

Fungal and Bacterial Infections Discrimination in ICU patients based on Serum Molecular Fingerprint

4th CHRC Annual Summit

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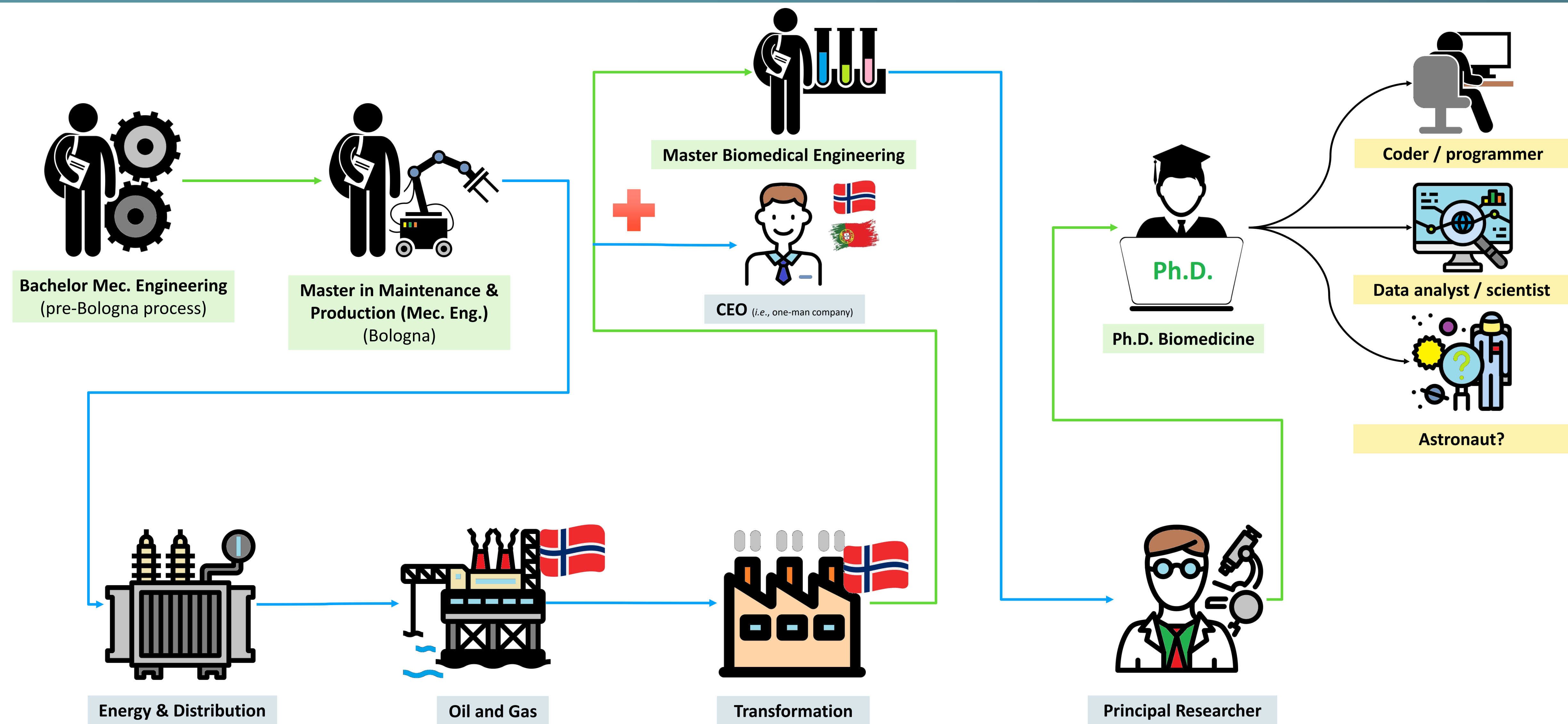
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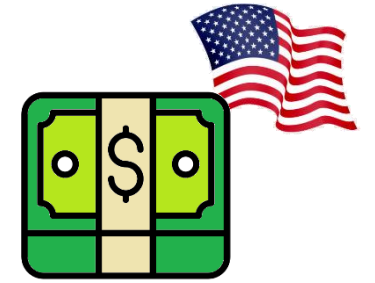
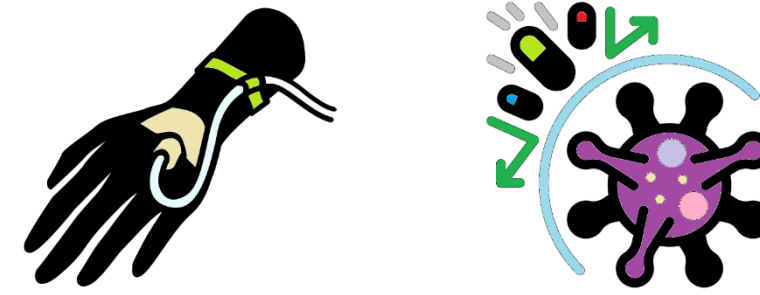
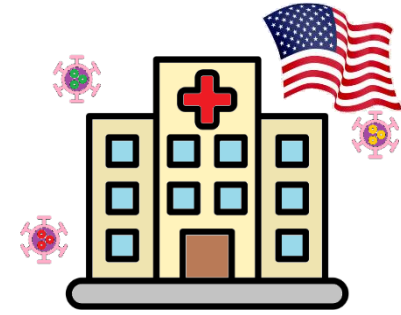
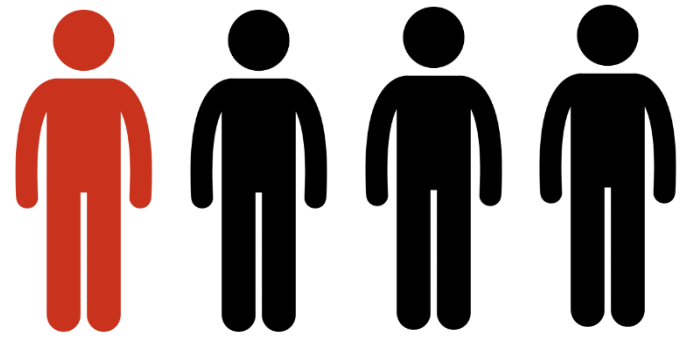
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The Path to Researcher – a non-linear model



Infections – the (not so hidden) cost



1

1 in 4 hospital-treated sepsis cases and half of all cases of sepsis with organ dysfunction treated in adult ICUs are health care associated ^[1] – WHO.

2

Hospital acquired infections (HAI) represent 4%, and 11% of these turn deadly. This translates into more than 70,000 deaths a year. ^[2] – CDC.

3

Most common HAI is central line-associated bloodstream infection (CLABSI), with the most common organisms being members of the Enterobacteriaceae family (e.g., Escherichia Coli and Klebsiella species). 45% of bacterial isolates are multidrug resistant. ^[2,3]

4

HAIs - yearly cost of \$6.5 billion. ^[4]



5

> 110,000 deaths, 16 million extra days of hospital stay and 7 billion € per year. ^[4]



6

12 people die in average (2013), 4606 per year. Antibiotic resistance species is also on the rise, e.g., Klebsiella pneumoniae rose from 16.5% in 2007 to 40.9% in 2014. ^[5]



The following exploratory study aims to provide a basis for a **robust predictive model** to quickly **discriminate and predict infection agent** (e.g., fungal, bacterial, type of strain, gram) in ICU patients, based on a serum analysis, enabling:

- ✓ customized treatment for each patient;
- ✓ faster recovery times and discharge from ICU;
- ✓ freeing up of beds in national health service;
- ✓ lower costs for all parts involved;
- ✓ provide physicians with the right tools to save lives.

[1] WHO, May 2022. Accessed last in 20/5/2023: <https://www.who.int/news/item/06-05-2022-who-launches-first-ever-global-report-on-infection-prevention-and-control>

[2] Magill, S. S., Edwards, J. R., & Fridkin, S. K. (2014). Survey of health care-associated infections. The New England journal of medicine, 370(26), 2542-2543.

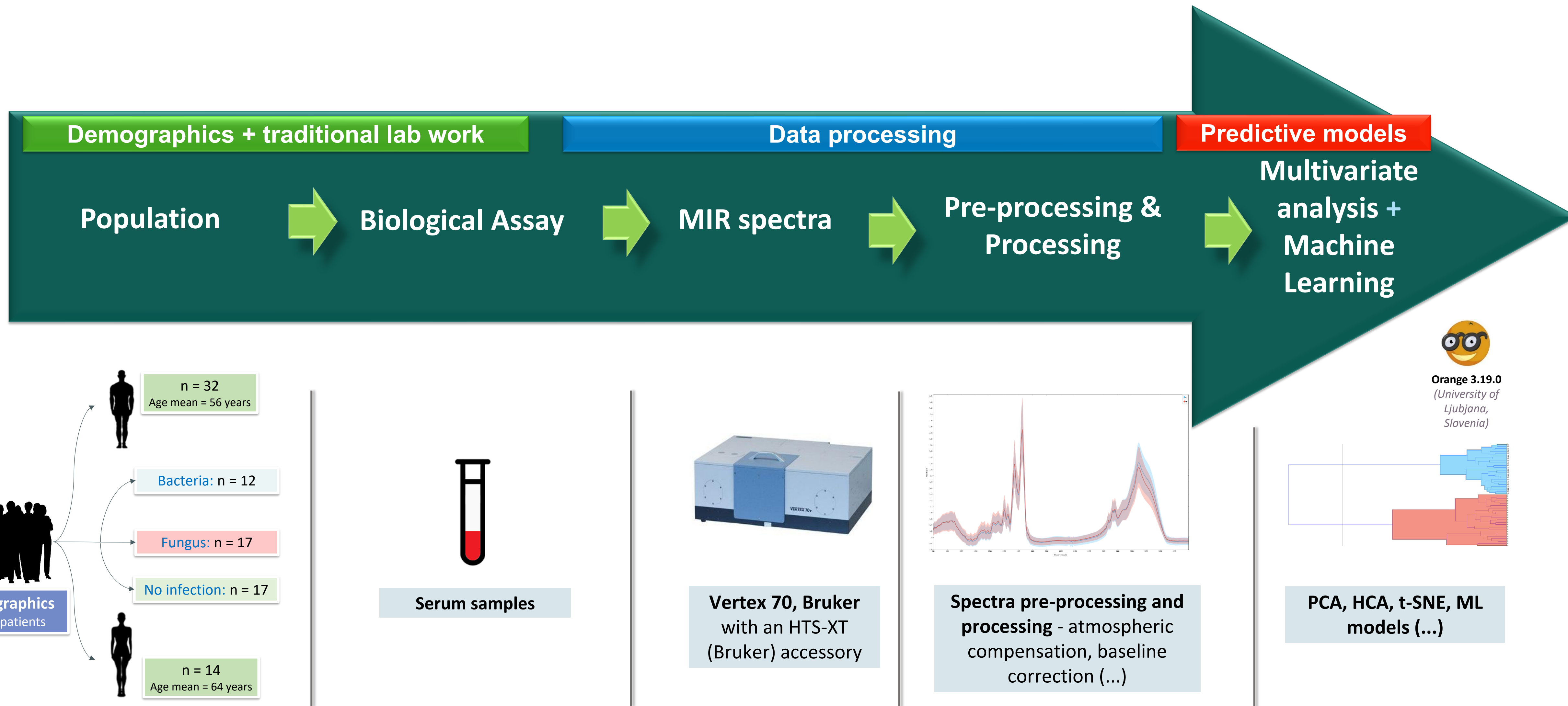
Morgan, D. J., Lomotan, L. L., Agnes, K., McGrail, L., & Roghmann, M. C. (2010). Characteristics of healthcare-associated infections contributing to unexpected in-hospital deaths. Infection Control & Hospital Epidemiology, 31(8), 864-866.

[3] Morgan, D. J., Lomotan, L. L., Agnes, K., McGrail, L., & Roghmann, M. C. (2010). Characteristics of healthcare-associated infections contributing to unexpected in-hospital deaths. Infection Control & Hospital Epidemiology, 31(8), 864-866.

[4] APEC Health Working Group, November 2013. Accessed last in 20/5/2023: https://www.apec.org/docs/default-source/Publications/2013/12/Cost-of-Healthcare-Associated-Infections-in-APEC-Economies-A-Review-of-the-Literature/2013_hwg_Isif_HAI-Literature-Review-Nov13.pdf

[5] OCDE, Health at a glance, November 2019. Accessed last in 20/5/2023: https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-2019_4dd50c09-en

The Study



Preliminary Results

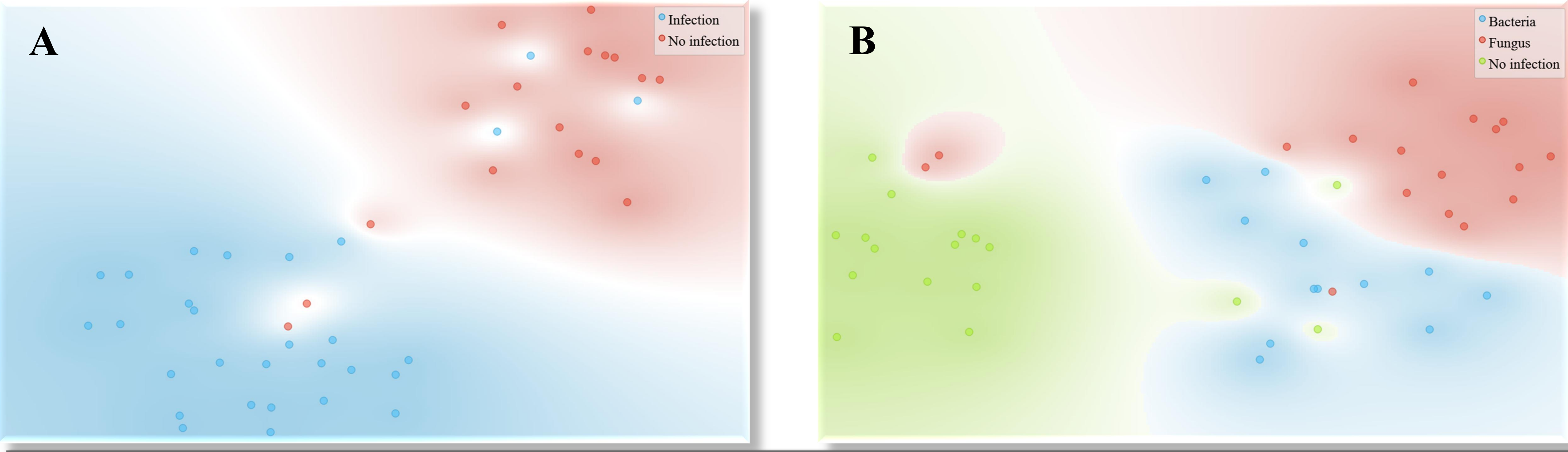
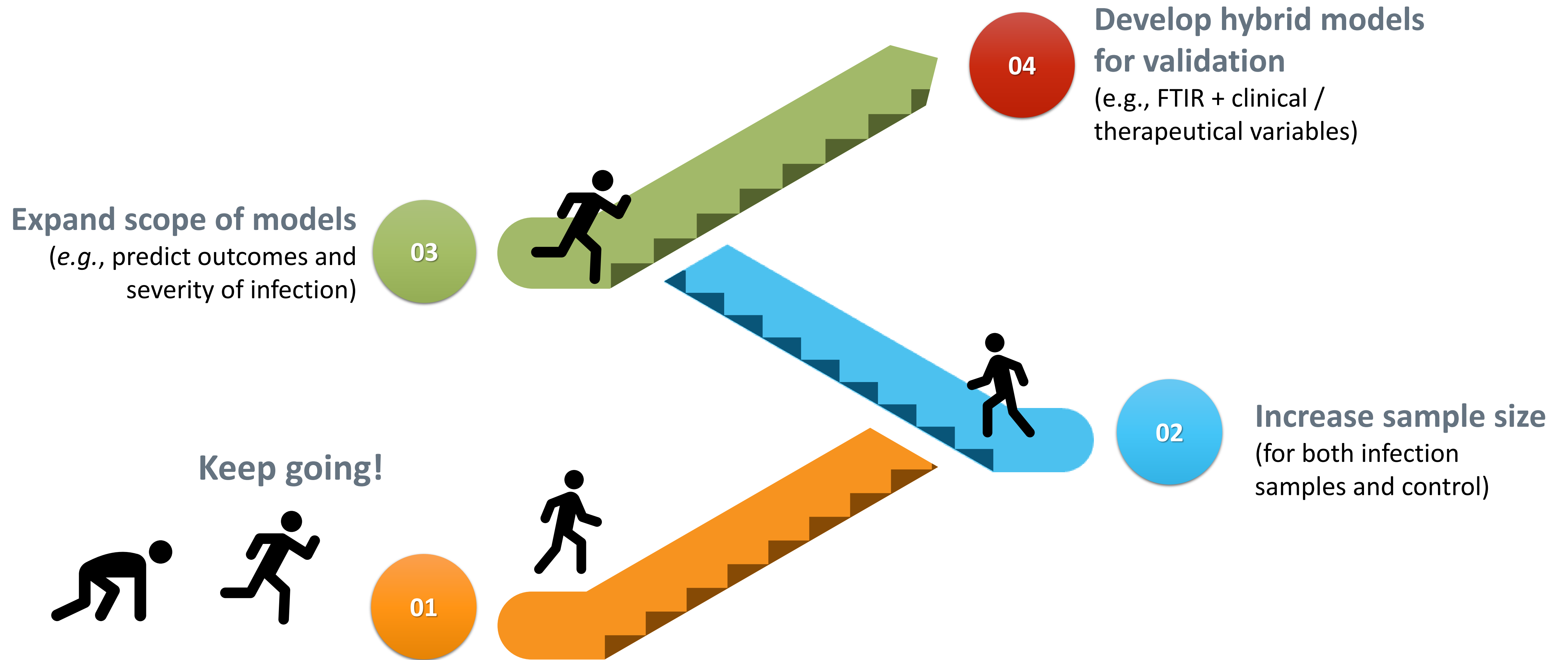


Figure 1. t-SNE of infected (**blue**) and non-infected (**red**) patients, based on serum normalized second derivative spectra (between 406-1800 and 2800-3992 cm⁻¹) (**A**), and between patients with bacterial (**blue**), fungal infection (**red**) or no infection (**green**) (**B**). The impact of a Fast Correlation Based Filter (FCBF) of normalized second derivative spectra (between 406-1800 and 2800-3992 cm⁻¹), was evaluated on a t-distributed Stochastic Neighbour Embedding (t-SNE), and a Naïve-Bayes model.

	AUC	Accuracy	Precision	Sensitivity	Specificity
A	0.933	0.812	0.814	0.812	0.906
B	0.988	0.800	0.905	0.800	0.956

Next Steps



L3S members (some of them...)



Luis Bento (supervisor), PhD
ICU and Neurotrauma Director in CHULC
M.D., Professor at NMS and CHRC member

➡ **Cecília Calado (co-supervisor), PhD**
Responsible for Lab. Of Health & Engineering (ISEL)
Coordinator of BSc and MSc in Biomedical Eng.

➡ **Luis Ramalhte, Biomedicine PhD candidate**
Scientific Director of CSTL-T HLA Laboratory, IPST

➡ **Viviana Caldeira, Biomedicine PhD candidate**
Osteopath & Knee Specialist
Professor at Red Cross

Tiago Alexandre Fonseca, MSc
Master in Biomedical Engineering

Cristiana Von Rekowski, MSc
Master in Biomedical Engineering

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