Supporting information

**S3 Algorithm:** Two level rule-based algorithm to analyse environmental data and extract night-time sleep pattern

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**Raw sleep data**

```
\[ o_i > 3 \text{m} \]
```

**invalid** \( o_i \); merge with previous block

```Y```

**Sleep onset**

```
\[ \hat{\tau}_{ii} > 25 \text{m} \]
```

**bed entry**

```
\[ \hat{\tau}_{ii} > 10 \text{m} \]
```

**sleep offset**

```
\[ \hat{\tau}_{ii} > 30 \text{m} \]
```

**Processed data**

```
\[ X \]
```

**state = invalid** \( \phi_i \); invalid state transition

**Processed data**

```
\[ X \]
```

**Good sleep**

```
\[ \hat{\tau}_{ii} > 45 \text{m} \]
```

**Moderate sleep**

```
\[ 25 < \hat{\tau}_{ii} < 45 \text{m} \]
```

**Restless sleep**

**Decide based on previous and posterior stage**

**Wandering**

**Unknown**

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