Proteomics & Metabolomics analysis of COVID-19 patients to identify biomarkers

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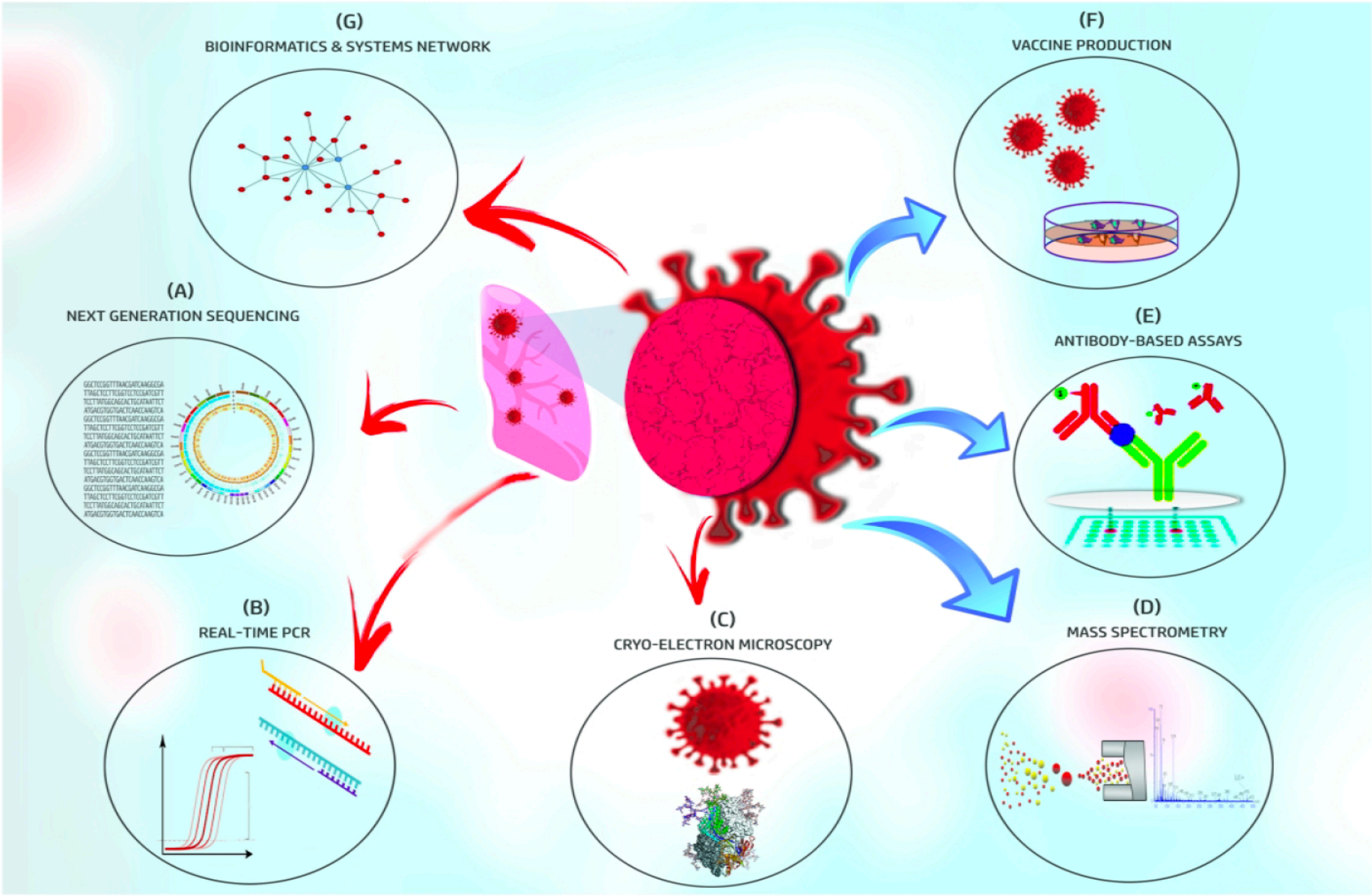
Outline

- Introduction
- Peptide based detection
- Biomarkers for severity prognosis
- Other ongoing projects
- Summary

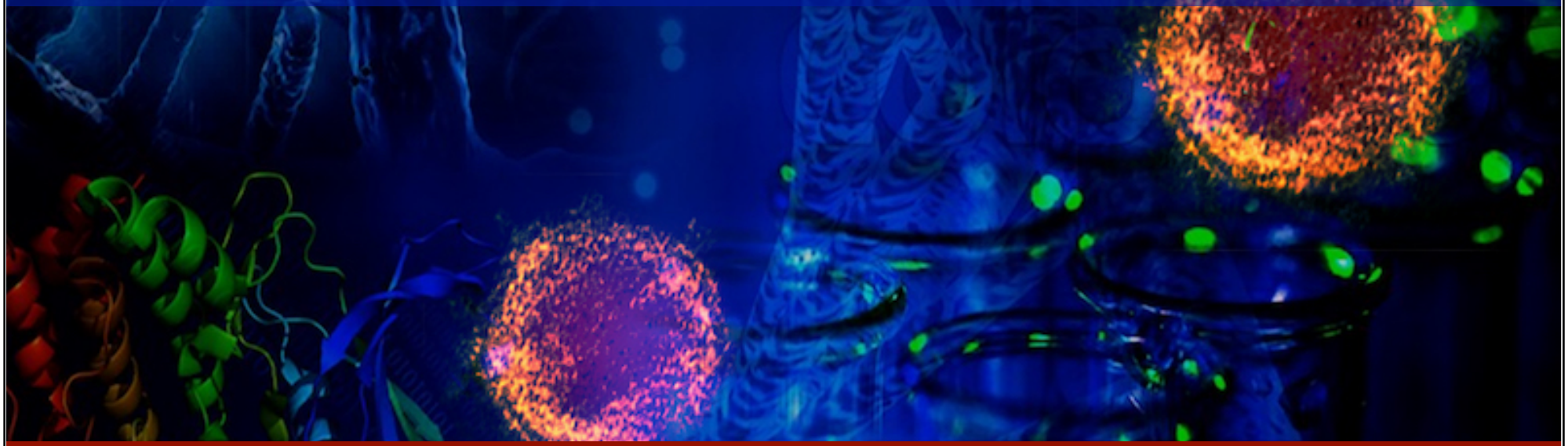
COVID-19: Proteomics and Multi-omics Research



Ray S, Srivastava S. ***OMICS A Journal of Integrative Biology, 2020***

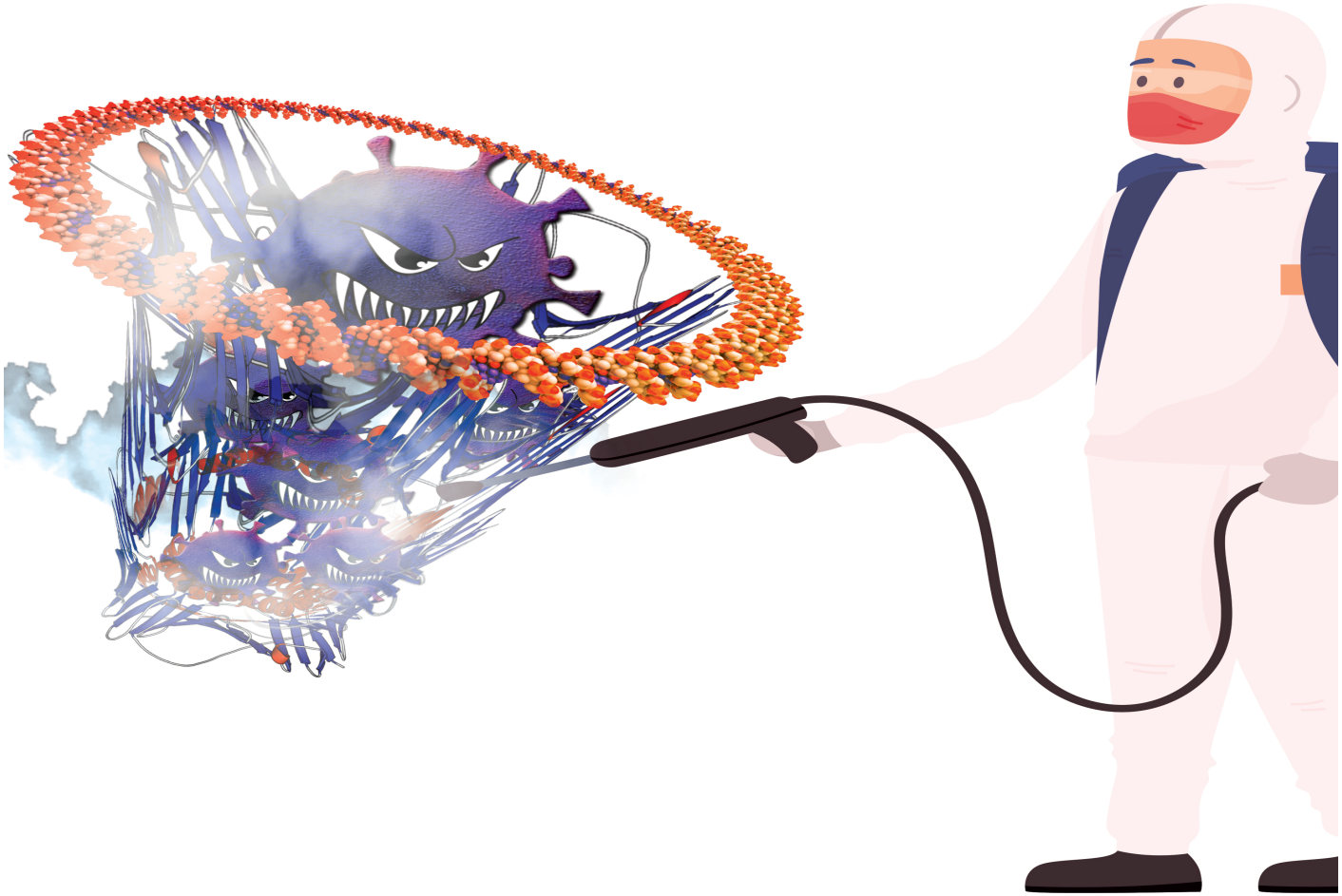
- **Peptide-based detection**
- **Biomarkers for severity**
- **Other ongoing projects**

(I) A Simplified Mass Spectrometry-based Proteomics Approach to detect SARS-CoV-2 from Nasopharyngeal Swab of COVID-19 patients

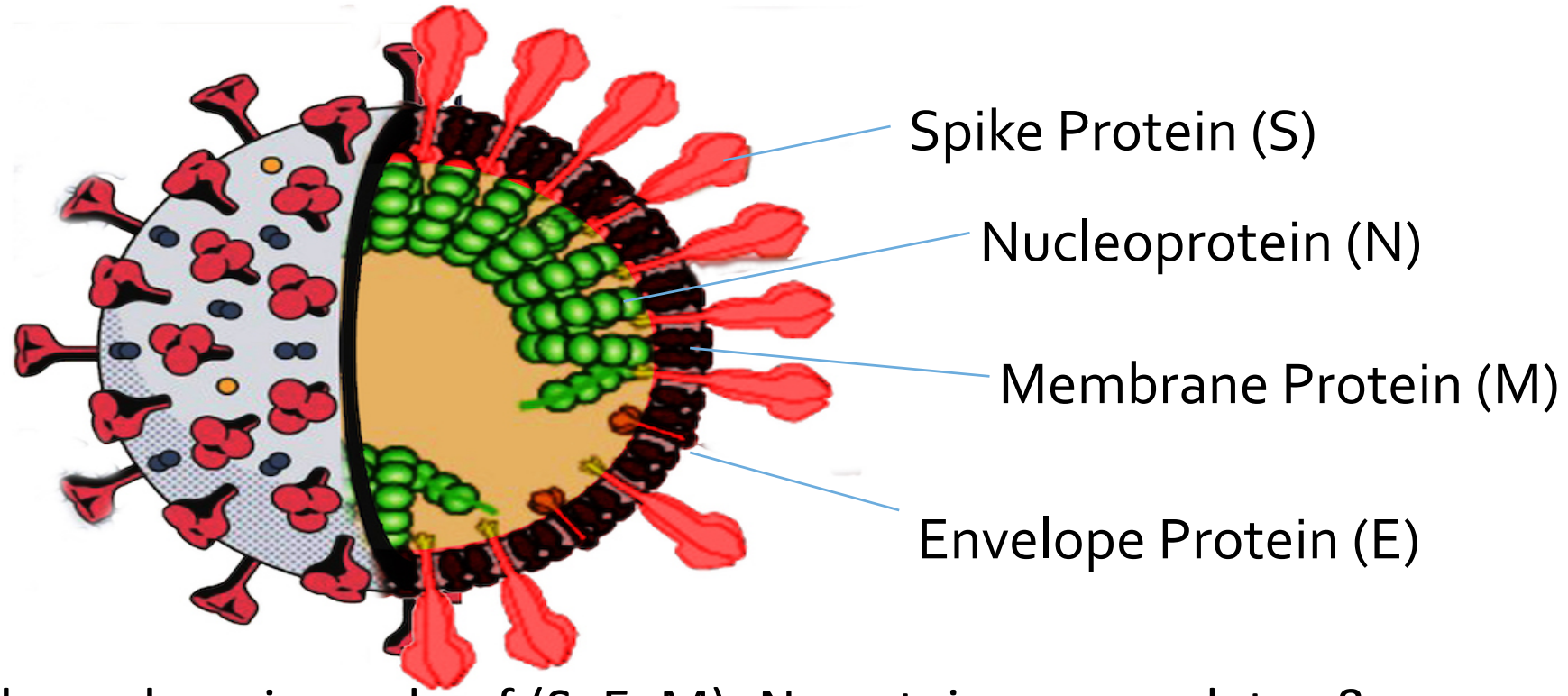



Challenges of Virus detection using Antibody tests
& Other Technologies!

How do we capture SARS-CoV-2 Peptides/ Proteins?



SARS-CoV-2 Proteins



- Viral envelope is made of (S, E, M); N-protein encapsulates & protects RNA genome
- S (less copies); E, M (Short & tightly membrane bound) difficult to identify
- N-Protein is main target for detection

Proteomics National Facility

High Resolution Mass Spectrometry based Proteomics Research and Training Facility at Indian Institute of Technology Bombay

URL: http://www.bio.iitb.ac.in/~sanjeeva/massfiitb/

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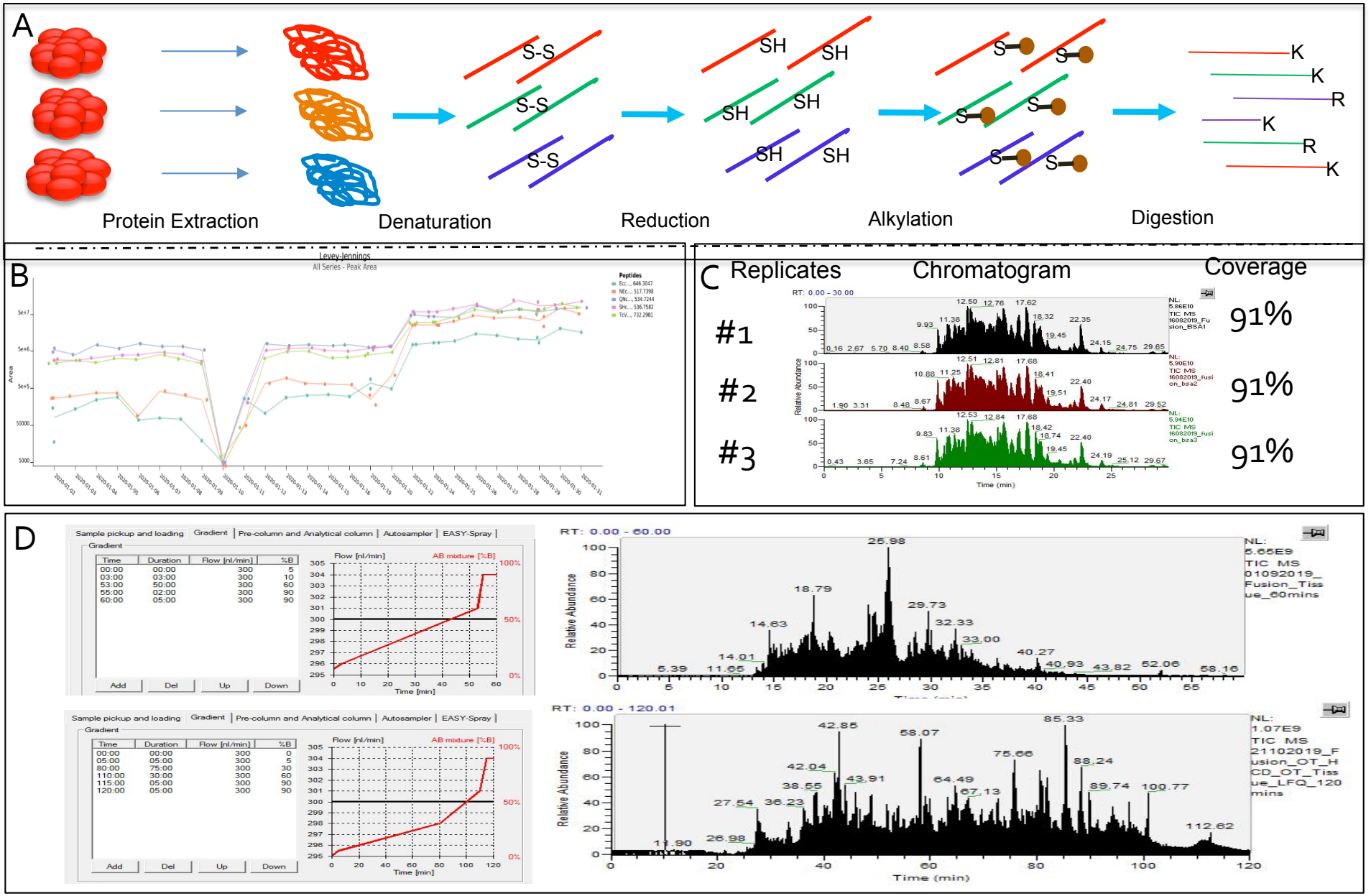
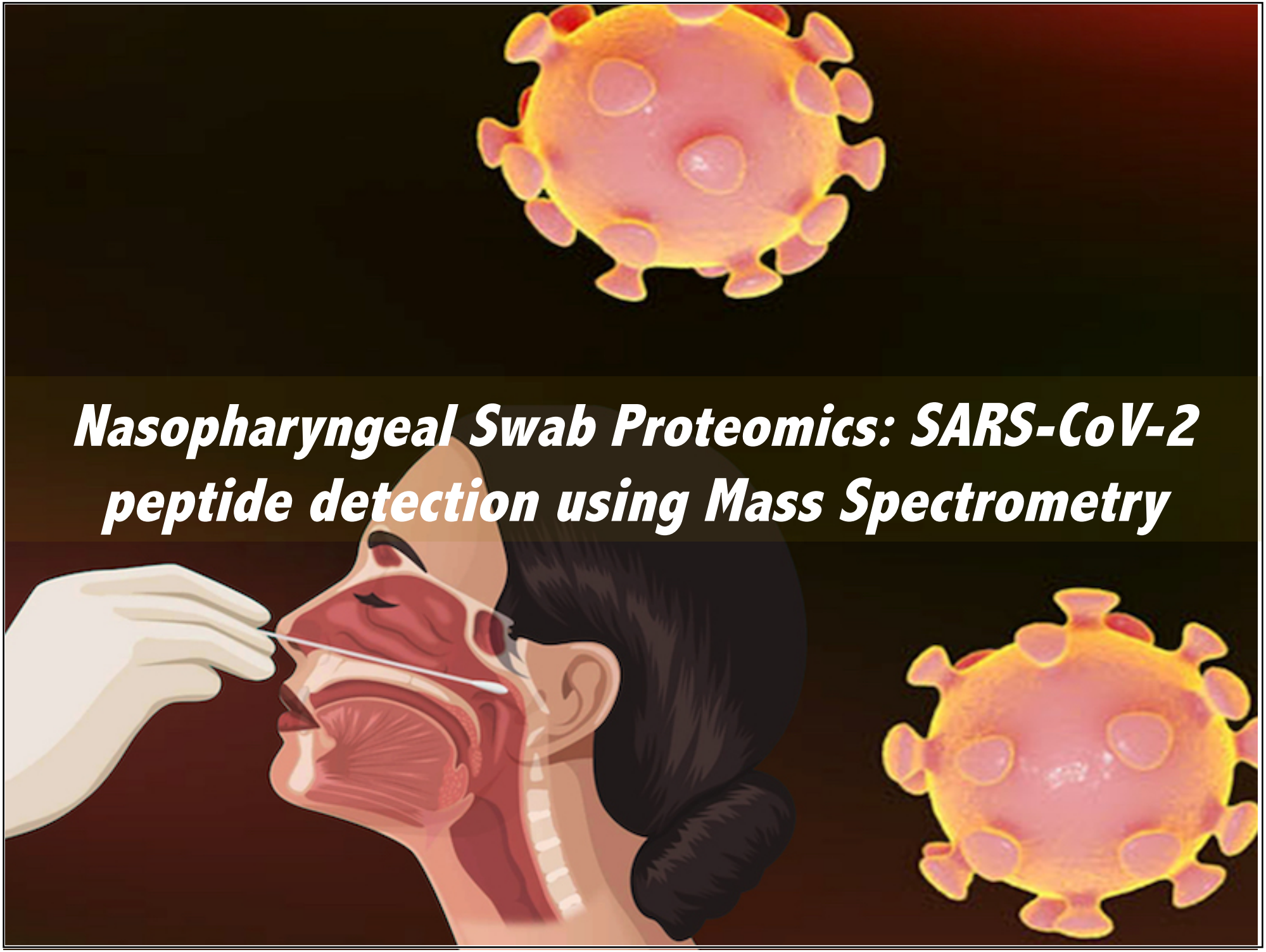
MS-based Proteomics Workflow

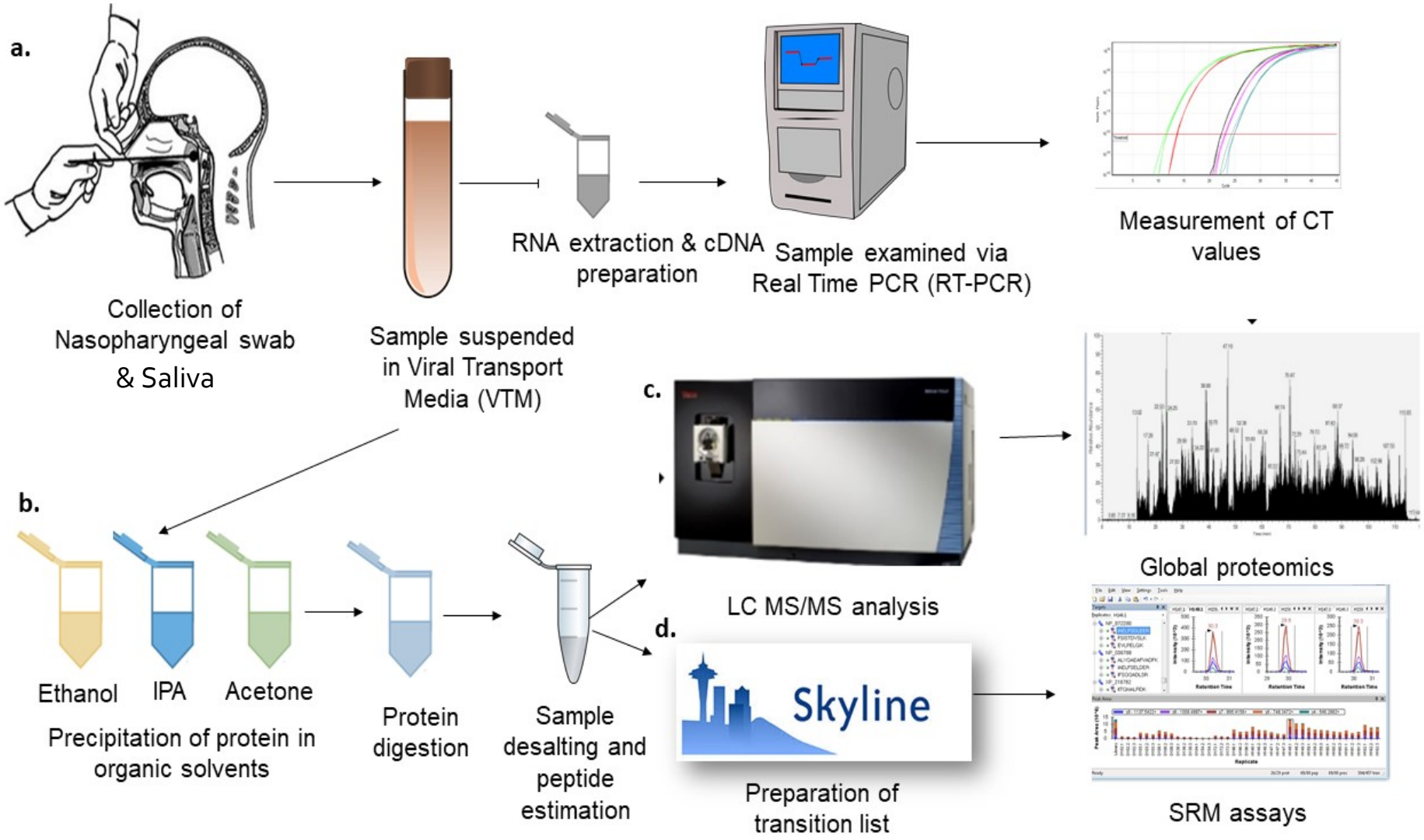


Kumar V. et al.. ***Frontiers Oncology (Rev), 2020***

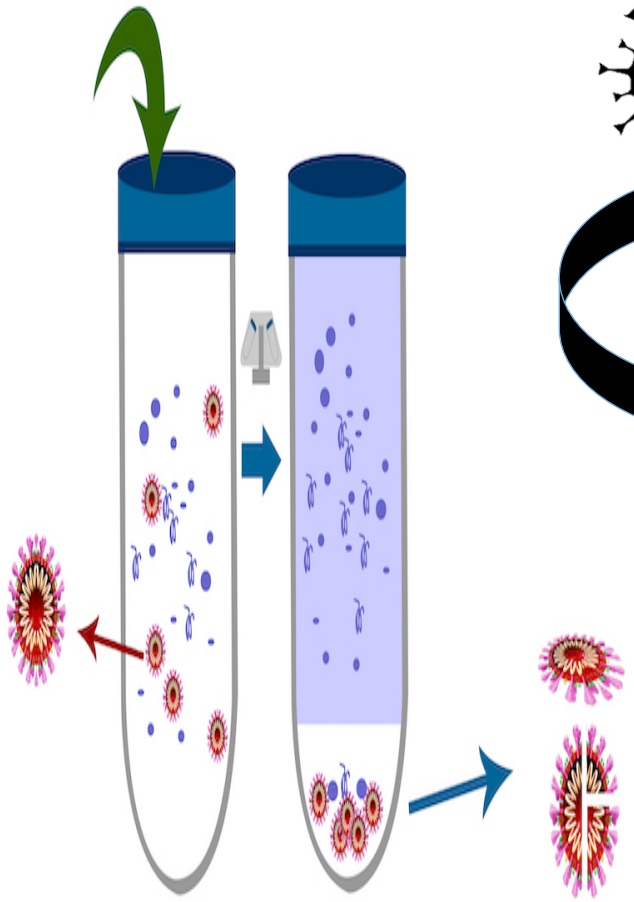

Nasopharyngeal Swab Proteomics: SARS-CoV-2
peptide detection using Mass Spectrometry

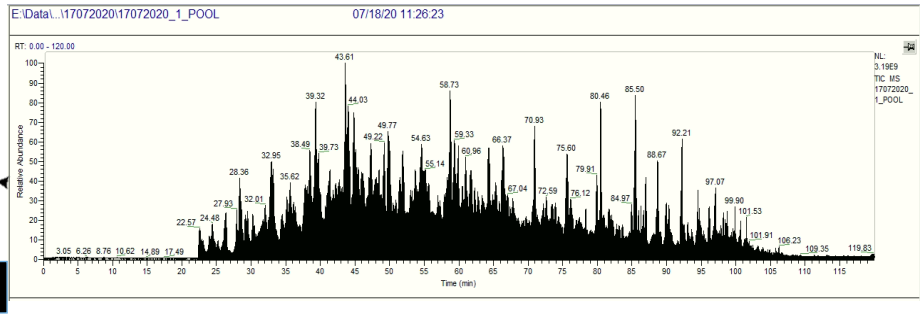
Proteomics Workflow for SARS-CoV-2 Detection

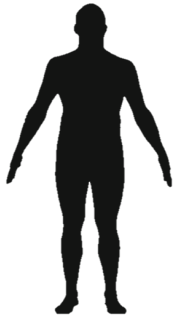
From NP Swab

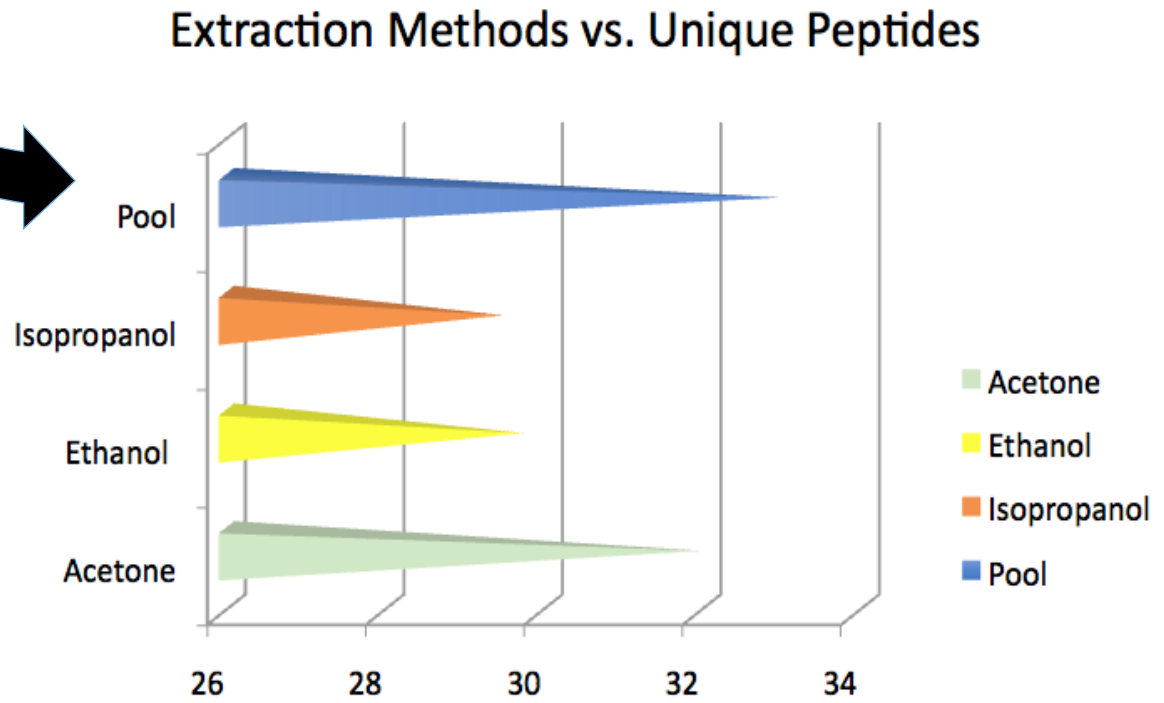


How to capture SARS-CoV-2 Peptides/ Proteins: Need to investigate various extraction methods!

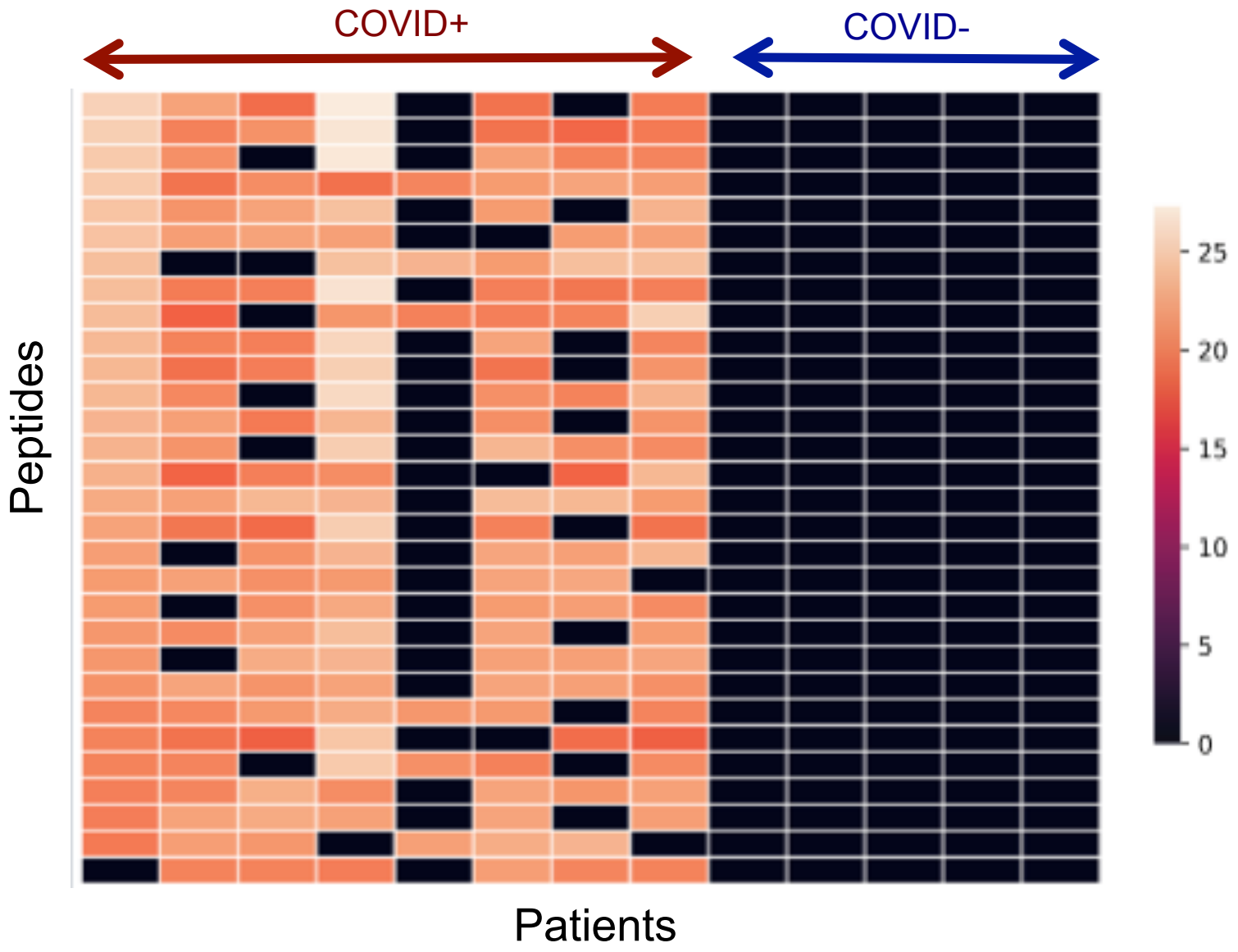




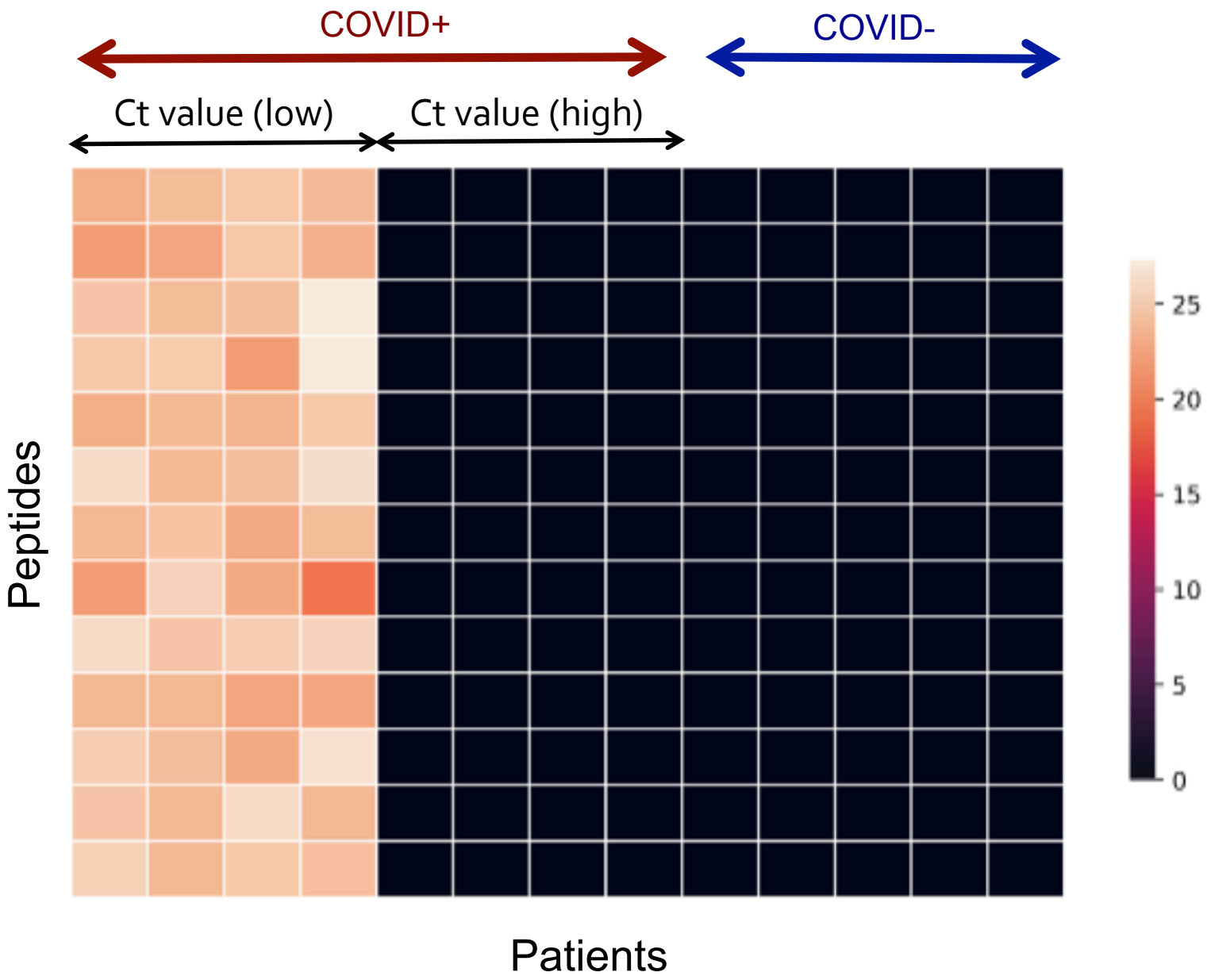


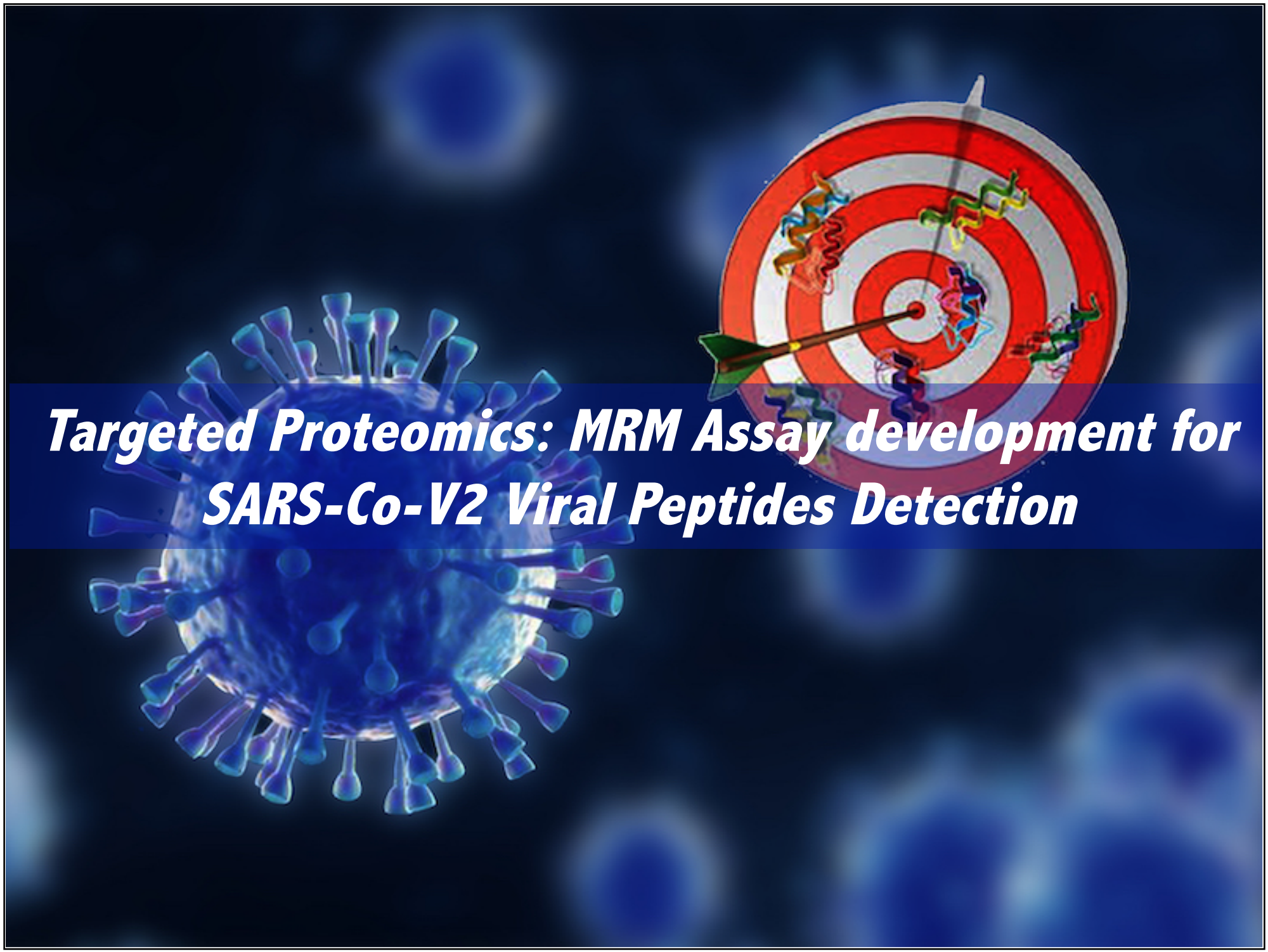


Viral peptides identified from respiratory specimen of COVID-19 patients

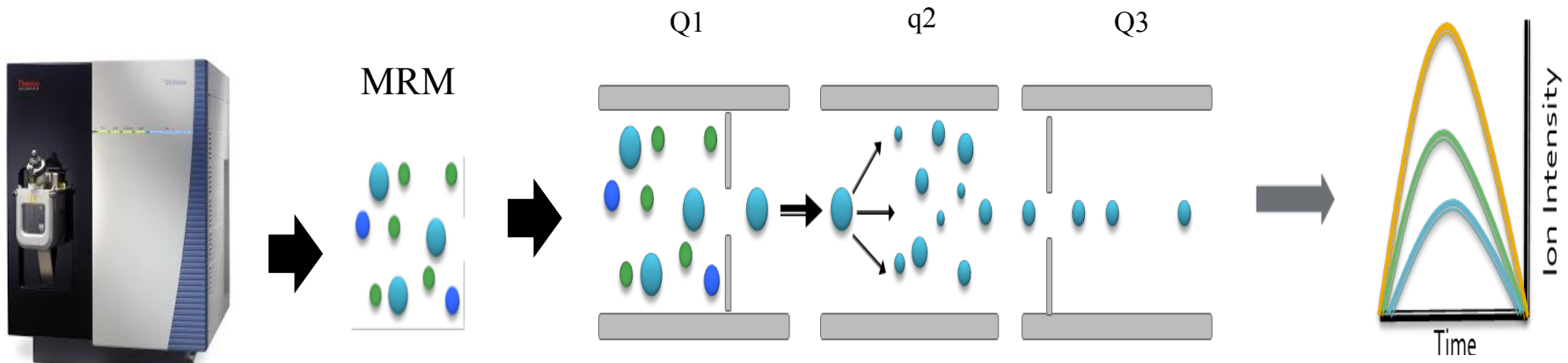


Viral associated peptides correlation with Ct values

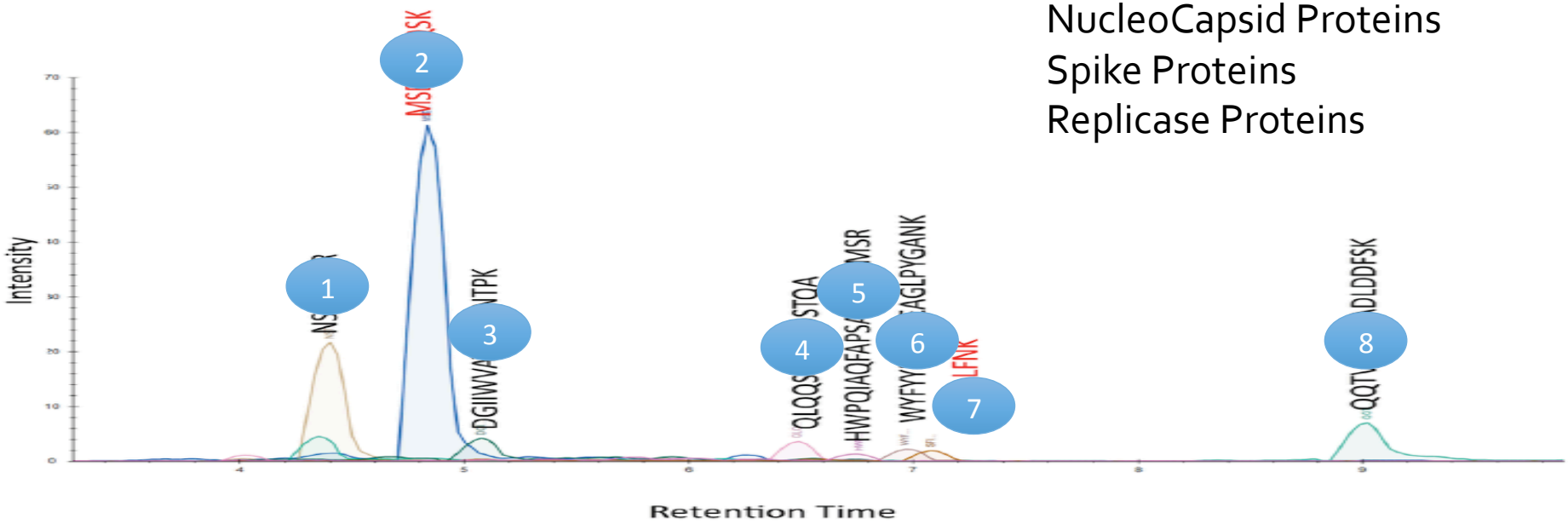



Targeted Proteomics: MRM Assay development for
SARS-Co-V2 Viral Peptides Detection

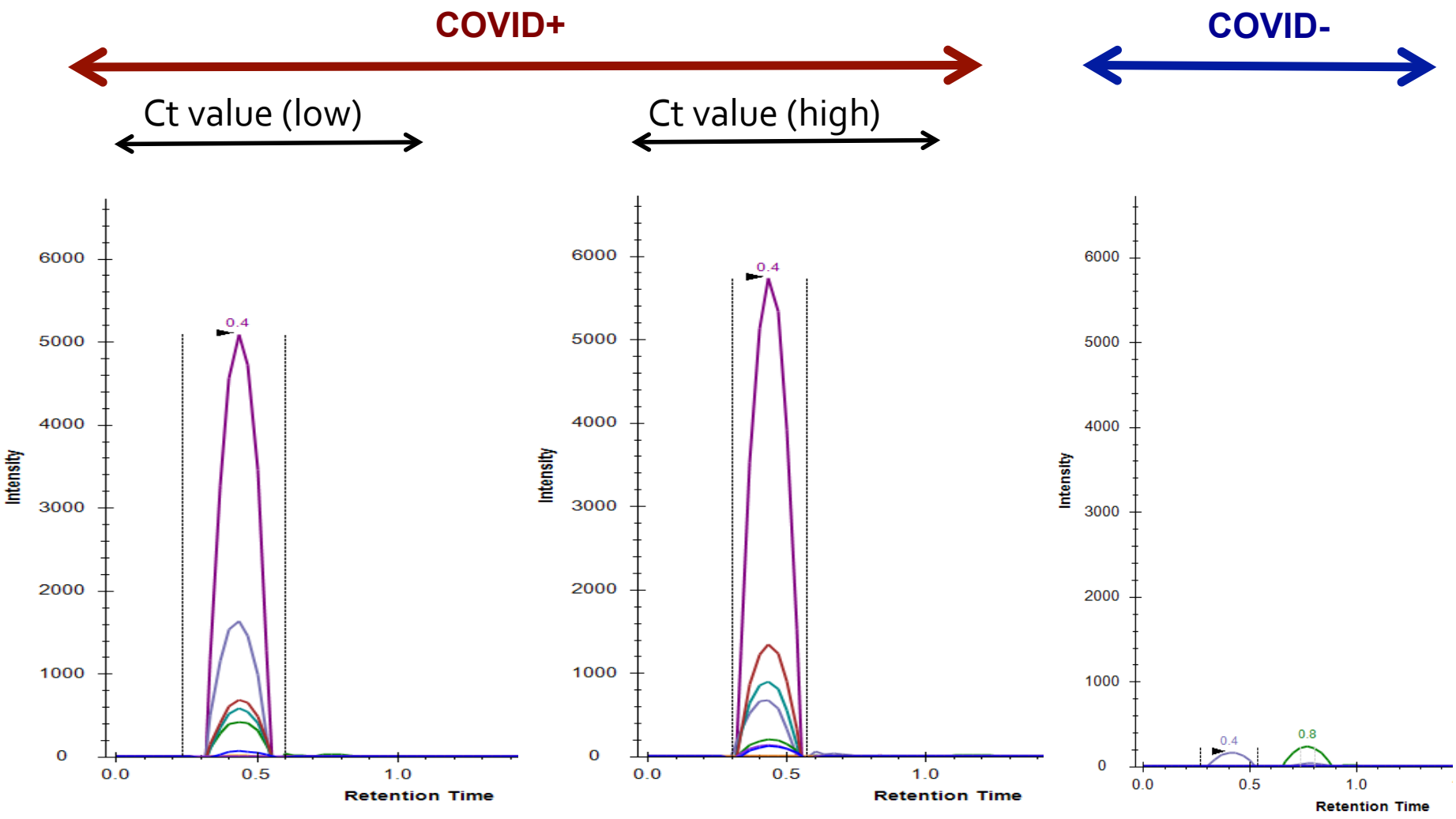
Detection of Viral Peptides Using MRM Assay



NucleoCapsid Proteins
Spike Proteins
Replicase Proteins



Development of MRM Assays from NP Swab Samples

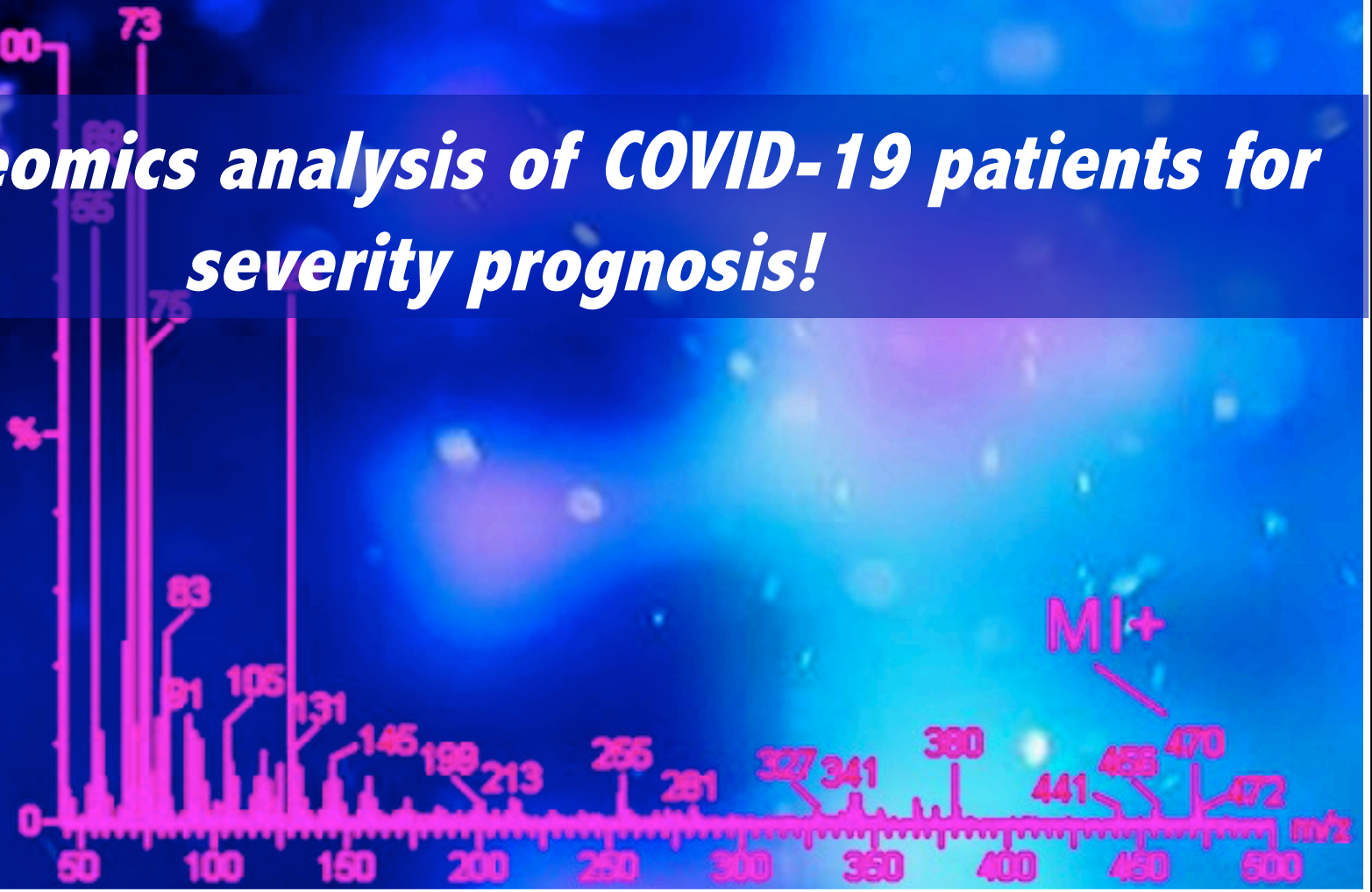


IDF: PAT/BS/SS-9/20-21

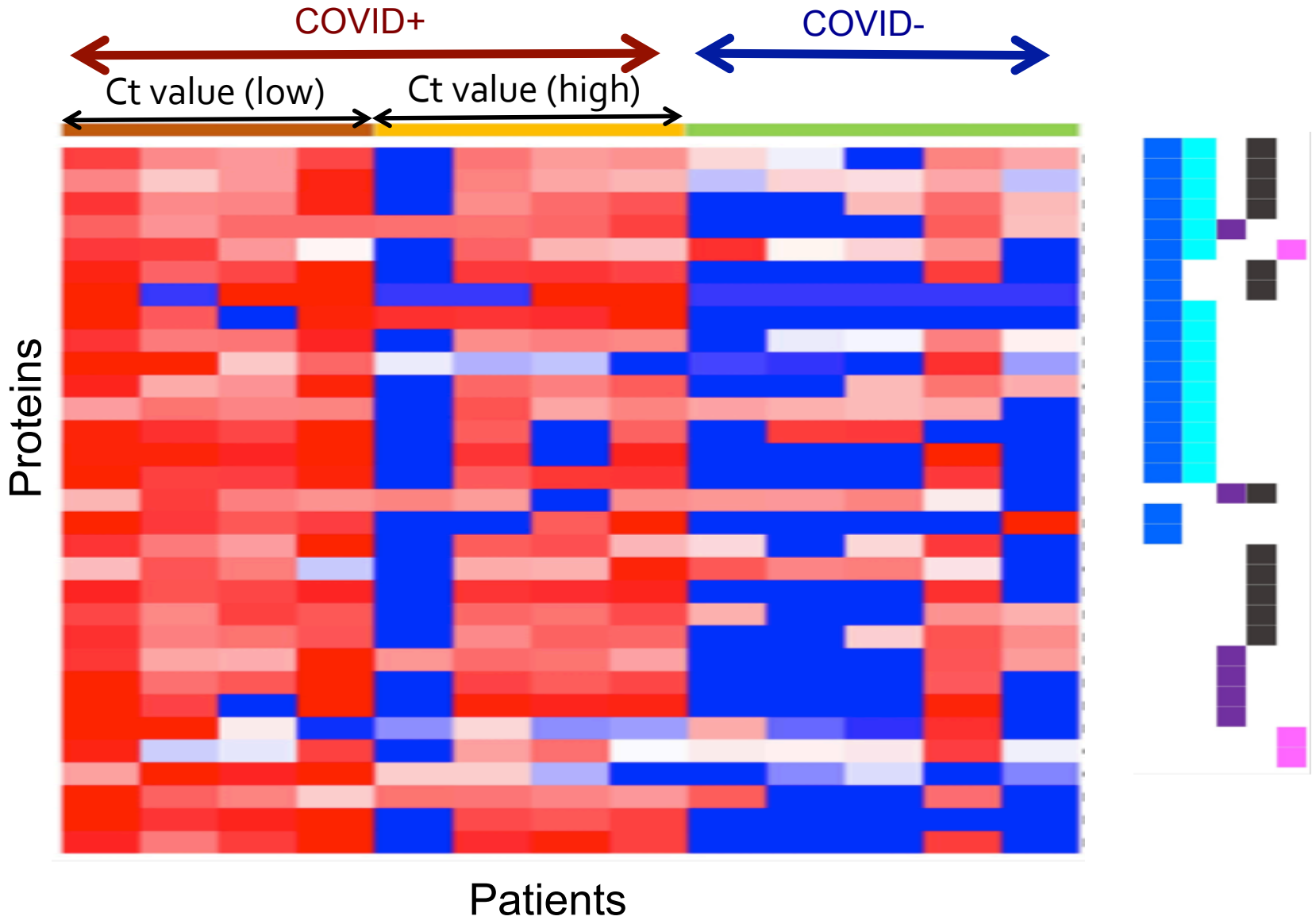

Next....Detection of SARS-Co-V2 Viral Peptides from Saliva?

- Peptide-based detection
- Biomarkers for severity
- Other ongoing projects

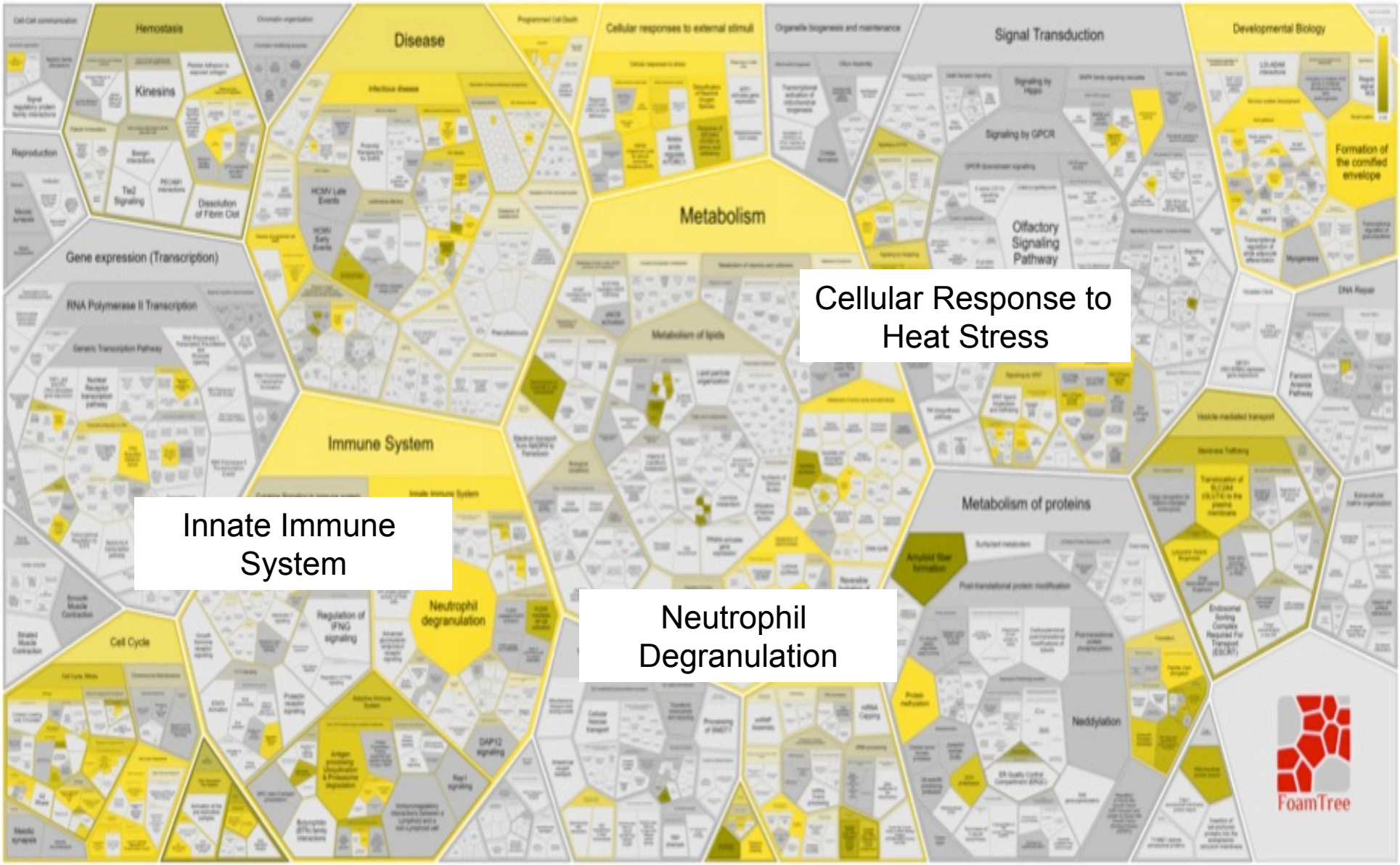
(II) Proteomics analysis of COVID-19 patients for severity prognosis!

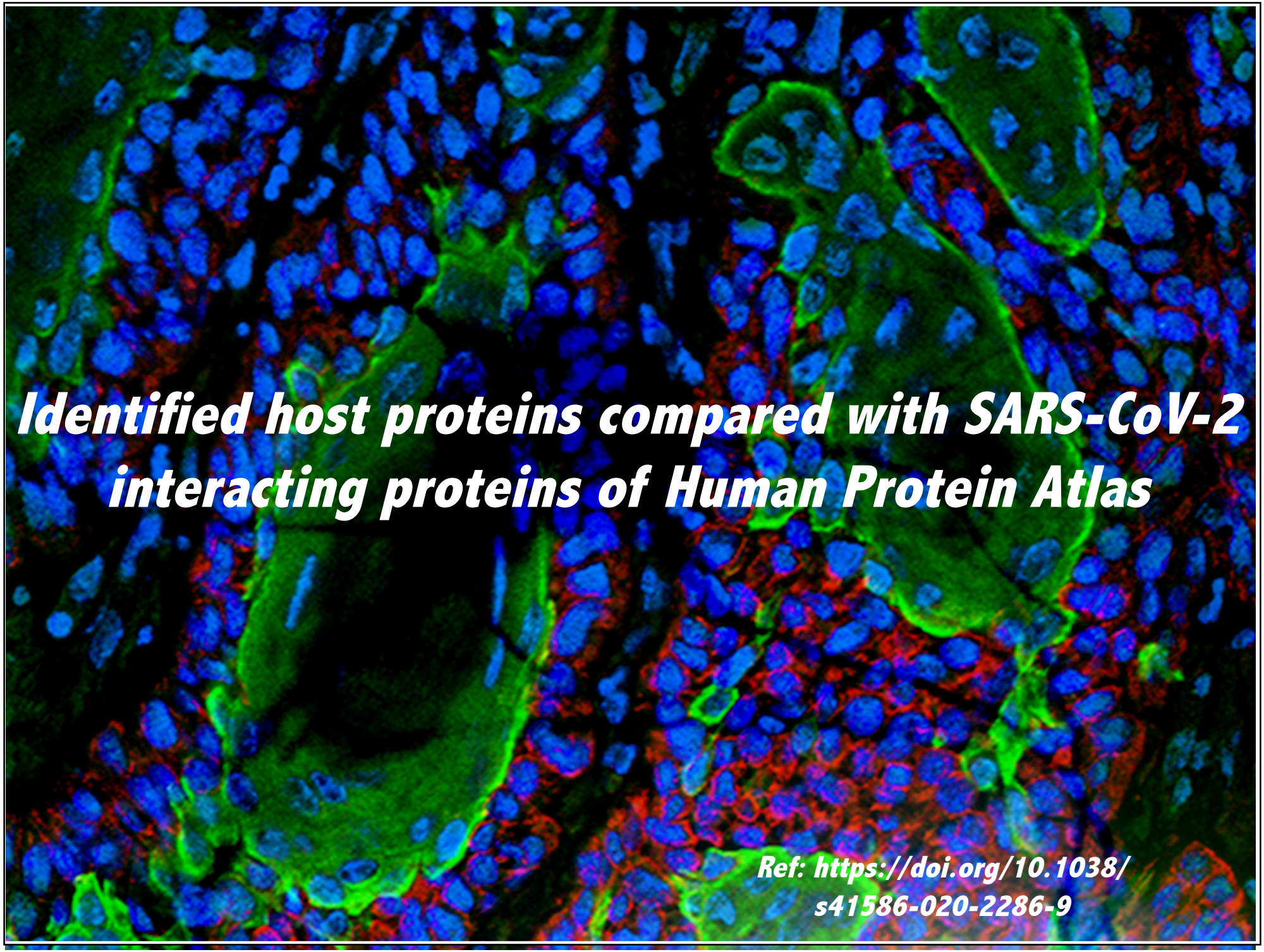


Host proteins modulated in respiratory specimen of COVID-19 patients

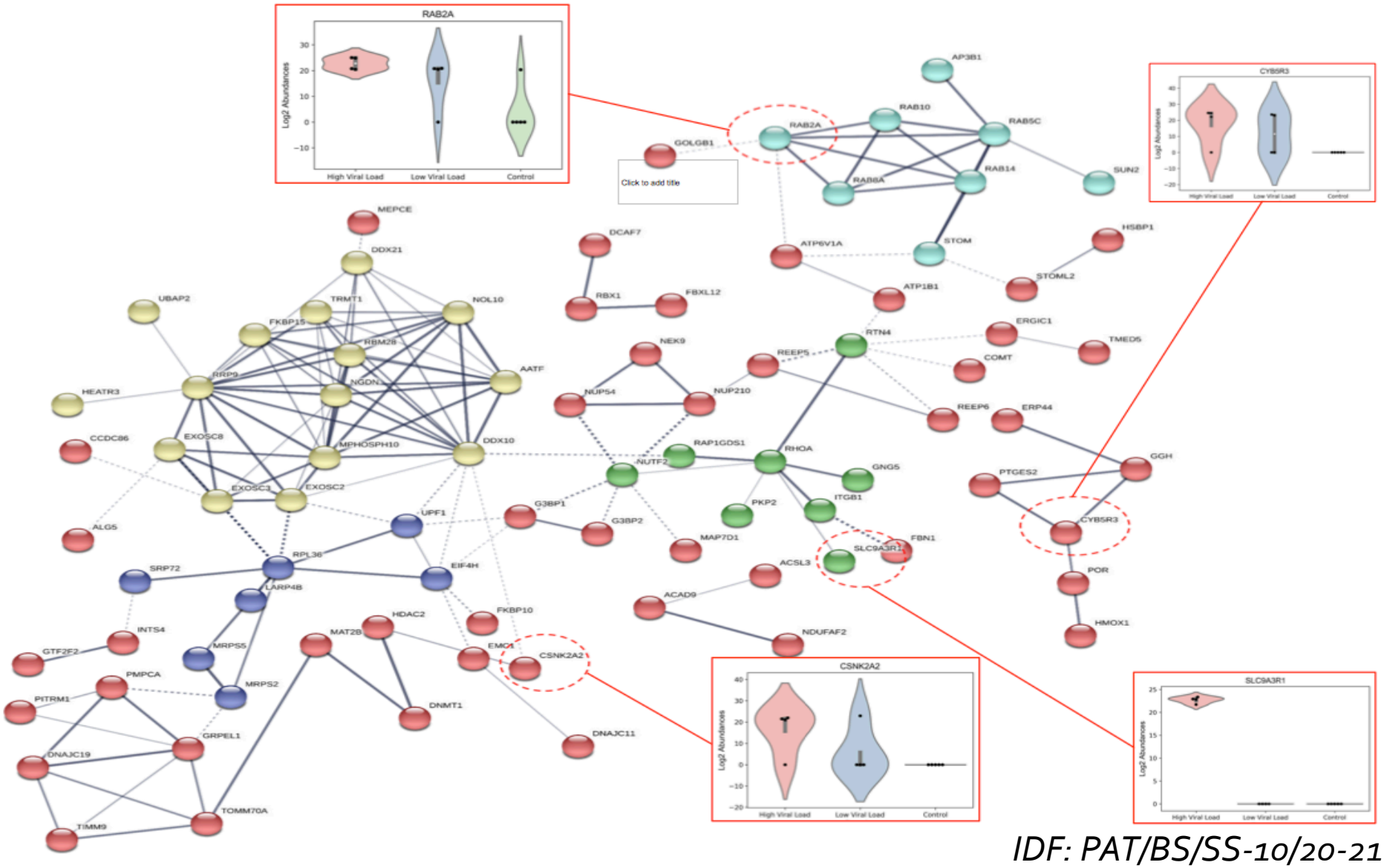


A landscape of Pathways modulated in COVID-19 patients



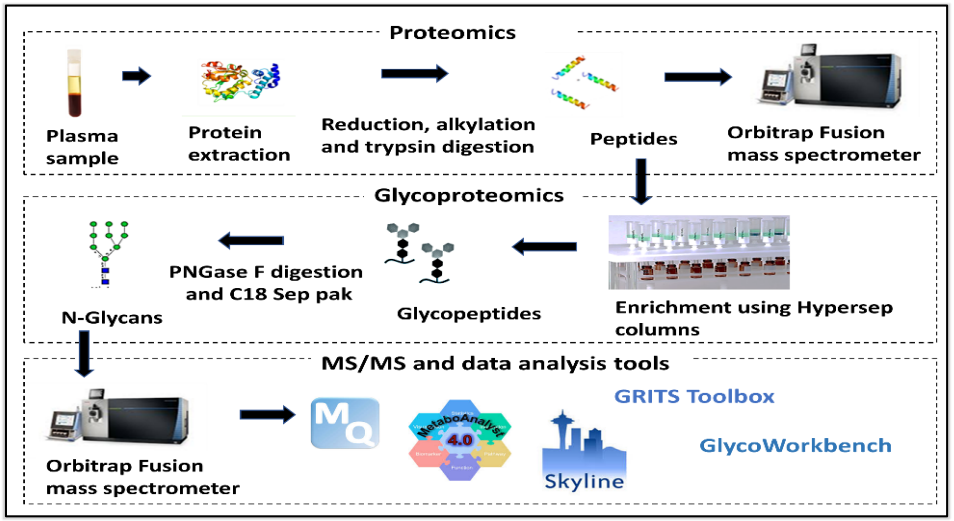

Identified host proteins compared with SARS-CoV-2 interacting proteins of Human Protein Atlas
Ref: https://doi.org/10.1038/s41586-020-2286-9

Host-COVID-19 Interaction Map & Biomarkers for Severity Prognosis

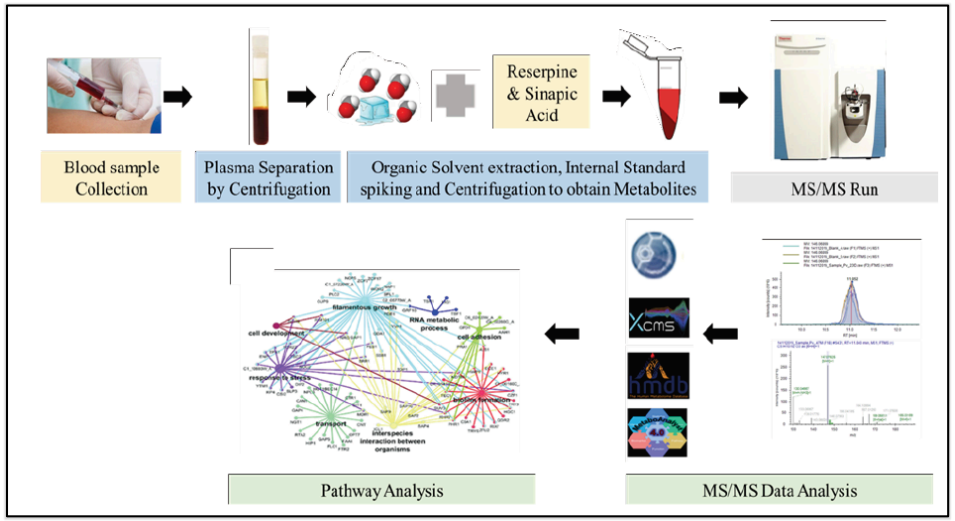


IDF: PAT/BS/SS-10/20-21

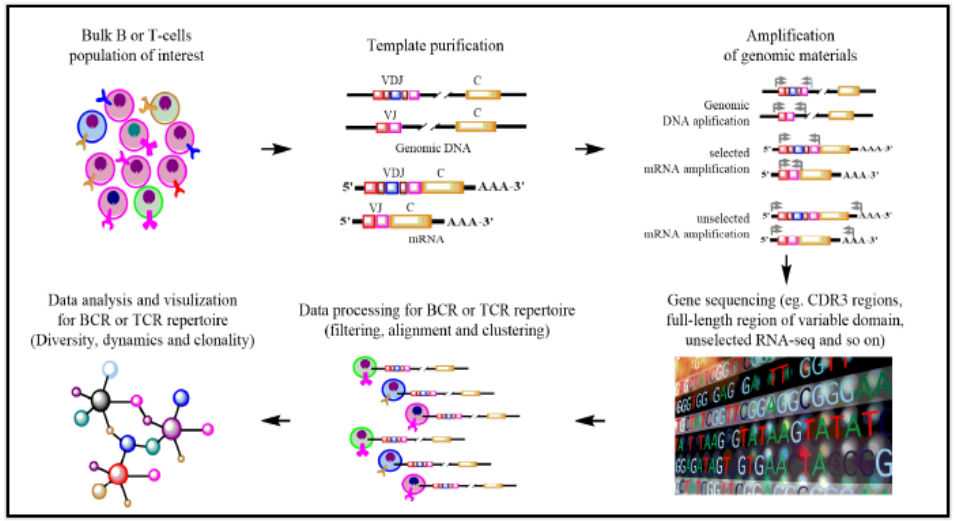
Other initiatives on COVID-19!



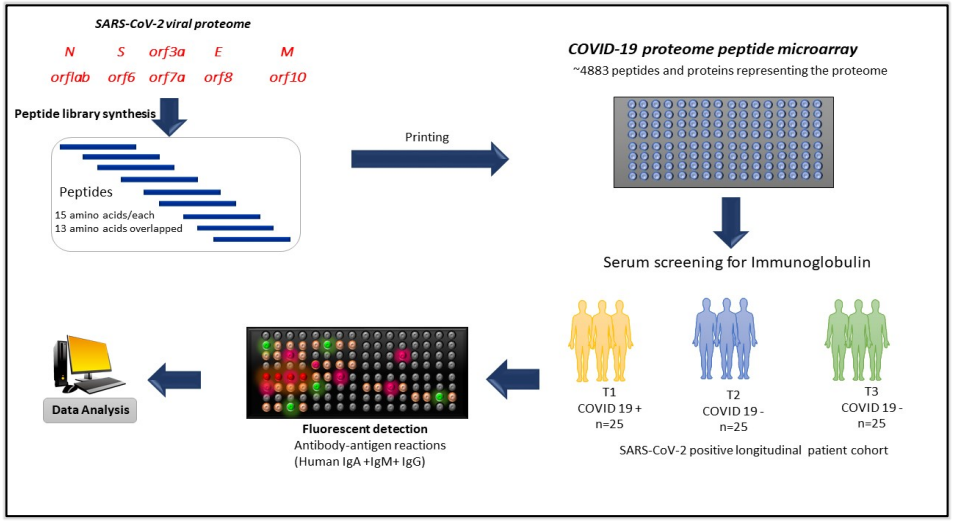
Proteomics investigation – targets for diagnosis



Metabolomics investigation – therapeutics



NGS - Immune system repertoire



Microarrays – epitope mapping & antibody response

Summary:

- Identification of peptides/ proteins that can aid diagnosis of SARS-CoV-2 from the nasal swab (& potentially Saliva) from COVID-19 patients using HT-MS platforms
- Implementation of global & targeted proteomics workflow to identify most significantly altered host proteins for severity prediction and prognostic value
- Other projects…epitope mapping, identification of targets for therapeutics

Thanks to Clinicians & Team of COVID-19 Project

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