MULTIMODAL MONITORING IN NEUROCRITICAL CARE

Submitted By: Shreya Gautam
sg3319

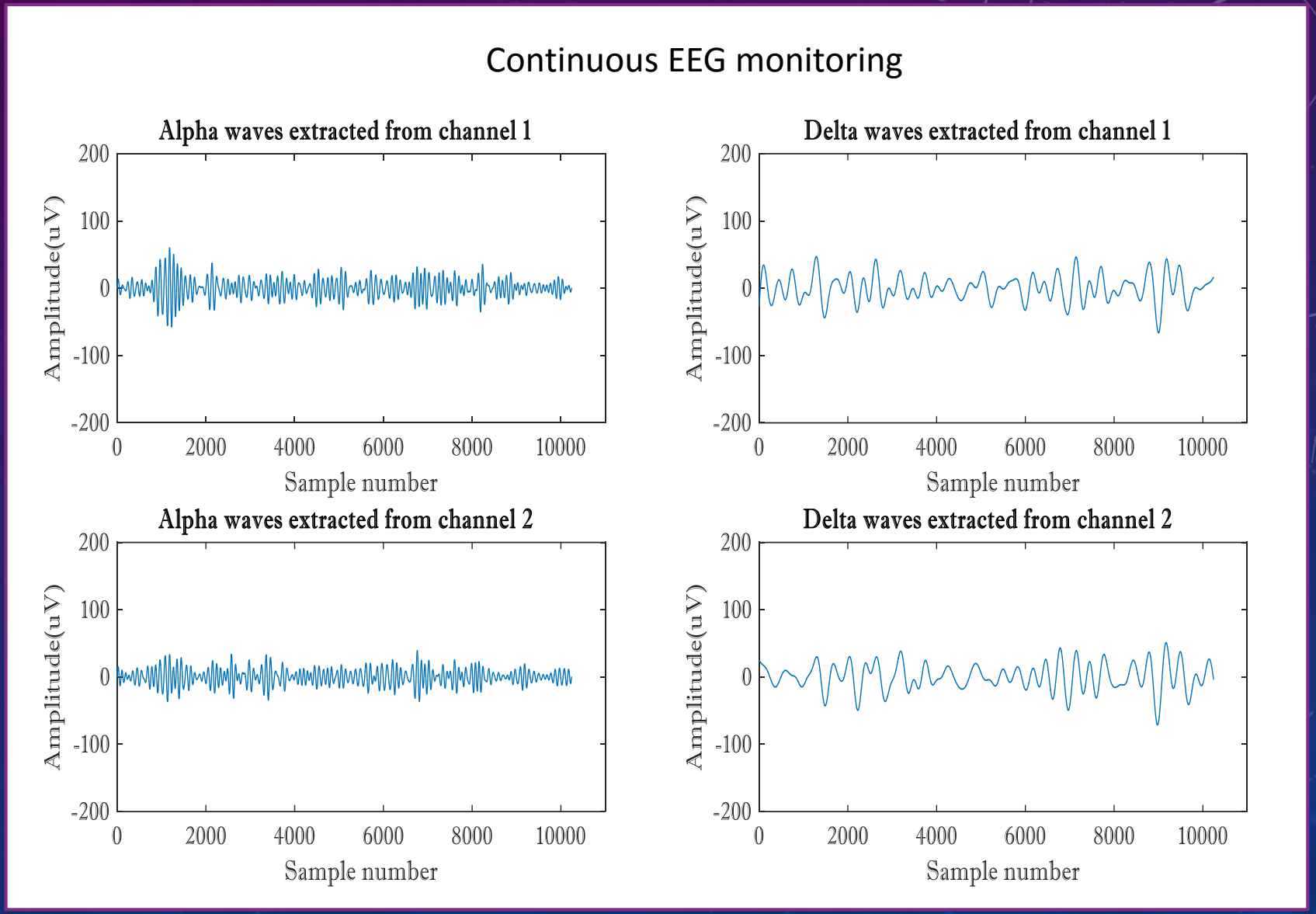
MOTIVATION

- Currently: Unimodal analysis of data
- Problem:
  - ❑ Several different machines
  - ❑ False alarms
  - ❑ Large time gap between consecutive monitoring tasks
- Proposal: Multimodal continuous monitoring
- Approach: Combine various datasets intelligently
- Aim: To predict secondary brain insults, brain ischemia

SIMULATION DATA

1) Continuous EEG signals: Taken from Bern-Barcelona EEG database.

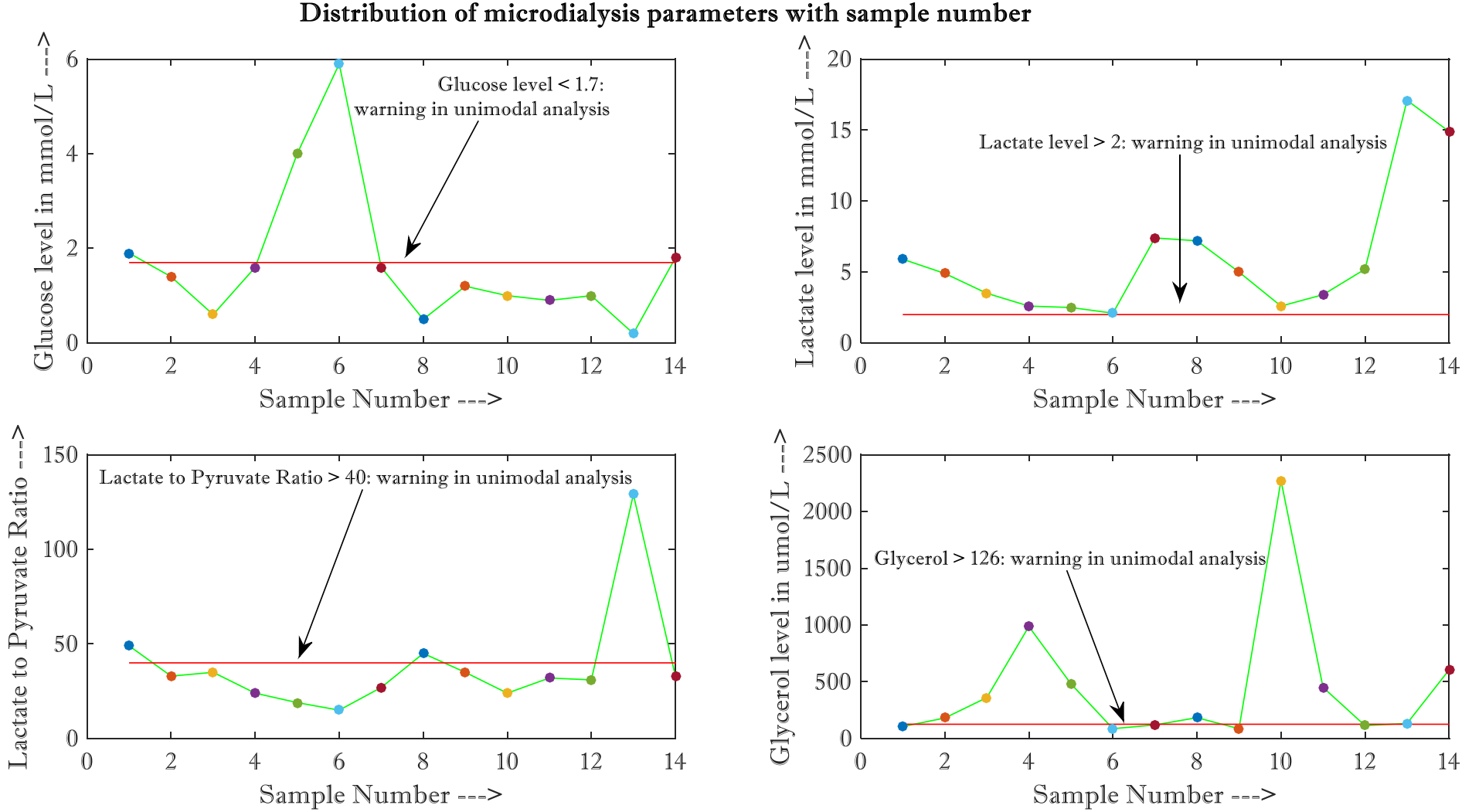
- ❑ Patients suffering from temporal lobe epilepsy.
- ❑ Sampling frequency: 1024 Hz.
- ❑ Number of samples: 10240.
- ❑ Parameters utilized (displaying for 1 patient):



SIMULATION DATA

2) Cerebral Microdialysis data:

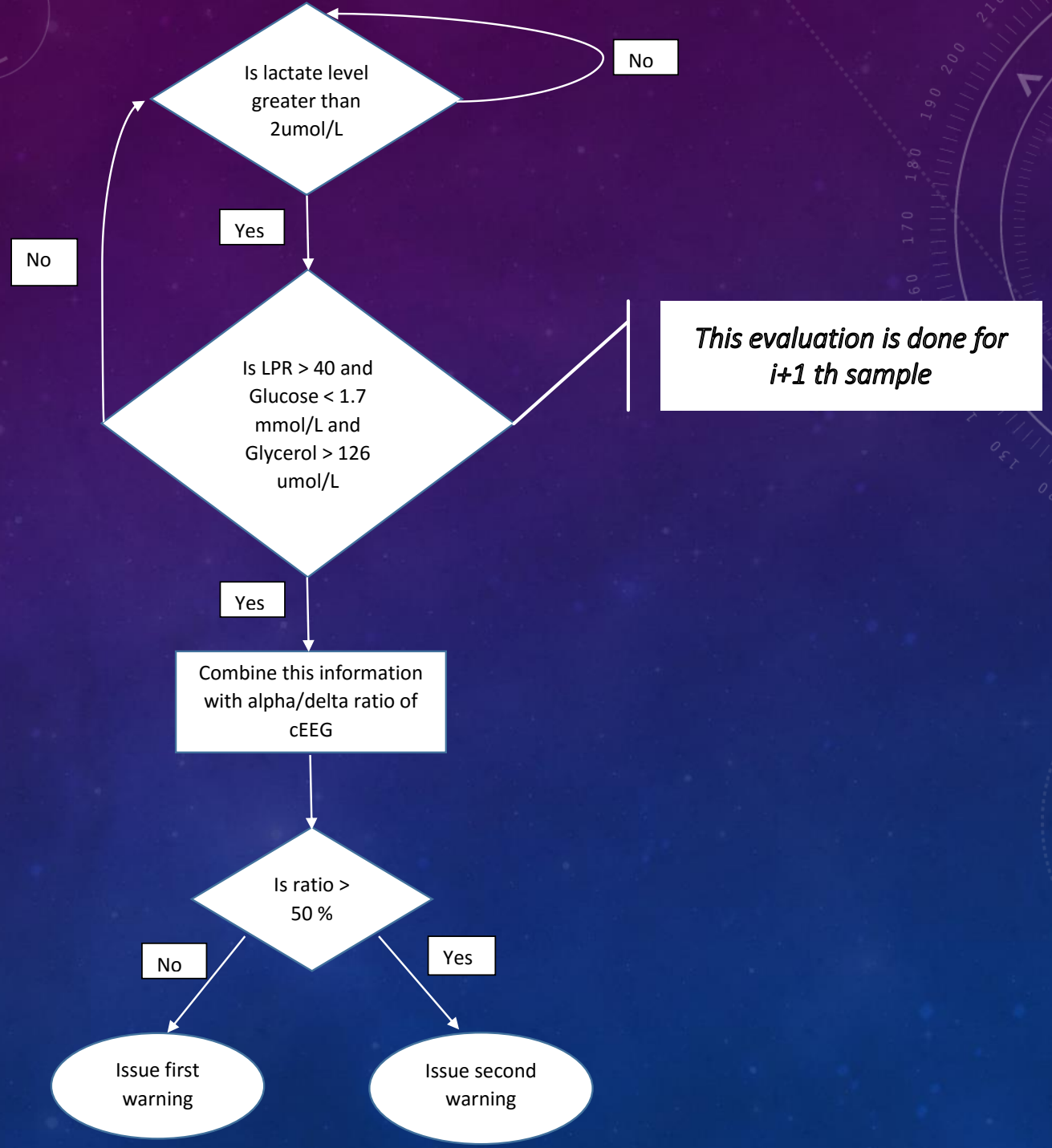
- 50 patients suffering from Traumatic Brain Injury (TBI).
- Sampling frequency: 0.1 Hz.
- Parameters utilized (displaying for 1 patient):



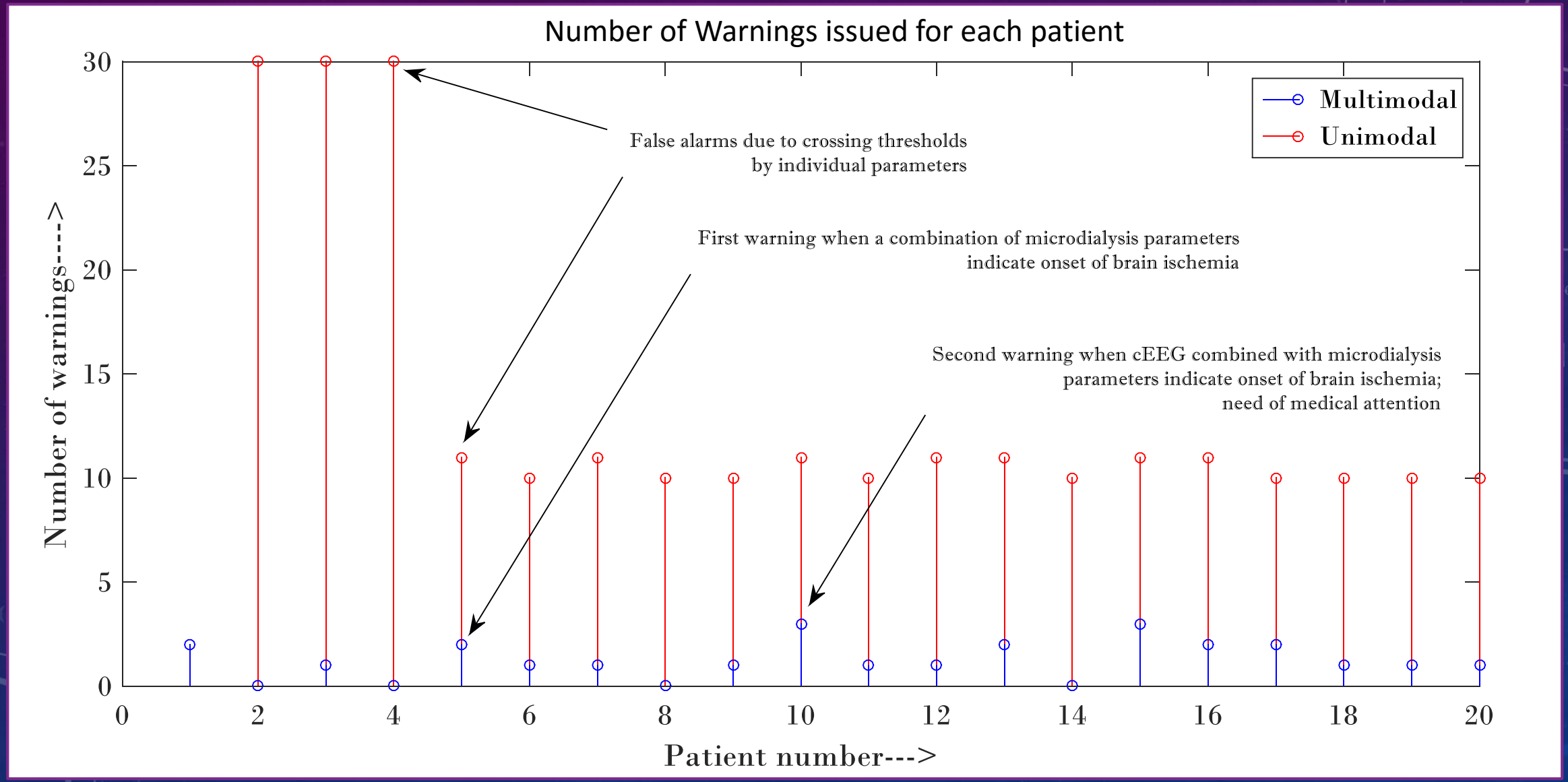
KEY FACTORS

- Sampling time of all data should be matched.
- Care should be taken such that different data are evaluated at the same time duration.
- Stationary and non-stationary datasets should be evaluated appropriately.
- Easier to remain in the time domain for stationary and non-stationary datasets.
- An inherent associated drawback would be that of time lag present among different machines or the variation in the time precision.

ALGORITHM


Is lactate level greater than 2umol/L
No
Yes
No
Is LPR > 40 and Glucose < 1.7 mmol/L and Glycerol > 126 umol/L
This evaluation is done for i+1 th sample
Yes
Combine this information with alpha/delta ratio of cEEG
Is ratio > 50 %
No
Yes
Issue first warning
Issue second warning

RESULTS


Number of Warnings issued for each patient
Multimodal
Unimodal
False alarms due to crossing thresholds
by individual parameters
First warning when a combination of microdialysis parameters
indicate onset of brain ischemia
Second warning when cEEG combined with microdialysis
parameters indicate onset of brain ischemia;
need of medical attention
Number of warnings--->
Patient number--->
0
5
10
15
20
25
30
0
2
4
6
8
10
12
14
16
18
20

REFERENCES

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[4] R.G. Andrzejak, K. Schindler, and C. Rummel, "Nonrandomness, nonlinear dependence, and nonstationarity of electroencephalographic recordings from epilepsy patients," Phys. Rev. E, vol. 86, 046206, 2012.

[5] Claassen, Jan, et al. "Quantitative continuous EEG for detecting delayed cerebral ischemia in patients with poor-grade subarachnoid hemorrhage."*Clinical neurophysiology* 115.12 (2004): 2699-2710.