

## **CLUE - TOOL FOR CLINICAL LABORATORY DATA UNDERSTANDING AND KNOWLEDGE EXTRACTION**



### **OVERVIEW**

**CLUE** (tool for Clinical Laboratory data Understanding and knowledge Extraction) is an advanced software tool for laboratory data analysis and knowledge extraction without the use of a-priori medical knowledge aiming at the improvement of laboratory and medical practices and the support of physicians in the generation of diagnoses. The tool exploits the availability of large medical datasets, deriving from the developments in the ICT framework that makes medical information more and more organised, allowing also the application of automatic data analysis tools.

**CLUE** can analyse medical data belonging to hundred thousands or millions of patients. This may improve both factors affecting clinical diagnosis of laboratory data because, on one side, they may enable continuous update of the standard medical thresholds through a much wider statistical basis and, on the other side, they may also help physicians interpreting the results and evaluating correlations among them, through advanced data mining algorithms.

**CLUE** may enhance significantly the quality of health services, improving the overall quality performance of the laboratory analyses and the reliability of the diagnoses, which, eventually, translates into economic benefits to the sanitary structure and to the patients. Indeed **CLUE** may help physicians diagnose the patient status in a more efficient way, avoiding useless and expensive laboratory tests and identifying more

quickly the correct pathology and possible treatment, increasing also patients' satisfaction.

### **FIELDS OF APPLICATION**

The analyses which can be performed using the **CLUE** software tool can be divided into two main groups:

- Statistical analysis;
- Patterns recognition.

Statistical analysis allows performing analyses aiming at updating the standard medical thresholds used in medical practice.

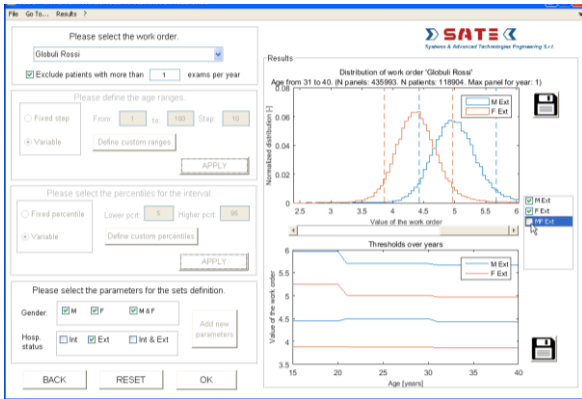
Patterns recognition aims at detecting meaningful groups of tests with no use of a priori knowledge and associating to them clinical diagnoses.

### **STATISTICAL ANALYSIS**

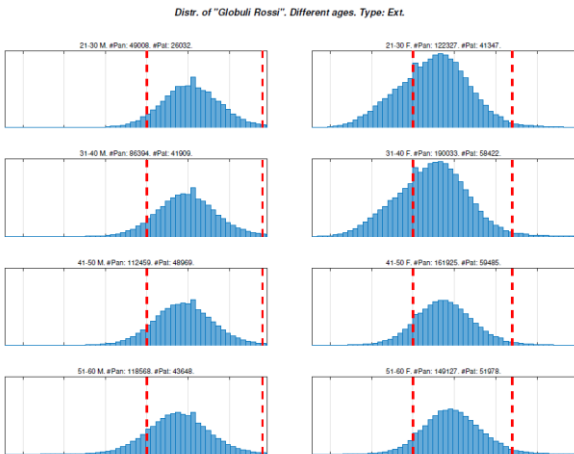
The analyses provided by **CLUE** allows the investigation of medical tests' distribution, in order to evaluate the suitability of the available medical thresholds used to determine if a test is "within the range" or "out of range". The statistical analyses provided by **CLUE** software tool allow to:

- Display the distributions of different subsets of the entire dataset (e.g. distinguishing between gender and hospitalization status), for customizable age ranges.
- Display the computed thresholds (customizable percentiles) for the customizable age ranges. This makes possible detecting if there are significant variations for different ages and subsets of patients.

- Saving the computed thresholds.
- Perform a correlation analysis in order to evaluate if two different tests are correlated between each other and analyse if the “anomalous” values (out of the thresholds) of one test are correlated to “anomalous” values also of the other one.
- Automatically compute the standard medical thresholds for several tests.



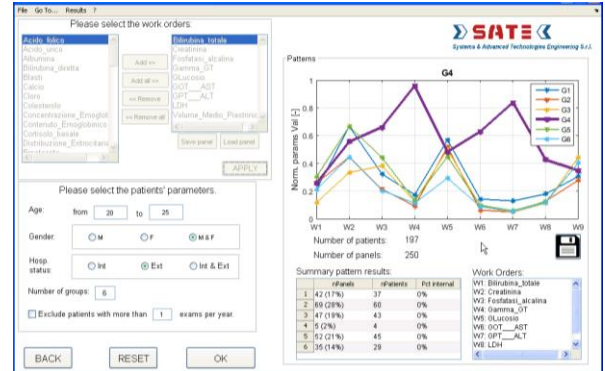
The use of **CLUE** software may enable a much better qualification and a continuous update of the standard thresholds than the broader statistical analysis used so far. This is in line with the emerging need of personalizing clinical pathways, because it enables tailoring the standard medical thresholds taking into account not only gender and age (as it is usually done in medical practice) but also a variety of factors e.g. geographic location, race, etc.



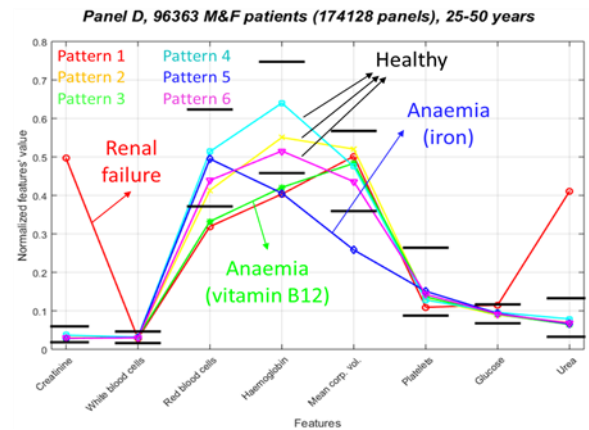
### PATTERN RECOGNITION

The pattern recognition allows applying data mining algorithms in order to extract knowledge from data without using a priori medical information. In particular **CLUE** identifies significant groups of patients (identified by

patterns) with similar medical conditions to which medical doctors could associate specific diagnoses.



These validated patterns can then be used for automatic diagnosis i.e. by associating a new set of measurements to one of the validated patterns to which a specific diagnosis can be associated. This may allow *automatizing* (i.e. improve the efficiency of) the interpretation of laboratory data generating suggested diagnoses based on the medical knowledge extracted, requiring little effort by physicians to configure the system. Moreover the adoption of **CLUE** may help *enhancing* laboratory data interpretation and pathology characterization by physicians, allowing also *sharing* the extracted medical knowledge among them.



Patents pending.

**CLUE** has been developed following a study carried out on behalf of ESA (European Space Agency) in collaboration with Azienda Unità Sanitaria Locale Modena (AUSL MO) - Dipartimento di Ingegneria Clinica. The view expressed herein can in no way be taken to reflect the official opinion of the European Space Agency.

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