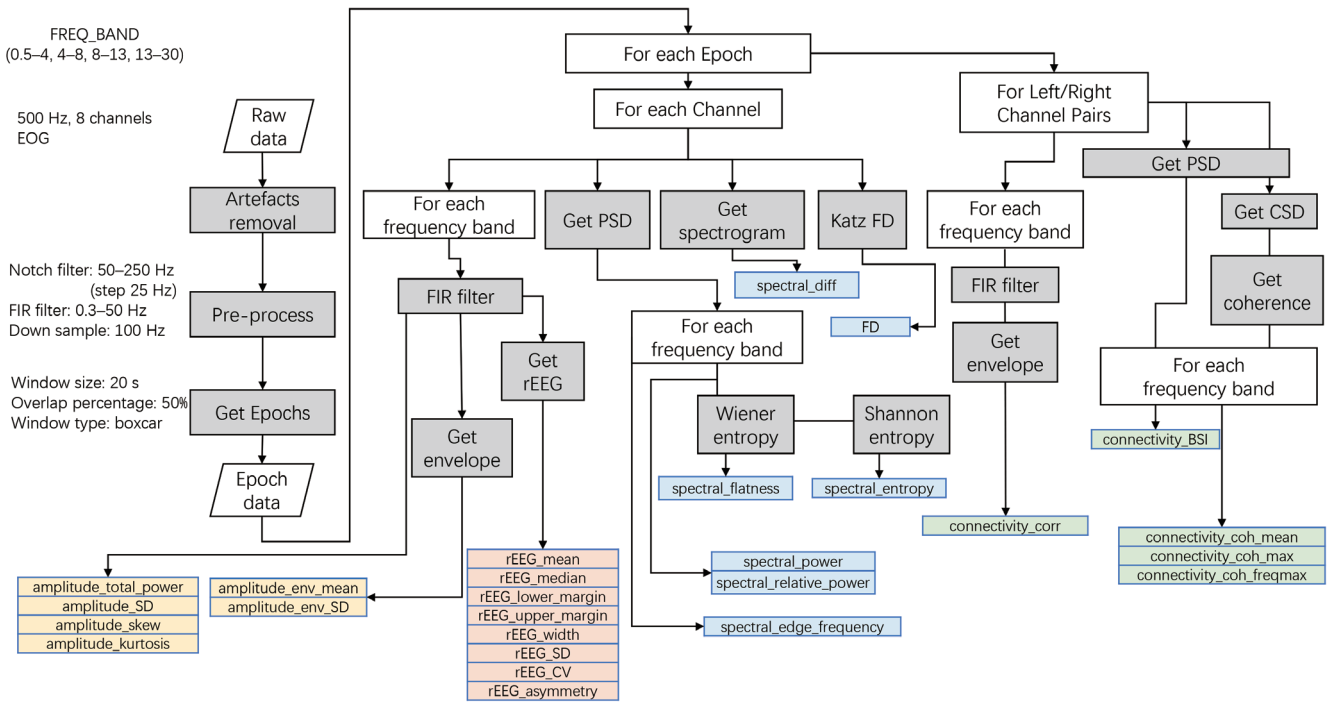


**Figure S1** Flowchart of the EEG signal feature extraction procedure for Auto-Neo-EEG. The boxes in yellow, orange, blue and green represent features related to amplitude, rEEG, spectral density and connectivity, respectively. EEG, electroencephalography; FIR, finite-impulse response; PSD, power spectral density; FD, fractal dimension; CSD, cross-PSD; rEEG, range EEG.


https://dx.doi.org/10.21037/atm-21-1564

**Table S1** Thirty findings for each EEG recording clinical report

| Finding class | General description for the findings |
|---|---|
| Sleep-wake cycling | Abnormal sleep-wake cycling |
| | Sleep cycling can be divided into AS and QS period |
| | Sleep cycling cannot be divided into AS and QS state |
| Background | Tracé discontinu pattern in sleep state |
| | Tracé alternant pattern in sleep state |
| | Continuous pattern in sleep state |
| | Tracé discontinu pattern in awake state |
| | Tracé alternant pattern in awake state |
| | Continuous pattern in awake state |
| | Burst suppression |
| | Abnormal symmetry and synchrony |
| | Hemisphere asymmetry/asynchronous ≤50% |
| | Hemisphere asymmetry/asynchronous >50% |
| | Borderline low voltage |
| | Abnormally low voltage |
| | Dysmaturity |
| Seizures | No obvious discharge |
| | Seizure |
| Waves | Spike waves rhythmic discharges |
| | Sharp waves rhythmic discharges |
| | Low amplitude fast wave rhythmic discharges |
| | Sleep state sharp wave |
| | Sleep state sharp-slow wave complex |
| | Sleep state spike wave |
| | Sleep state spike-slow wave complex |
| | Awake state abnormal wave |
| | Awake state sharp wave |
| | Awake state sharp-slow wave complex |
| | Awake state spike wave |
| | Awake state spike-slow wave complex |

EEG, electroencephalography; AS, active sleep; QS, quiet sleep.


https://dx.doi.org/10.21037/atm-21-1564

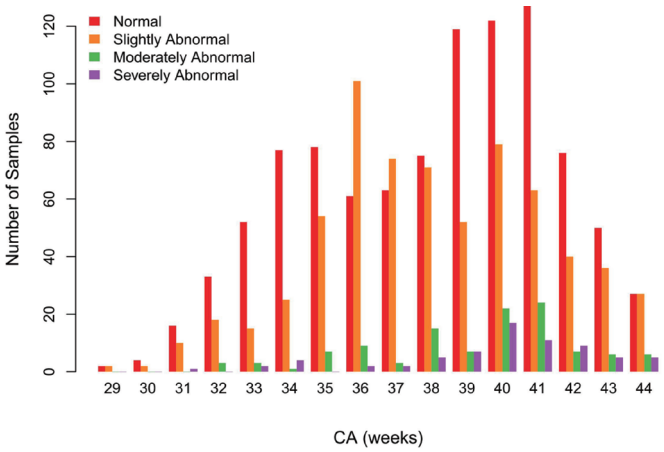


**Figure S2** Detailed CA distribution for all samples in the neonatal EEG dataset. Sample numbers in each CA week are divided into four groups according to the EEG report conclusion label. EEG, electroencephalography; CA, conceptional age.

**Table S2** Relationship between clinical systems and EEG report conclusion

| Disease Classification | Normal (N=992) | Slightly abnormal (N=674) | Moderately abnormal (N=115) | Severely abnormal (N=70) |
|---|---|---|---|---|
| HIE | 71 (50%, OR =0.93, P=0.7) | 40 (28%, OR =0.77, P=0.2) | 19 (13%, OR =2.2, P=0.006) | 12 (8%, OR =2.2, P=0.02) |
| Cardiopulmonary disease | 62 (56%, OR =1, P=0.8) | 44 (40%, OR =1.1, P=0.6) | 5 (5%, OR =0.73, P=0.7) | 0 (0%, OR =0, P=0.03) |
| Central nervous system infection | 43 (41%, OR =0.76, P=0.1) | 41 (39%, OR =1.1, P=0.8) | 13 (12%, OR =2, P=0.05) | 9 (8%, OR =2.2, P=0.04) |
| Intracranial hemorrhage | 81 (63%, OR =1.2, P=0.3) | 32 (25%, OR =0.68, P=0.06) | 11 (9%, OR =1.4, P=0.4) | 5 (4%, OR =1, P=0.8) |
| Congenial metabolic disease | 7 (24%, OR =0.45, P=0.05) | 11 (38%, OR =1, P=0.9) | 3 (10%, OR =1.7, P=0.4) | 8 (28%, OR =7.3, P=7e-05) |
| Temporary metabolic disorder | 131 (72%, OR =1.3, P=0.02) | 44 (24%, OR =0.66, P=0.02) | 5 (3%, OR =0.44, P=0.09) | 2 (1%, OR =0.29, P=0.09) |
| Perinatal stroke | 5 (38%, OR =0.72, P=0.6) | 6 (46%, OR =1.3, P=0.6) | 1 (8%, OR =1.2, P=0.6) | 1 (8%, OR =2, P=0.4) |
| Premature | 482 (53%, OR =0.99, P=0.9) | 372 (41%, OR =1.1, P=0.1) | 35 (4%, OR =0.62, P=0.02) | 22 (2%, OR =0.64, P=0.07) |
| Genetic factors/syndrome | 32 (50%, OR =0.93, P=0.8) | 21 (33%, OR =0.9, P=0.8) | 8 (12%, OR =2, P=0.08) | 3 (5%, OR =1.2, P=0.7) |
| Unexplained convulsions | 31 (35%, OR =0.65, P=0.05) | 38 (43%, OR =1.2, P=0.4) | 14 (16%, OR =2.5, P=0.005) | 6 (7%, OR =1.8, P=0.2) |
| Other | 47 (63%, OR =1.2, P=0.4) | 25 (33%, OR =0.92, P=0.8) | 1 (1%, OR =0.21, P=0.1) | 2 (3%, OR =0.71, P=1) |

Each box contains the number of patients, percentage of patients in this clinical system, OR compared to background and P value (P) by Fisher's exact test. EEG, electroencephalography; HIE, hypoxic ischemic encephalopathy; OR, odds ratio.


https://dx.doi.org/10.21037/atm-21-1564

**Table S3** Interrater agreement for report conclusion between two experts for 96 EEG recording subjects

| Patient | CA | Gender | Outcome by expert 1 | Outcome by expert 2 |
|---|---|---|---|---|
| 1 | 42+4 | Male | Severely abnormal | Severely abnormal |
| 2 | 40+3 | Male | Normal | Normal |
| 3 | 34+2 | Male | Slightly abnormal | Slightly abnormal |
| 4 | 43+4 | Female | Severely abnormal | Severely abnormal |
| 5* | 41+3 | Male | Severely abnormal | Moderately abnormal |
| 6 | 39+6 | Male | Normal | Normal |
| 7 | 40+2 | Male | Normal | Normal |
| 8* | 39+1 | Female | Slightly abnormal | Normal |
| 9 | 41+5 | Female | Slightly abnormal | Slightly abnormal |
| 10 | 35+2 | Male | Moderately abnormal | Moderately abnormal |
| 11 | 41+6 | Male | Normal | Normal |
| 12 | 40 | Male | Normal | Normal |
| 13 | 44+4 | Male | Moderately abnormal | Moderately abnormal |
| 14 | 40+1 | Female | Moderately abnormal | Moderately abnormal |
| 15 | 42 | Female | Moderately abnormal | Moderately abnormal |
| 16 | 41 | Female | Severely abnormal | Severely abnormal |
| 17 | 39+5 | Female | Severely abnormal | Severely abnormal |
| 18 | 39 | Male | Normal | Normal |
| 19 | 40+4 | Male | Normal | Normal |
| 20 | 37+3 | Female | Slightly abnormal | Slightly abnormal |
| 21 | 37+2 | Male | Moderately abnormal | Moderately abnormal |
| 22 | 41+5 | Male | Normal | Normal |
| 23 | 41+1 | Female | Normal | Normal |
| 24 | 44 | Male | Severely abnormal | Severely abnormal |
| 25 | 34+3 | Male | Normal | Normal |
| 26 | 41+1 | Male | Normal | Normal |
| 27 | 42+5 | Female | Slightly abnormal | Slightly abnormal |
| 28 | 40+5 | Male | Normal | Normal |
| 29 | 34+4 | Female | Normal | Normal |
| 30 | 37+3 | Female | Normal | Normal |
| 31 | 33+2 | Female | Normal | Normal |
| 32 | 38+4 | Female | Slightly abnormal | Slightly abnormal |
| 33 | 36+2 | Female | Slightly abnormal | Slightly abnormal |
| 34 | 35+2 | Male | Normal | Normal |
| 35 | 37 | Male | Slightly abnormal | Slightly abnormal |
| 36 | 39 | Male | Normal | Normal |
| 37 | 34+3 | Male | Normal | Normal |
| 38 | 39+6 | Female | Slightly abnormal | Slightly abnormal |
| 39 | 41+1 | Male | Slightly abnormal | Slightly abnormal |
| 40 | 36+3 | Female | Normal | Normal |
| 41 | 41+3 | Male | Normal | Normal |
| 42 | 35+3 | Female | Normal | Normal |
| 43 | 38+2 | Female | Slightly abnormal | Slightly abnormal |
| 44 | 32+1 | Male | Normal | Normal |
| 45 | 33+4 | Female | Slightly abnormal | Slightly abnormal |
| 46 | 42+1 | Male | Normal | Normal |
| 47 | 39 | Male | Normal | Normal |
| 48* | 37+5 | Female | Slightly abnormal | Normal |
| 49 | 32+3 | Male | Slightly abnormal | Slightly abnormal |
| 50 | 39 | Female | Slightly abnormal | Slightly abnormal |
| 51 | 31+4 | Male | Slightly abnormal | Slightly abnormal |
| 52 | 34+5 | Male | Slightly abnormal | Slightly abnormal |
| 53 | 37+2 | Female | Slightly abnormal | Slightly abnormal |
| 54 | 38+1 | Female | Slightly abnormal | Slightly abnormal |
| 55 | 38+3 | Male | Moderately abnormal | Moderately abnormal |
| 56 | 33+3 | Female | Slightly abnormal | Slightly abnormal |
| 57 | 35+3 | Male | Moderately abnormal | Moderately abnormal |
| 58* | 37+3 | Female | Normal | Slightly abnormal |
| 59 | 35+1 | Male | Normal | Normal |
| 60 | 34+3 | Male | Normal | Normal |
| 61 | 36+5 | Male | Normal | Normal |
| 62 | 39+6 | Male | Normal | Normal |
| 63* | 36+4 | Male | Normal | Slightly abnormal |
| 64 | 37+6 | Male | Normal | Normal |
| 65 | 34+4 | Male | Normal | Normal |
| 66* | 40+1 | Male | Slightly abnormal | Moderately abnormal |
| 67 | 41+3 | Male | Normal | Normal |
| 68 | 33+1 | Male | Slightly abnormal | Slightly abnormal |
| 69 | 38+4 | Male | Normal | Normal |
| 70 | 39+1 | Female | Slightly abnormal | Slightly abnormal |
| 71 | 33+6 | Male | Normal | Normal |
| 72 | 35+2 | Female | Normal | Normal |
| 73 | 42+1 | Female | Moderately abnormal | Moderately abnormal |
| 74 | 41+4 | Male | Normal | Normal |
| 75 | 34+6 | Female | Normal | Normal |
| 76 | 35 | Male | Normal | Normal |
| 77 | 40+6 | Female | Moderately abnormal | Moderately abnormal |
| 78 | 43+4 | Male | Moderately abnormal | Moderately abnormal |
| 79 | 40+3 | Male | Severely abnormal | Severely abnormal |
| 80 | 40+2 | Male | Severely abnormal | Severely abnormal |
| 81 | 39+5 | Female | Moderately abnormal | Moderately abnormal |
| 82 | 39+6 | Male | Severely abnormal | Severely abnormal |
| 83 | 40+1 | Male | Moderately abnormal | Moderately abnormal |
| 84 | 41+4 | Male | Severely abnormal | Severely abnormal |
| 85 | 40+3 | Female | Severely abnormal | Severely abnormal |
| 86 | 35+5 | Male | Severely abnormal | Severely abnormal |
| 87 | 42+2 | Male | Moderately abnormal | Moderately abnormal |
| 88 | 38+1 | Female | Moderately abnormal | Moderately abnormal |
| 89 | 40+1 | Male | Moderately abnormal | Moderately abnormal |
| 90 | 40+2 | Female | Moderately abnormal | Moderately abnormal |
| 91 | 39+2 | Female | Severely abnormal | Severely abnormal |
| 92* | 40+1 | Male | Moderately abnormal | Severely abnormal |
| 93* | 38+3 | Female | Moderately abnormal | Severely abnormal |
| 94 | 41+5 | Male | Severely abnormal | Severely abnormal |
| 95 | 43+2 | Male | Severely abnormal | Severely abnormal |
| 96* | 40+4 | Male | Moderately abnormal | Slightly abnormal |

*, subjects inconsistent for report conclusion level between two experts. EEG, electroencephalography.


https://dx.doi.org/10.21037/atm-21-1564

**Table S4** The performance of Auto-Neo-EEG in predicting report conclusions by absolute CA difference

| Strategy | Dataset | Predicted label | Original label | | | | TP | TN | FP | FN | Sensitivity | Specificity | Accuracy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Normal | Slightly abnormal | Moderately abnormal | Severely abnormal | | | | | | | |
| Predicted by absolute CA difference | Model-developing dataset | Normal (0, 2.9] | 352 | 129 | 19 | 5 | 352 | 593 | 153 | 493 | 41.66% | 79.49% | 59.4% |
| | | Slightly abnormal (2.9, 7.6] | 321 | 177 | 16 | 12 | 177 | 658 | 349 | 407 | 30.31% | 65.34% | 52.48% |
| | | Moderately abnormal (7.6, 14.5] | 152 | 172 | 27 | 8 | 27 | 1161 | 332 | 71 | 27.55% | 77.76% | 74.67% |
| | | Severely abnormal (14.5, Inf] | 20 | 106 | 36 | 39 | 39 | 1365 | 162 | 25 | 60.94% | 89.39% | 88.25% |
| | Validation dataset | Normal (0, 2.9] | 42 | 21 | 2 | 1 | 42 | 89 | 24 | 105 | 28.57% | 78.76% | 50.38% |
| | | Slightly abnormal (2.9, 7.6] | 51 | 25 | 2 | 0 | 25 | 117 | 53 | 65 | 27.78% | 68.82% | 54.62% |
| | | Moderately abnormal (7.6, 14.5] | 35 | 25 | 5 | 1 | 5 | 182 | 61 | 12 | 29.41% | 74.9% | 71.92% |
| | | Severely abnormal (14.5, Inf] | 19 | 19 | 8 | 4 | 4 | 208 | 46 | 2 | 66.67% | 81.89% | 81.54% |

EEG, electroencephalography; CA, conceptional age; TP, true positive, TN, true negative, FP, false positive, FN, false negative.


https://dx.doi.org/10.21037/atm-21-1564

**Table S5** The performance of Auto-Neo-EEG in predicting report conclusions in each pair-wise comparison

| Prediction strategy | Dataset | Prediction Label | Original label | | | | Sensitivity | Specificity | Accuracy | AUC (95% CI) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Normal | Slightly abnormal | Moderately abnormal | Severely abnormal | | | | |
| Severely abnormal *vs.* others | Model-developing dataset | F | 1,507 | | | 0 | 100% | 98.69% | 98.74% | 1.000 (0.999–1.000) |
| | | T | 20 | | | 64 | | | | |
| | Validation dataset | F | 244 | | | 0 | 100% | 96.06% | 96.15% | 0.984 (0.970–0.999) |
| | | T | 10 | | | 6 | | | | |
| Moderately abnormal *vs.* slightly abnormal + normal | Model-developing dataset | F | 1,245 | | 14 | – | 85.71% | 87.12% | 87.03% | 0.919 (0.885–0.955) |
| | | T | 184 | | 84 | – | | | | |
| | Validation dataset | F | 210 | | 6 | – | 64.71% | 88.61% | 87.01% | 0.857 (0.741–0.973) |
| | | T | 27 | | 11 | – | | | | |
| Slightly abnormal *vs.* normal | Model-developing dataset | F | 692 | 221 | – | – | 62.16% | 81.89% | 73.83% | 0.784 (0.759–0.808) |
| | | T | 153 | 363 | – | – | | | | |
| | Validation dataset | F | 107 | 48 | – | – | 46.67% | 72.79% | 62.87% | 0.647 (0.576–0.718) |
| | | T | 40 | 42 | – | – | | | | |
| Abnormal *vs.* normal | Model-developing dataset | F | 728 | | 160 | | 78.55% | 86.15% | 82.59% | 0.906 (0.892-0.921) |
| | | T | 117 | | 586 | | | | | |
| | Validation dataset | F | 109 | | 45 | | 60.18% | 74.15% | 68.08% | 0.713 (0.648-0.777) |
| | | T | 38 | | 68 | | | | | |
| Total number | Model-developing dataset | | 845 | 584 | 98 | 64 | – | – | – | – |
| | Validation dataset | | 147 | 90 | 17 | 6 | – | – | – | – |

EEG, electroencephalography; AUC, area under the curve; CI, confidence interval; T, true, F, false.


https://dx.doi.org/10.21037/atm-21-1564