

# TOXICOLOGICAL ANALYSIS IN PATIENTS WITH INHALATION INJURY DURING THEIR HOSPITALIZATION

Inhalation injury (INHI) is caused by inhalation of hot steam and/or products of combustion. The upper airways are damaged mainly by hot air, the lower respiratory tract is usually affected rather by toxins and chemicals.

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## REFERENCES:

[1] Miller K, Chang A. Acute inhalation injury. Emerg Med Clin North Am [Internet]. 2003;21:533–57. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0733862703000117>  
 [2] Hwang J, Xu C, Agnew R.J., et al. Health Risks of Structural Firefighters from Exposure to Polycyclic Aromatic Hydrocarbons: A Systematic Review and Meta-Analysis. Int J Environ Res Public Health [Internet]. 2021;18:4209. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8071552/>

**ABBREVIATION:** ABSI: abbreviated burn severity index; BAL: bronchoalveolar lavage; CRP: C-reactive protein; OH-PAHs: hydroxy-polycyclic aromatic hydrocarbons; PAHs: polycyclic aromatic hydrocarbons; PCT: procalcitonin; TBSA: total body surface area; 1-OH-Naph: 1-hydroxynaphthalene; 2-OH-Naph: 2-hydroxynaphthalene; 2-OH-Fluo: 2-hydroxyfluorene; 3-OH-Fluo: 3-hydroxyfluorene; 1-OH-Phen: 1-hydroxyphenanthrene; 4-OH-Phen: 4-hydroxyphenanthrene; 9-OH-Phen: 9-hydroxyphenanthrene; 2/3-OH-Phen: 2/3-hydroxyphenanthrene; 1-OH-Pyr: 1-hydroxypyrene.

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## INTRODUCTION

- ❖ The level and duration of exposure to the toxic compounds can strongly influence the inhalation injury (INHI) severity, treatment, and its success [1].
- ❖ Polycyclic aromatic hydrocarbons (PAHs) are one of the smoke components in large fires and enter the body by inhalation [2].
- ❖ PAHs and their metabolites (OH-PAHs) may affect the INHI grade, patients' status, and prognosis for recovery.

## AIMS

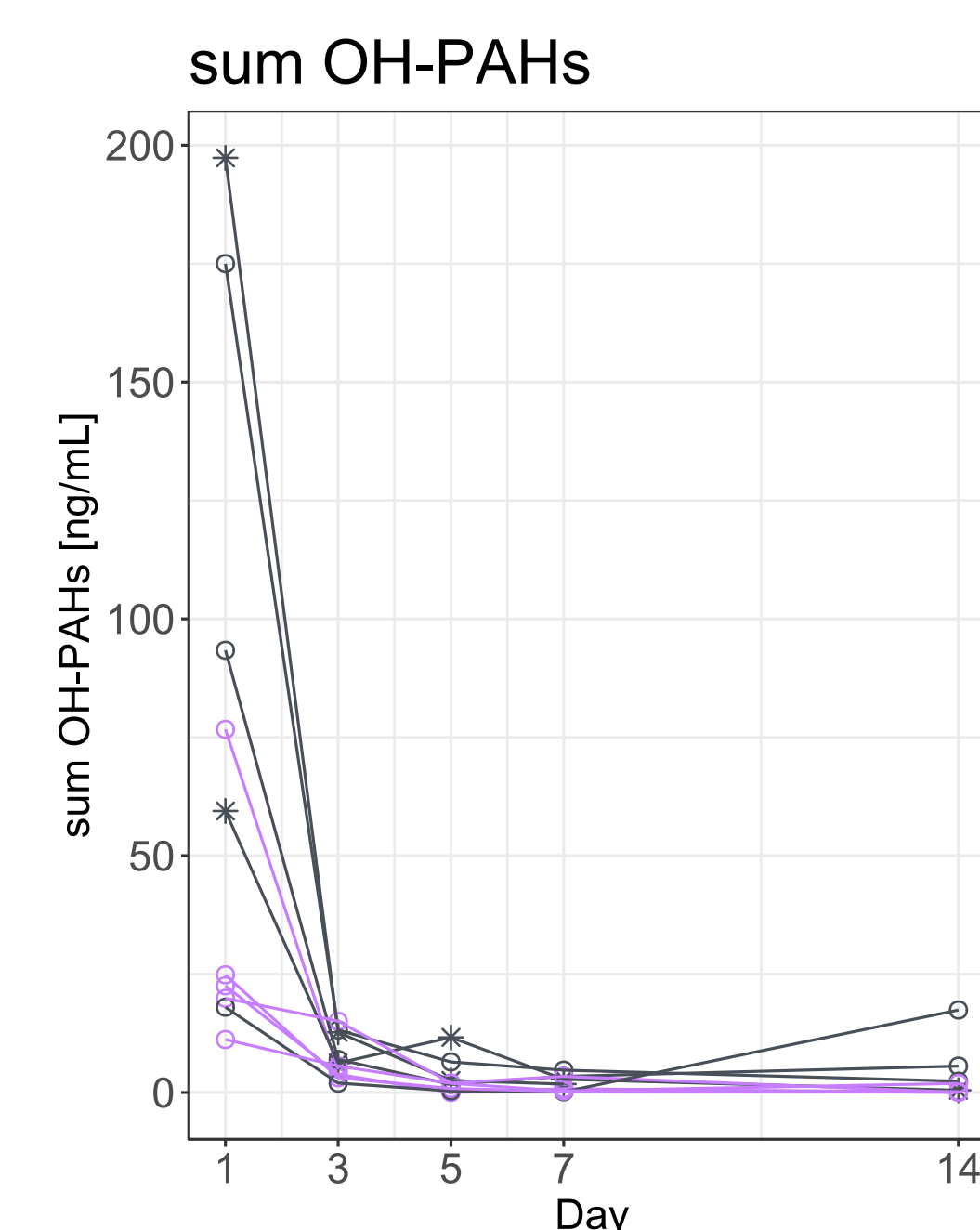
- I. To determine the most abundant PAHs in the bronchoalveolar lavage (BAL) and OH-PAHs in urine.
- II. To describe the dynamic changes in the levels of these toxic compounds throughout hospitalization in BAL and in urine.
- III. To correlate these findings with clinical variables of the patients with inhalation injury at the beginning of the hospitalization.

## METHODOLOGY

- ❖ The samples (BAL and urine) were collected at the Department of Burns and Plastic Surgery, University Hospital Brno, Czech Republic, from 2020 to 2023.
- ❖ The composition and amounts of PAHs (using GC-MS) and their derivatives such as nitro-PAHs and oxy-PAHs (using APGC-MS/MS) were measured in BAL samples.
- ❖ In urine samples, only the hydroxylated metabolites of PAHs (OH-PAHs) were measured.
- ❖ The analysis of toxic compounds run in the Trace Analytical Laboratory RECETOX RI.

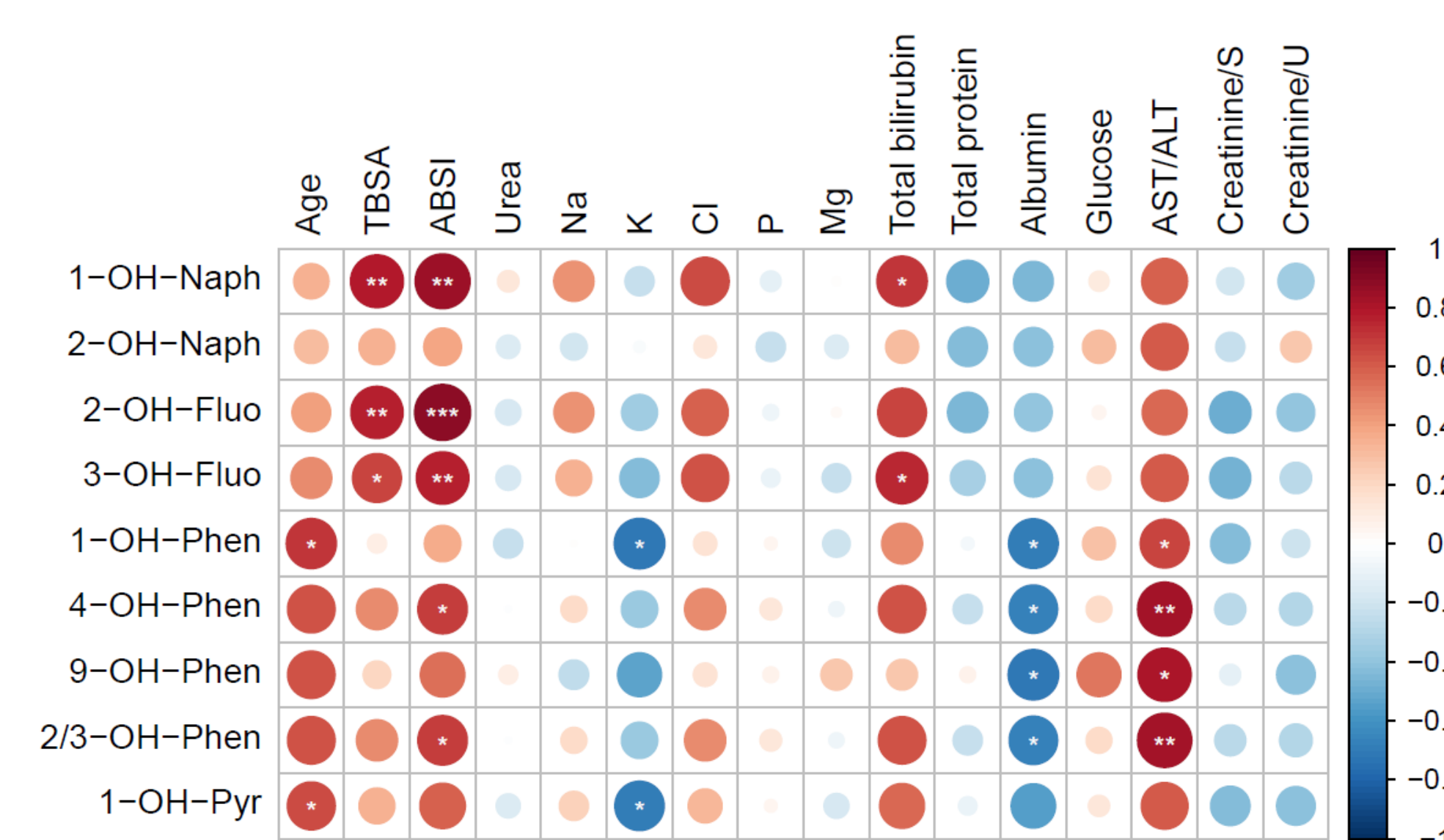
## RESULTS

- 1 Trace amounts (0.003 – 3.8 ng/ml) of the measured PAHs and their nitro- and oxy-derivates were detected in BAL samples. Only exception, the 1,4-naphthoquinone was detected as high abundant (IQR 98.3 – 150.75 ng/ml).
- 2 High concentration of OH-PAHs sum in urine decrease during first 3 days of hospitalization.
- 3 There is a strong positive correlation between some of the clinical markers and OH-PAHs in urine such as TBSA and ABSI score with OH-Fluo's, and AST/ALT ratio with OH-Phen's.
- 4 High-Grade INHI was associated with higher presence of some OH-PAHs in urine, mainly with total concentration of OH-PAHs in day 14 of the hospitalization.



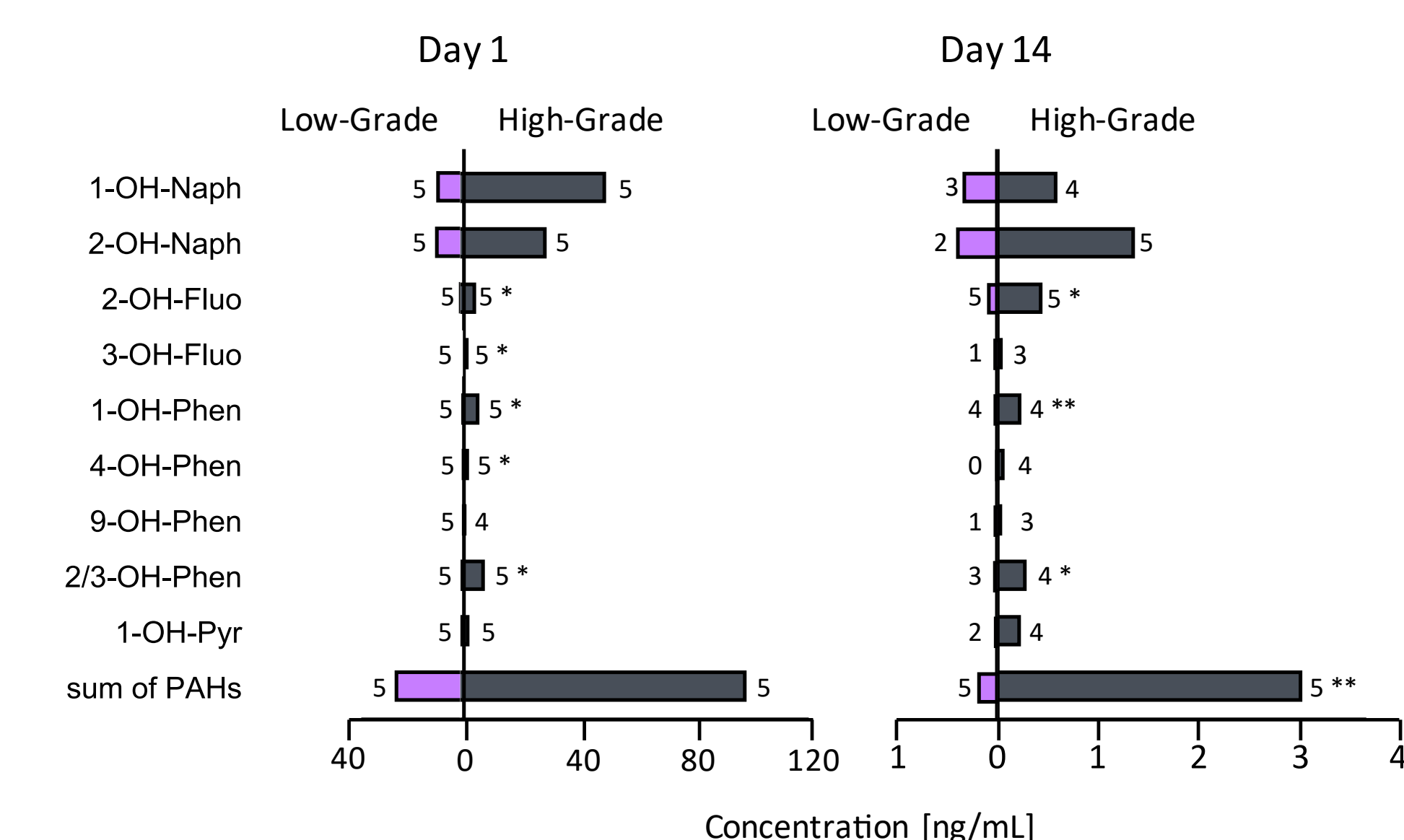
**Figure 1.** Kinetic graph for the sum of hydroxylated metabolites of polycyclic aromatic hydrocarbons (OH-PAHs) in the urine samples of ten patients with inhalation injury (INHI)

3 There is a strong positive correlation between some of the clinical markers and OH-PAHs in urine such as TBSA and ABSI score with OH-Fluo's, and AST/ALT ratio with OH-Phen's.



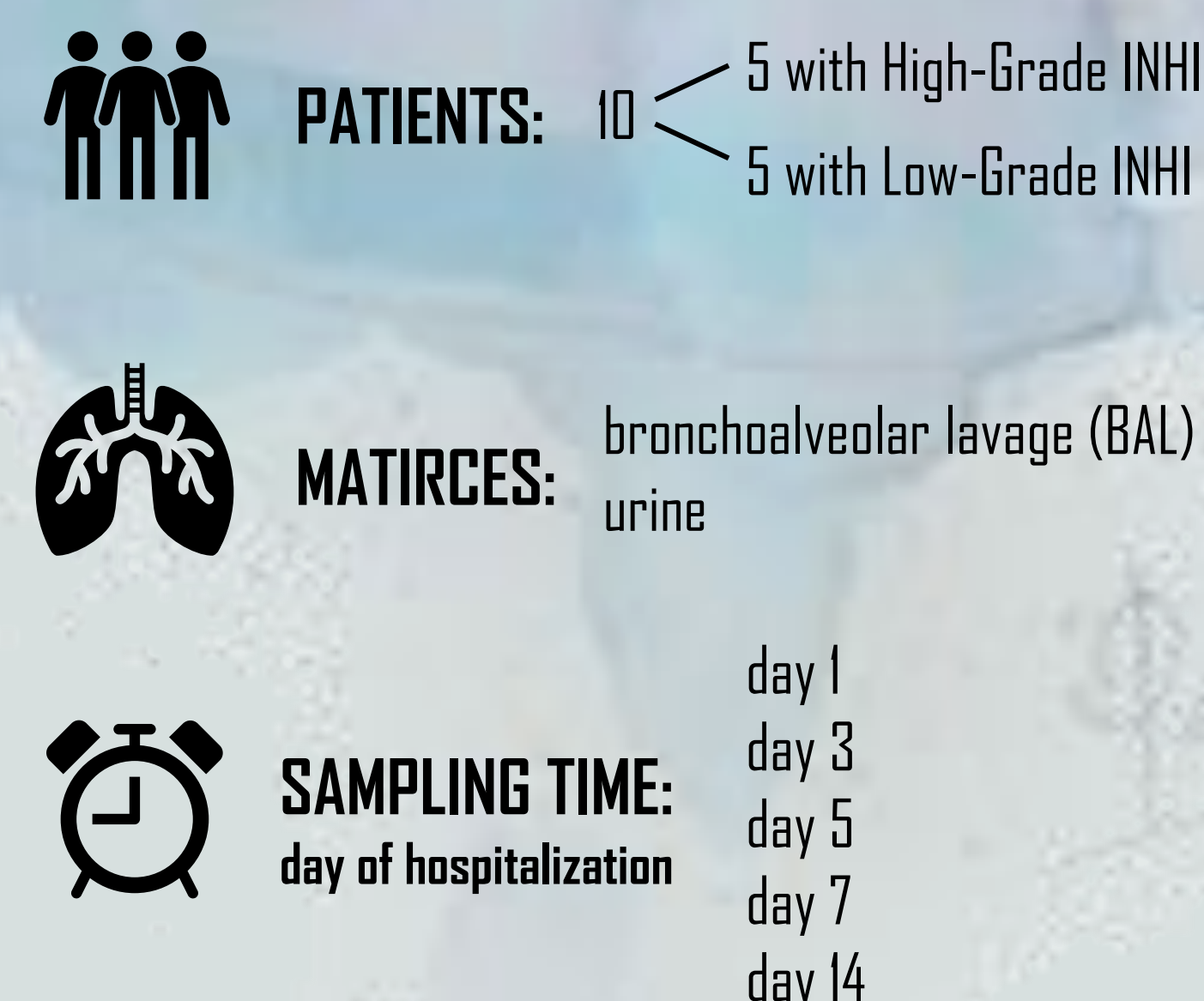
**Figure 2.** Correlation between clinical variables and urine concentrations of hydroxylated metabolites of polycyclic aromatic hydrocarbons (OH-PAHs) in patients with inhalation injury on Day 1 of hospitalization: \*\*\*p<0.001, \*\*p<0.01, \*p<0.05. Creatinine/S – creatinine in blood serum, Creatinine/U – creatinine in urine

4 High-Grade INHI was associated with higher presence of some OH-PAHs in urine, mainly with total concentration of OH-PAHs in day 14 of the hospitalization.

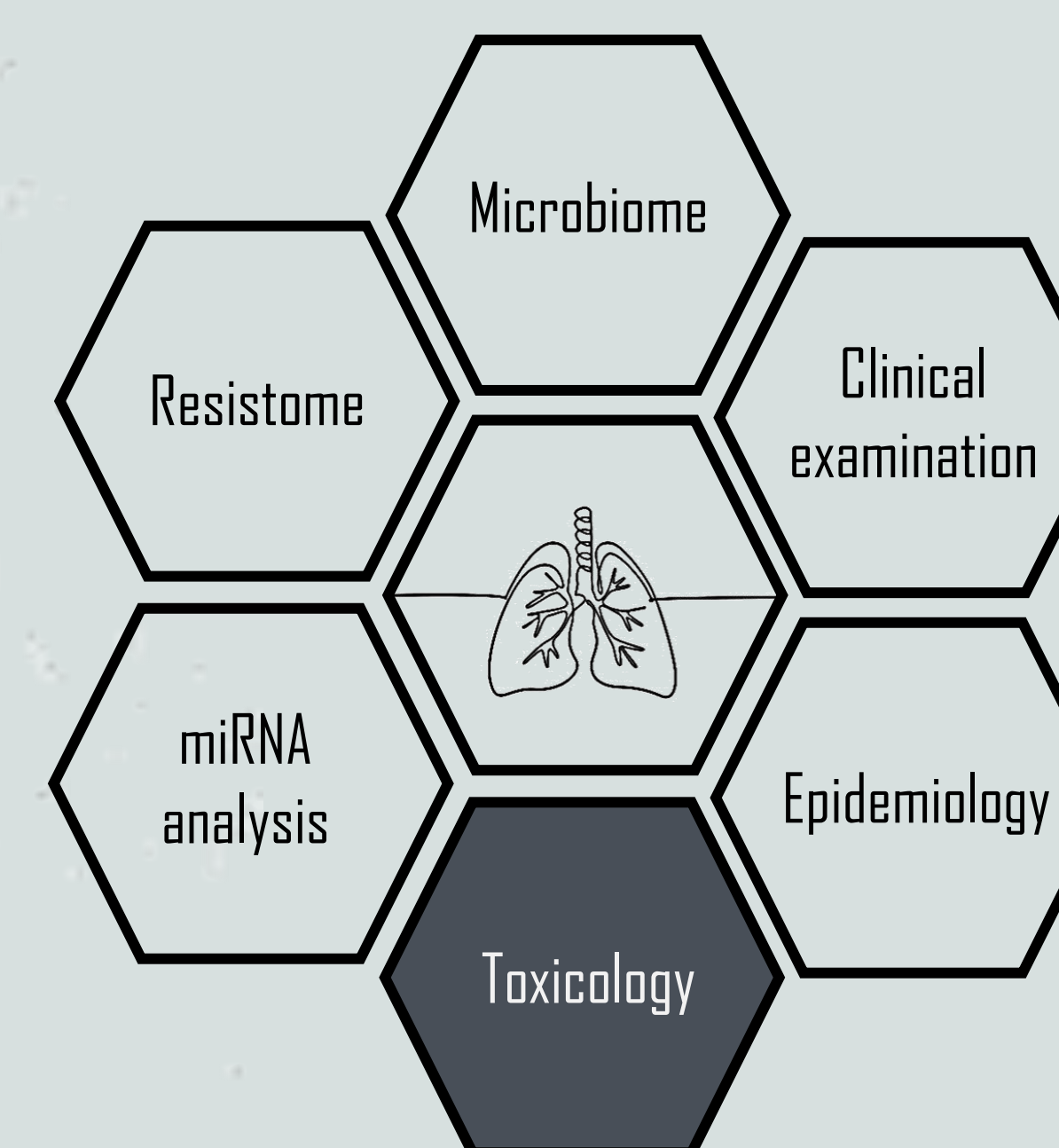


**Figure 3.** Differences in the hydroxylated metabolites of polycyclic aromatic hydrocarbons (OH-PAHs) in urine between the patient's groups with Low-Grade (< 3) and High-Grade (≥ 3) of inhalation injury (INHI) for day 1 and 14 of hospitalization (\*p<0.1, \*\*p<0.05); the number of included patients are shown next to the bar-plot

## DESIGN OF TOXICOLOGICAL PART



## INHI PROJECT



## CONCLUSIONS

- ❖ The OH-PAHs levels in urine can be measured reliably. In patients with INHI, OH-PAHs in urine were correlated with several clinical variables (AST/ALT, TBSA, ABSI).
- ❖ High-Grade INHI was associated with higher total concentrations of OH-PAHs in day 14 of the hospitalization.
- ❖ The results from BAL samples indicating that this matrix is not suitable for analysis of PAHs due to the concentration below the limit of quantification.

**IMPORTANT!**  
Sum of OH-PAHs in urine has a potential to serve as a prognostic marker in these patients.