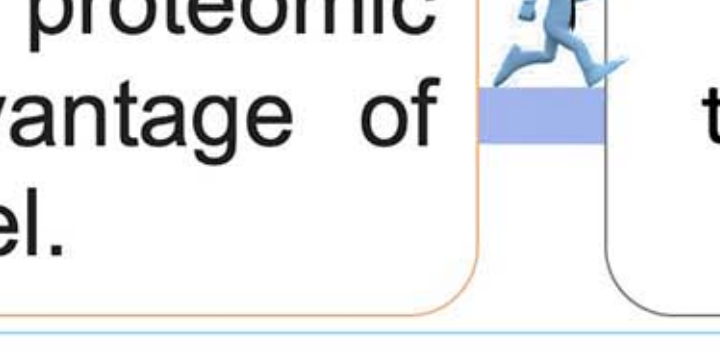
P_1126 (THY5 - Histological diagnosis: PTC)



P_1149 (THY5 - Histological diagnosis: PTC)

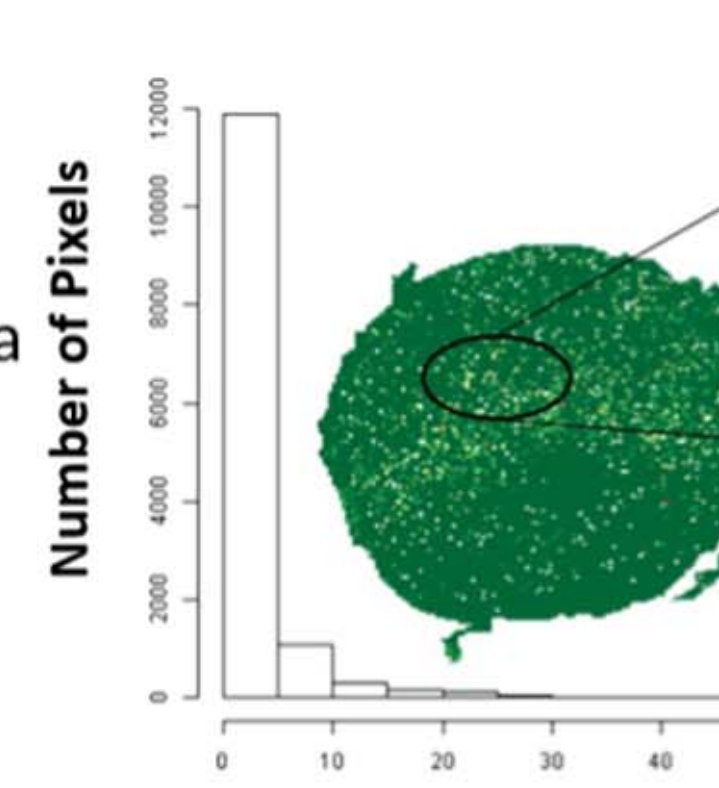


P_1187 (THY5 - Histological diagnosis: PTC)

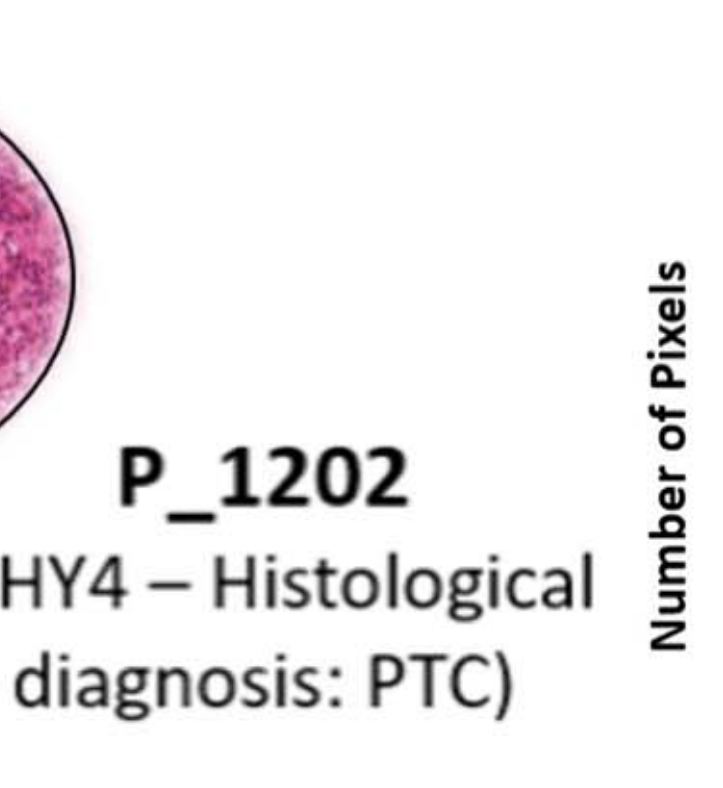


INDETERMINATE

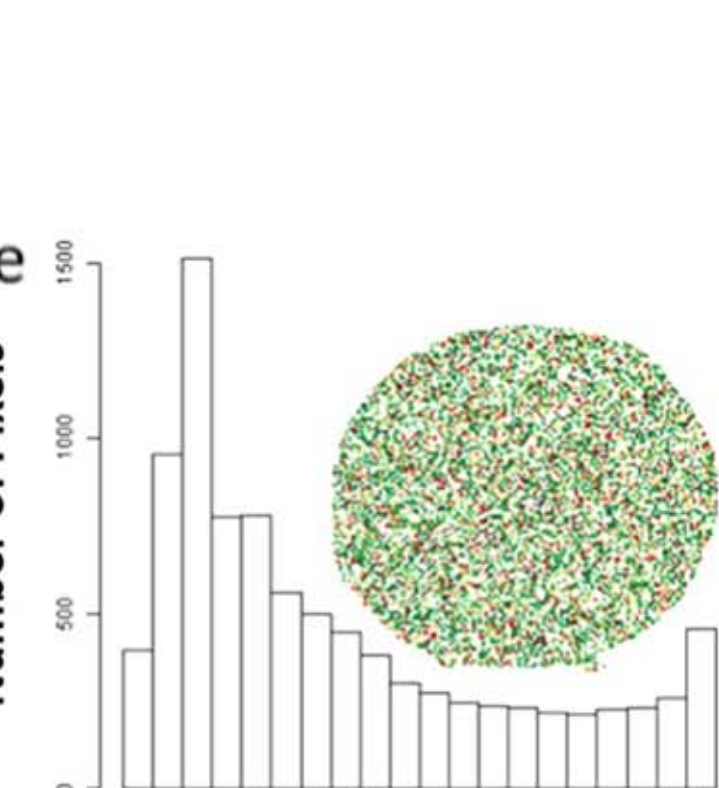
P_1082 (THY3 - Histological diagnosis: hyperplastic)



P_1202 (THY4 - Histological diagnosis: PTC)



P_1188 ex vivo (THY5 - Histological diagnosis: lymph node metastasis)



CONCLUSIONS

We introduces a novel methodological approach to build a proteomic diagnostic tool in thyroid cytopathology by taking advantage of MALDI-MSI technology combined with a biostatistical model.

Reduced number of unnecessary treatments and cost-effectiveness for the healthcare system.

REFERENCES:
[1] Piga I et al., The management of haemoglobin interference for the MALDI-MSI proteomics analysis of thyroid fine needle aspiration biopsies. Analytical and Bioanalytical Chemistry. 411, pages 5007-5012 (2019).
[2] Piga I et al., Feasibility Study for the MALDI-MSI Analysis of Thyroid Fine Needle Aspiration Biopsies: Evaluating the Morphological and Proteomic Stability Over Time. Proteomics Clinical Application. 13(1):e1700170 (2019).
[3] Capitoli G et al., MALDI-MSI as a Complementary Diagnostic Tool in Cytopathology: A Pilot Study for the Characterization of Thyroid Nodules. Cancers. 11(9), 1377 (2019).