# **Sleep Analysis Guide: Interpreting Wearable Device Data for Clinical Insights**

## **1. Core Sleep Metrics & Clinical Significance**

### **Sleep Duration Patterns**

* **Total Sleep Time (TST)**
  + Normal range: 7-9 hours for adults

Clinical significance:  
   
< 6 hours: Potential chronic sleep deprivation

> 9 hours: May indicate depression or underlying health issues

* + Irregular patterns: Circadian rhythm disruption
  + Action triggers:
    - Consistent <6 hours: Sleep hygiene intervention
    - Irregular patterns: Lifestyle assessment
    - Sudden changes: Medical evaluation

### **Sleep Architecture**

* **Deep Sleep Percentage**
  + Optimal range: 15-23% of TST

Clinical indicators:  
   
Low deep sleep (<10%):

- Potential sleep disorders

- Chronic stress

- Poor recovery

- Aging-related changes

High deep sleep (>25%):

- Recovery from sleep debt

- Physical exhaustion

* + - Recent exercise adaptation
* **REM Sleep Percentage**
  + Target range: 20-25% of TST

Key patterns:  
   
Reduced REM:

- Alcohol consumption

- Certain medications

- Stress/anxiety

Excessive REM:

- Depression

- REM rebound

* + - Irregular sleep schedule

## **2. Physiological Markers**

### **Heart Rate Dynamics**

* **Nighttime Heart Rate**
  + Normal pattern:
    - 10-15 bpm drop from daytime average
    - Lowest during deep sleep

Clinical red flags:  
   
- Elevated nighttime HR (>10% above baseline)

- Minimal day-night variation

* + - Irregular HR patterns during sleep

### **Heart Rate Variability (HRV)**

* **Nocturnal HRV Patterns**
  + Optimal trend:
    - Higher during deep sleep
    - Gradual increase through night

Interpretation guide:  
   
Low HRV indicators:

- Overtraining

- Poor recovery

- Stress load

- Illness onset

High HRV indicators:

- Good recovery

- Stress resilience

* + - Adaptive capacity

## **3. Sleep Quality Indicators**

### **Sleep Continuity**

* **Wake After Sleep Onset (WASO)**
  + Normal range: <30 minutes

Clinical assessment:  
   
WASO > 45 minutes:

- Sleep maintenance insomnia

- Environmental disturbances

- Medical conditions (pain, nocturia)

Pattern Analysis:

- Timing of awakenings

- Duration patterns

* + - Frequency per night

### **Sleep Efficiency**

* **Calculation & Interpretation**
  + Target: >85%

Clinical significance:  
   
<80% Efficiency:

- Poor sleep quality

- Potential sleep disorders

- Lifestyle factors

Trending Changes:

- Gradual decline: Chronic issues

* + - Sudden drops: Acute stressors

## **4. Advanced Pattern Recognition**

### **Sleep Onset Patterns**

* **Sleep Latency Analysis**
  + Optimal range: 10-20 minutes

Clinical insights:  
   
<5 minutes: Sleep deprivation

>30 minutes: Insomnia tendency

* + Variable patterns: Circadian disruption

### **Movement Patterns**

* **Restlessness Indicators**
  + Normal range: <15 movements/hour

Warning signs:  
   
Excessive movement:

- Potential RLS

- Sleep apnea

- Pain conditions

Pattern clusters:

- Time-based analysis

* + - Correlation with sleep stages

## **5. Clinical Decision Support**

### **Intervention Triggers**

**Primary Indicators**   
Immediate Attention:

- Sleep efficiency <70% for >1 week

- Deep sleep <10% for >2 weeks

- HRV declining trend >30%

- Consistent sleep latency >45 min

Monitoring Required:

- TST variation >2 hours

- WASO increasing trend

* - Irregular sleep timing

### **Pattern-Based Recommendations**

**Clinical Response Guide**   
Sleep Maintenance Issues:

- Sleep restriction therapy

- Environment optimization

- Stress management

Circadian Disruption:

- Light therapy

- Schedule adjustment

- Meal timing modification

Recovery Optimization:

- Exercise timing adjustment

- Stress management

* - Nutrition planning

## **6. Data Integration Principles**

### **Contextual Factors**

**Essential Considerations**   
Environmental:

- Room temperature

- Light exposure

- Noise levels

Behavioral:

- Exercise timing

- Meal patterns

- Work schedule

Physiological:

- Stress levels

- Physical activity

* - Health conditions

### **Long-term Trending**

**Pattern Analysis Framework**   
Weekly Trends:

- Sleep timing consistency

- Deep sleep patterns

- Recovery metrics

Monthly Analysis:

- Chronic stress indicators

- Adaptation patterns

* - Lifestyle impact