Understanding Risk Factors of Fatigue and Sleep in Wildland Firefighters

Andrew Jeklin, MSc. Candidate

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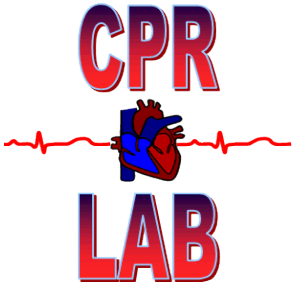
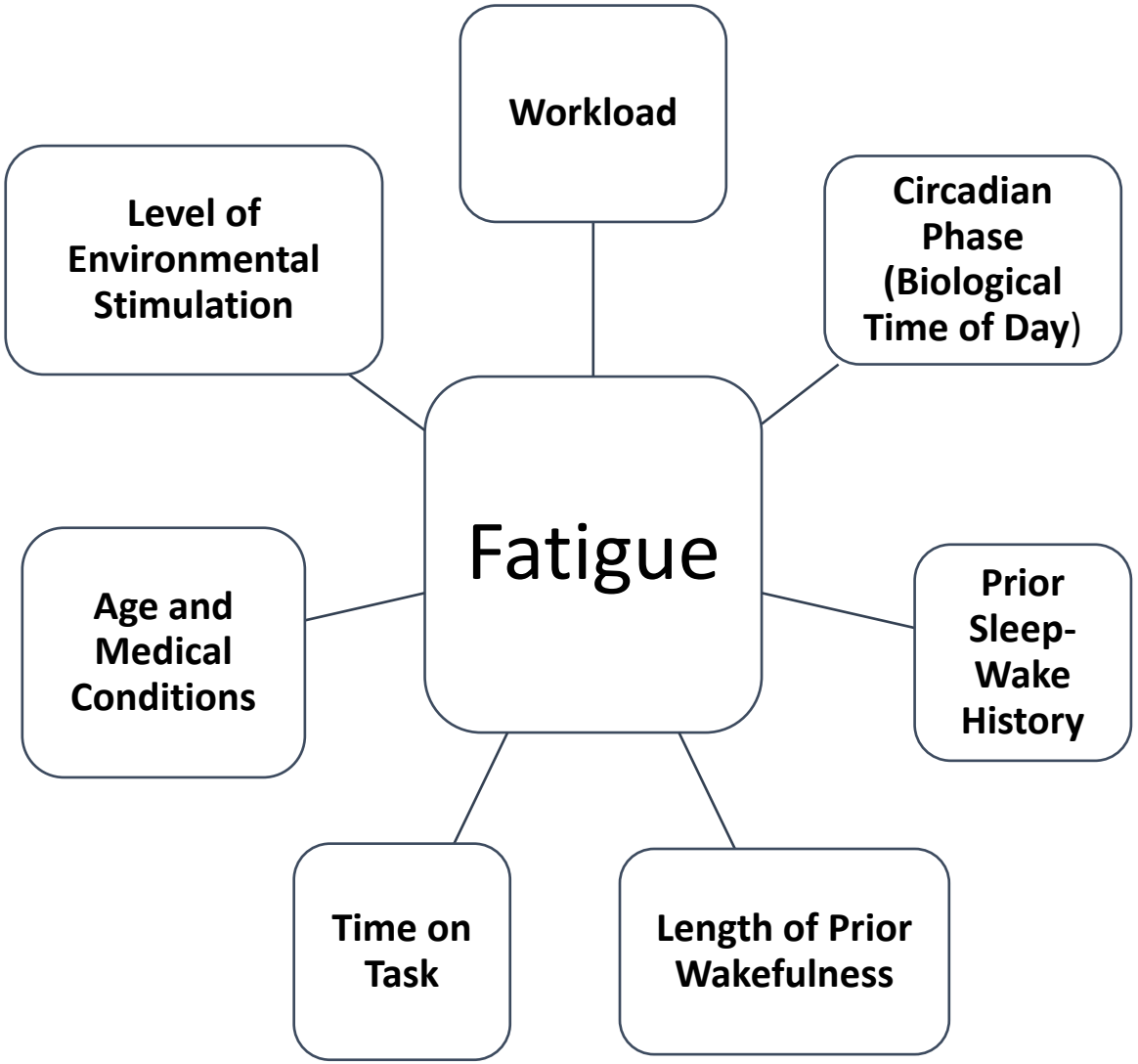


Defining Fatigue

- A physiological state of diminished mental and physical performance capacity caused by acute or chronic sleep deprivation or incomplete recovery from prior work



Defining Fatigue

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- Disproportionately high amount of workplace accidents
  - ~ 2x the provincial injury rate[1]
  - Overexertion and strain 45% of FF injuries[1]
  - Fatigue 7-10% globally and $35B in lost productivity[3]

Study Objectives

1. Understand fatigue and sleep in firefighters

2. Investigate impact of current schedule

3. Build on current fatigue risk management plan

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Project Design

- Recruited 40 Participants (30 WF, 10 MT)

- Testing occurred prior to and immediately after each shift for full work cycle

- Measured objective and subjective levels of:
    1. Fatigue
    2. Sleep
    3. Alertness
    4. Performance

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Measurements

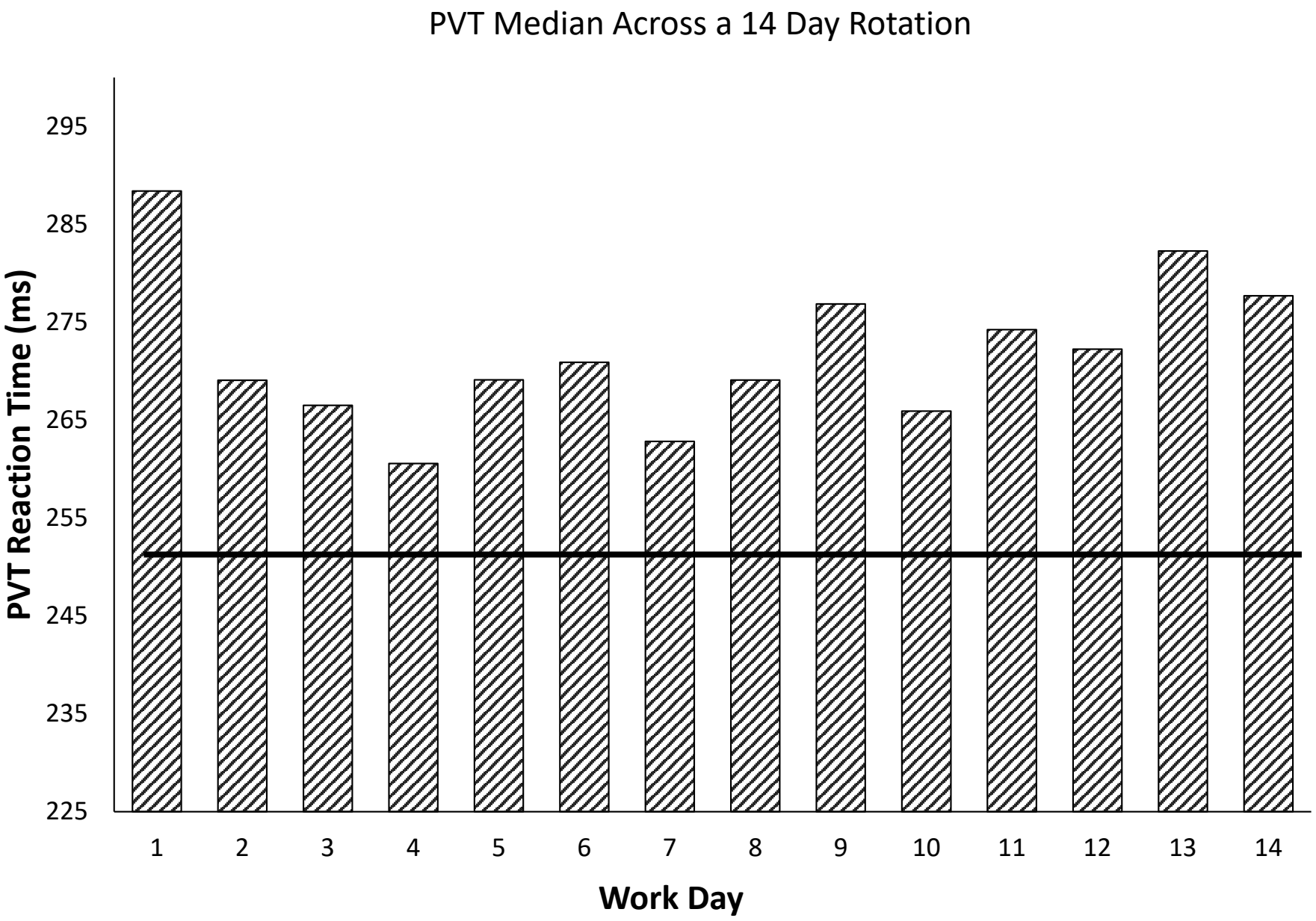
1) <u>Fatigue:</u>

- Objective reaction time tests of performance
  - 5 min Psychomotor vigilance test (PVT) (ms)
    - Median RT (ms)
    - Lapses (>355 ms)
- Daily subjective questionnaires
  - Visual Analogue Scales (0-10)

2) <u>Sleep:</u>

- Actigraph and sleep logs
  - Total Sleep Time (TST)
  - Efficiency (%)
- Subjective sleepiness and quality questionnaires

Results: Objective Cognitive Performance



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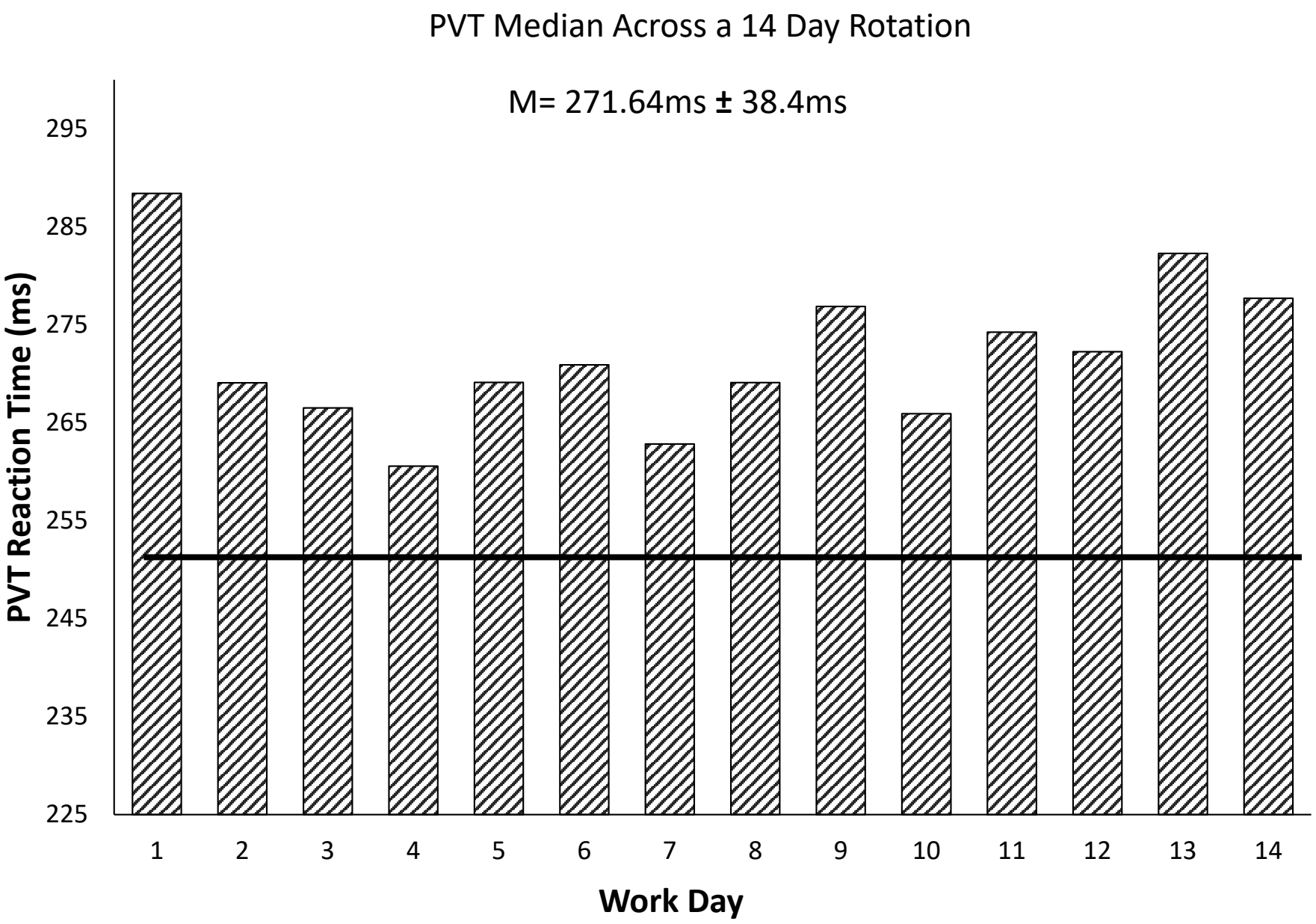

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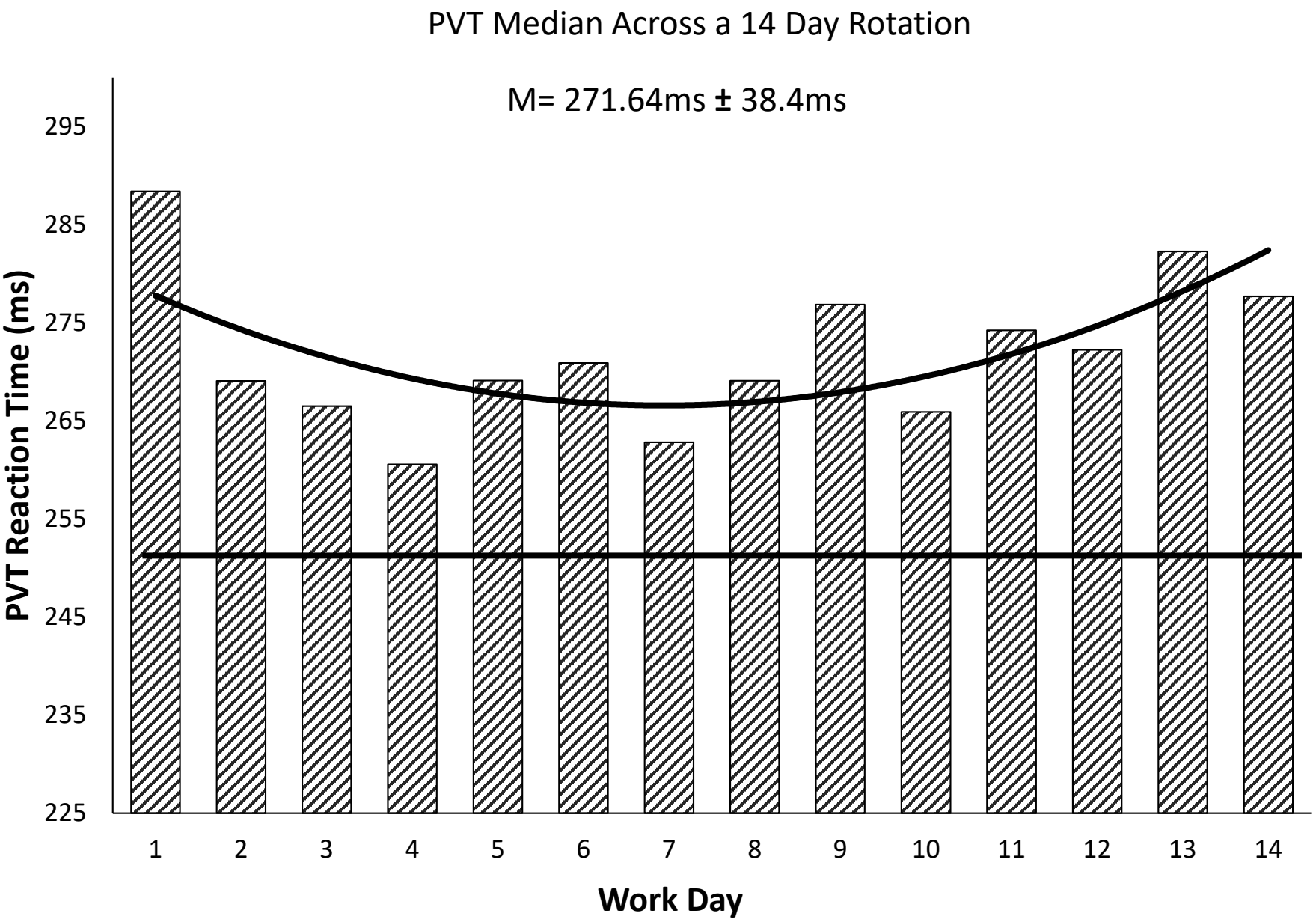

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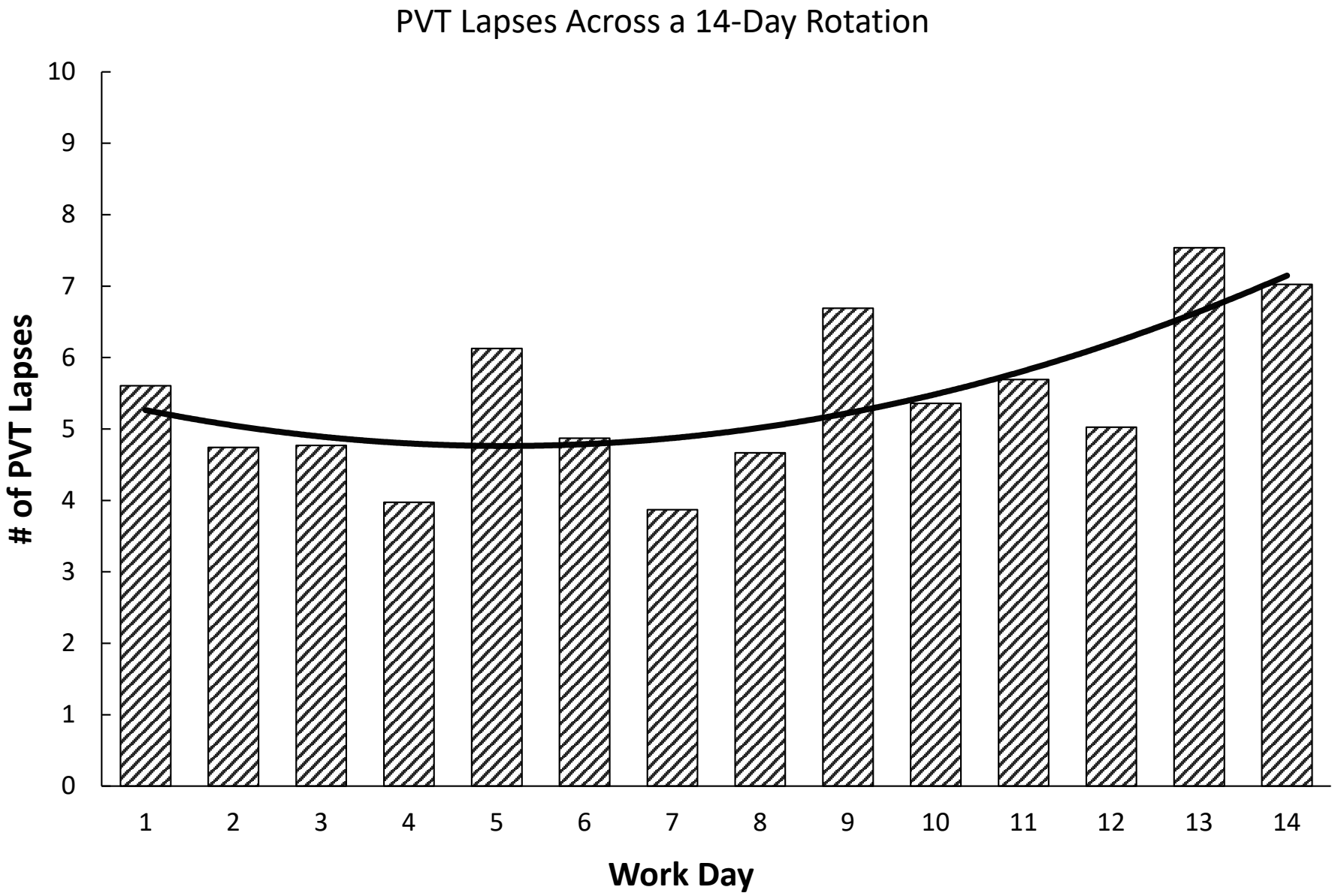
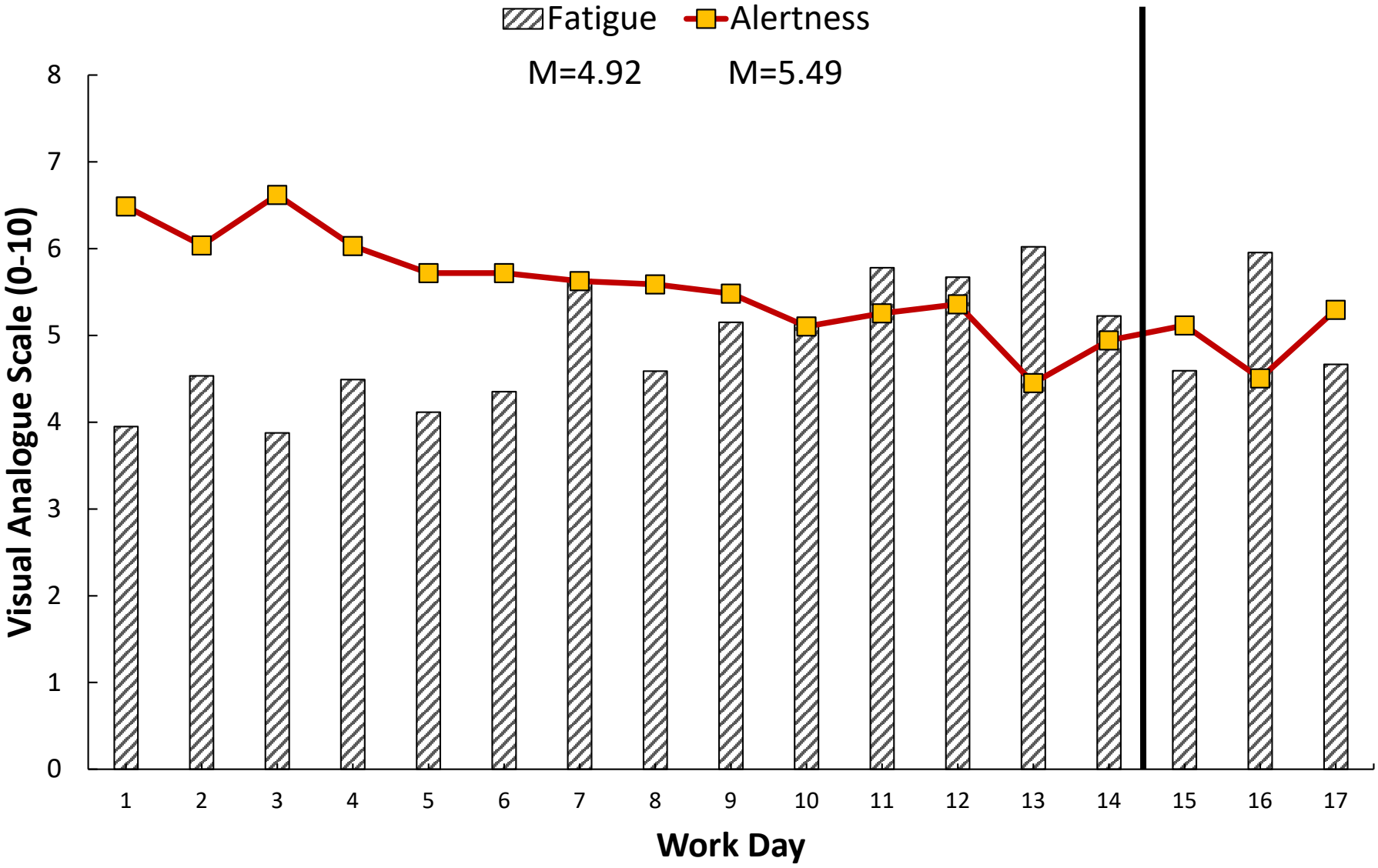
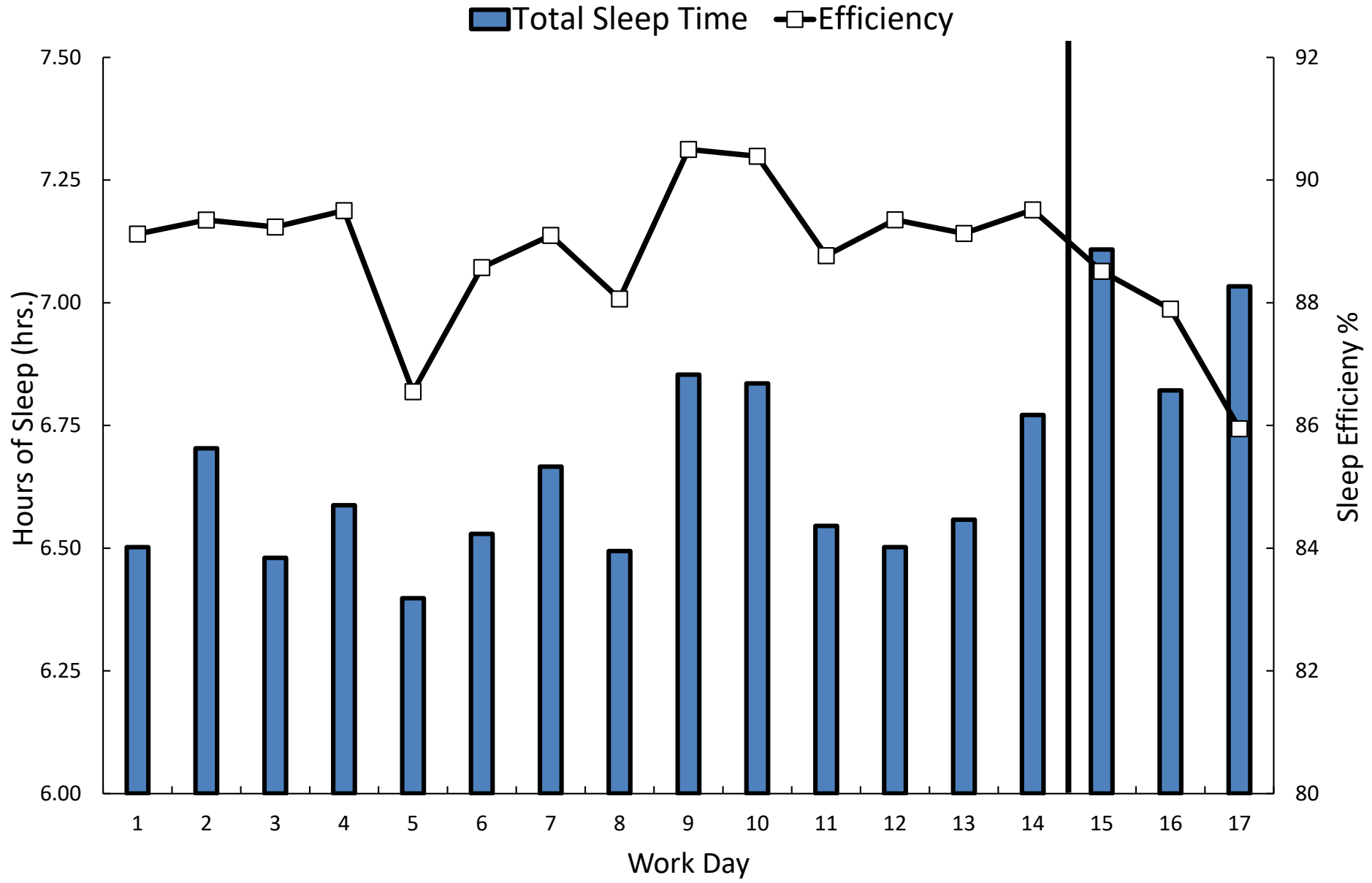


Results: Subjective Fatigue



Results: Objective Sleep



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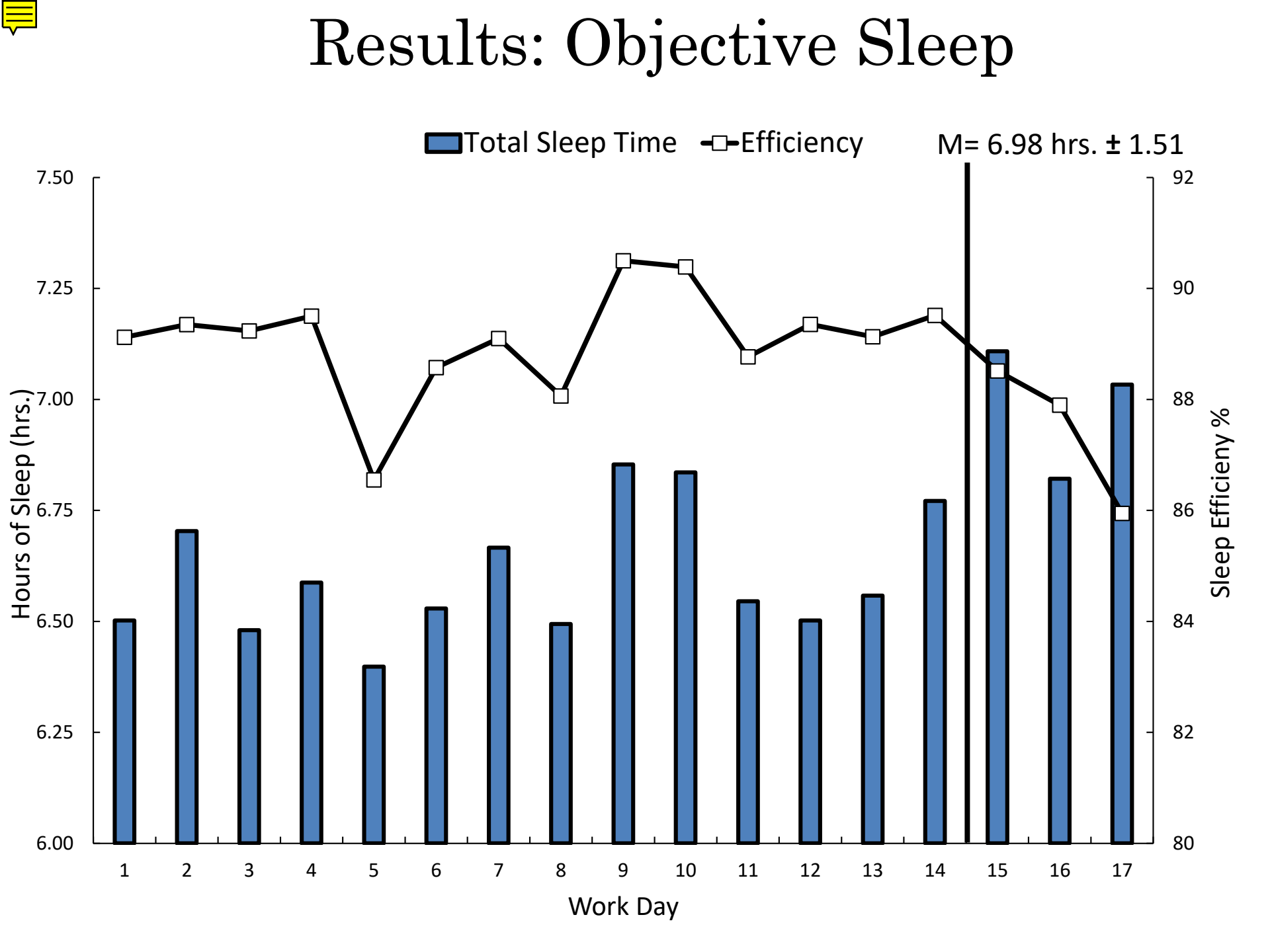
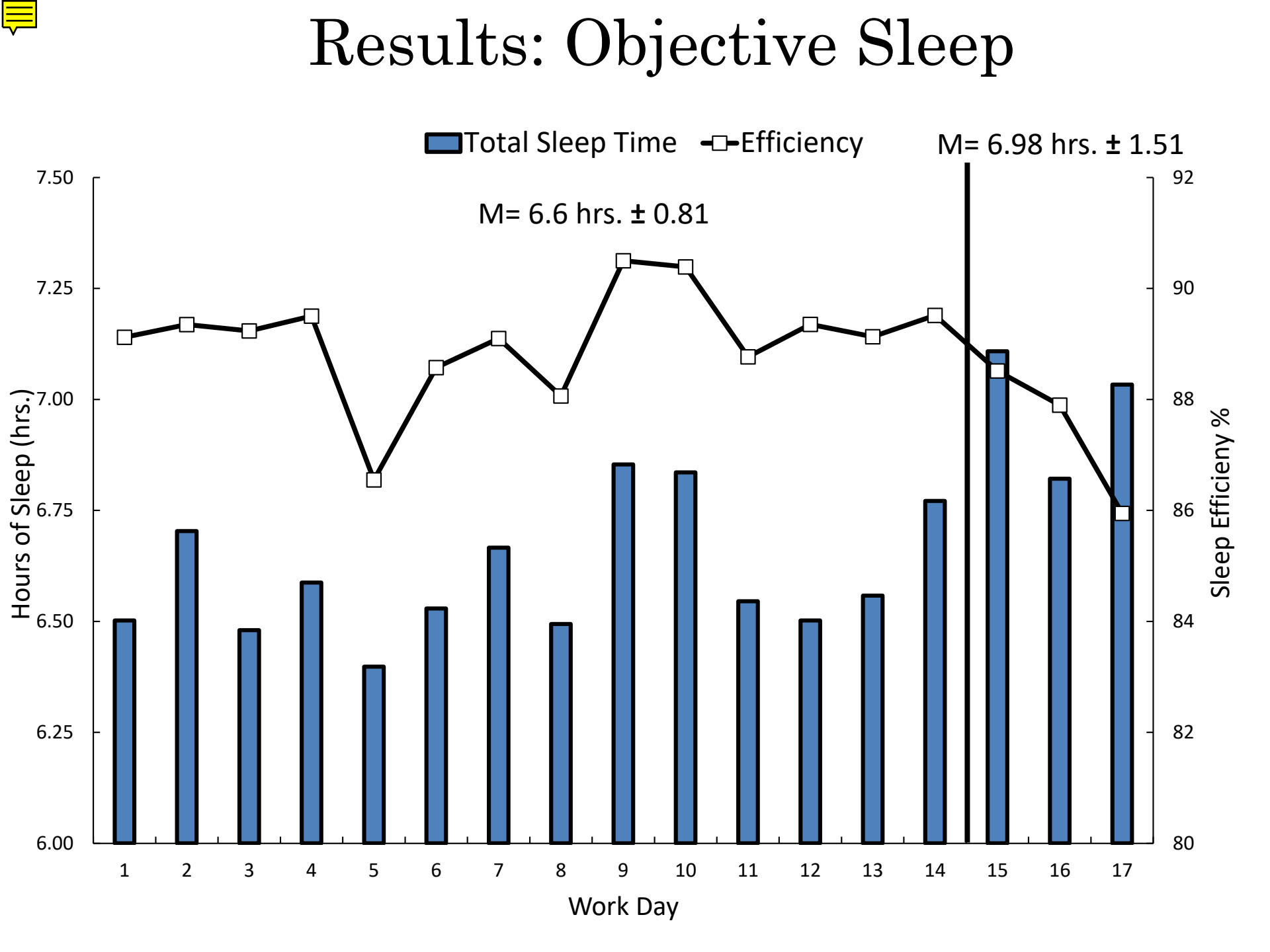
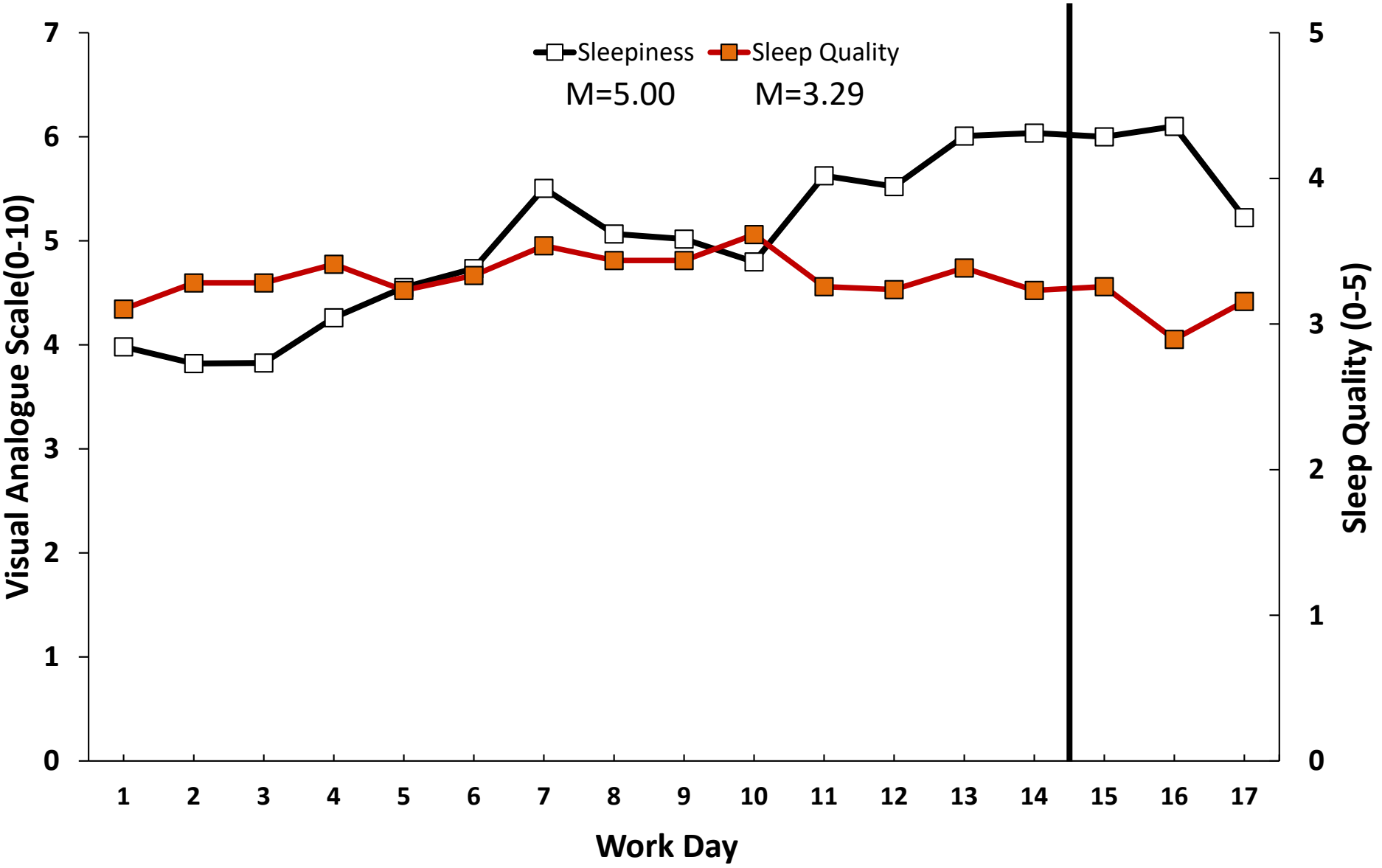


Results: Objective Sleep



Results: Subjective Sleepiness & Quality



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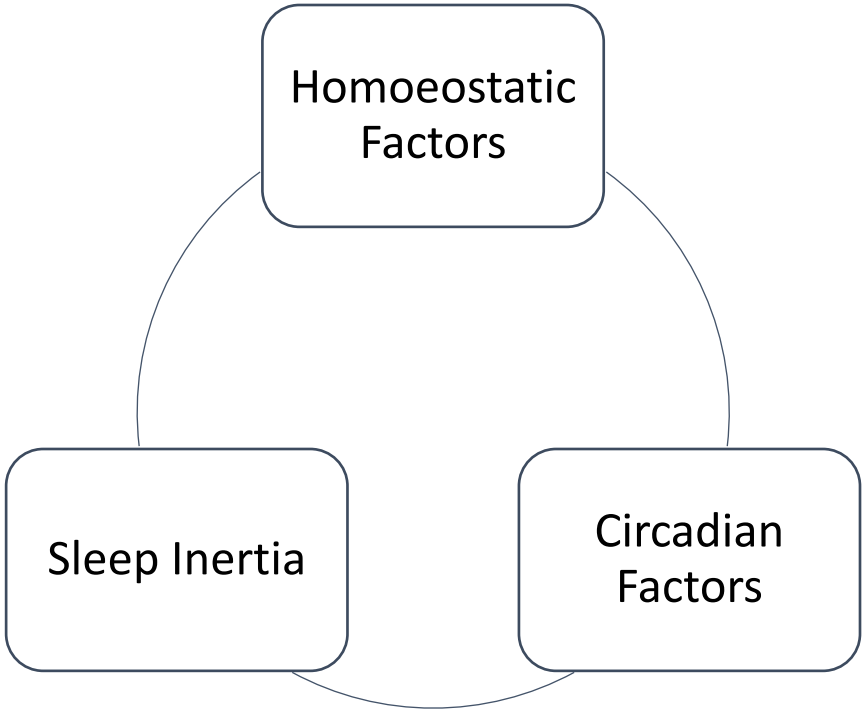
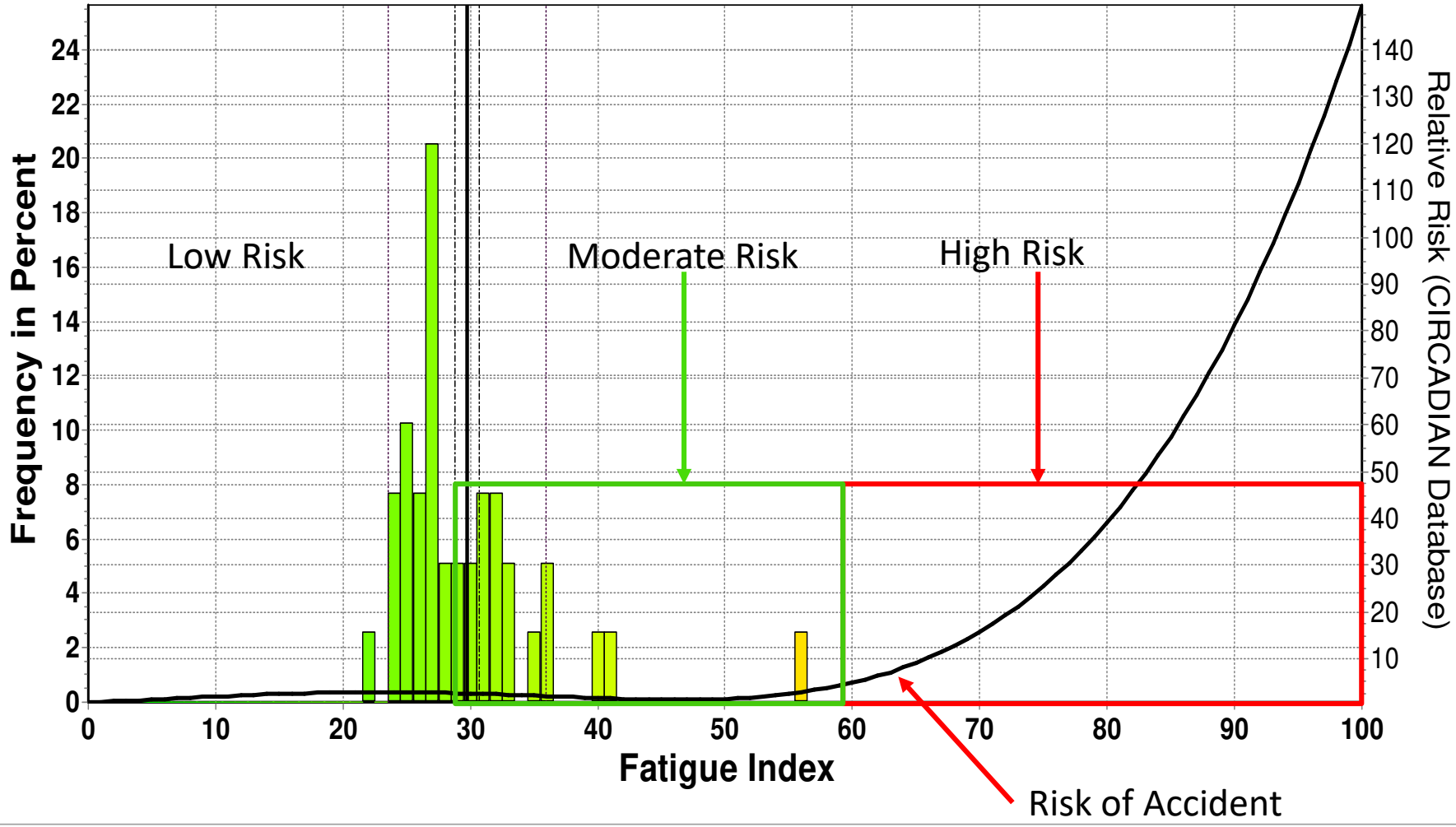
Bio-Mathematical Fatigue Risk Assessment

1) Circadian Alertness Simulator- CAS

- CAS converts schedule and sleep data into three fatigue levels:
    1. Green Zone- Low Fatigue Risk 0-30
    2. Yellow Zone- Average Fatigue Risk 31-60
    3. Red Zone- High Fatigue Risk 61-100

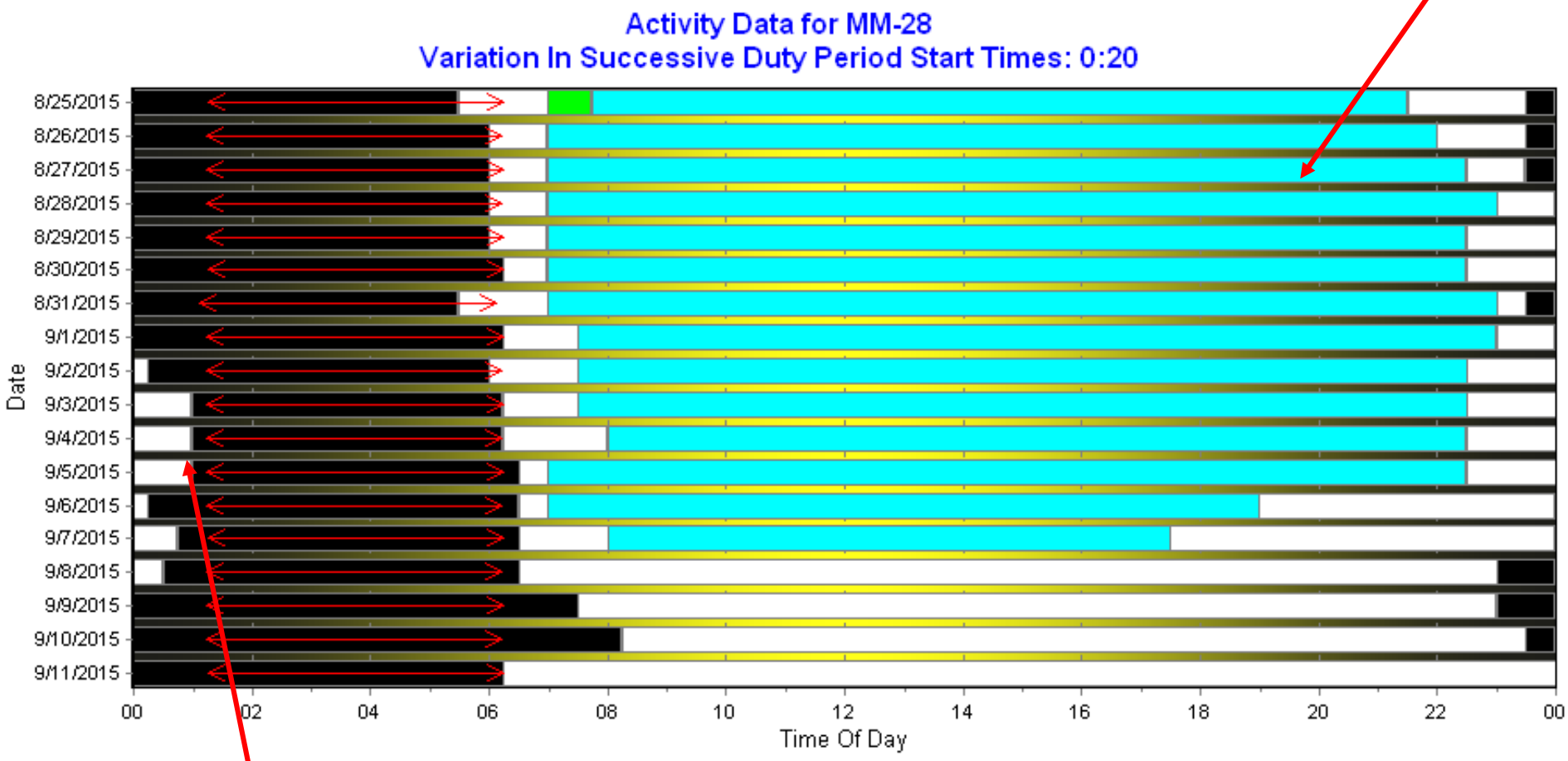


CAS Fatigue Index Score= 29.4



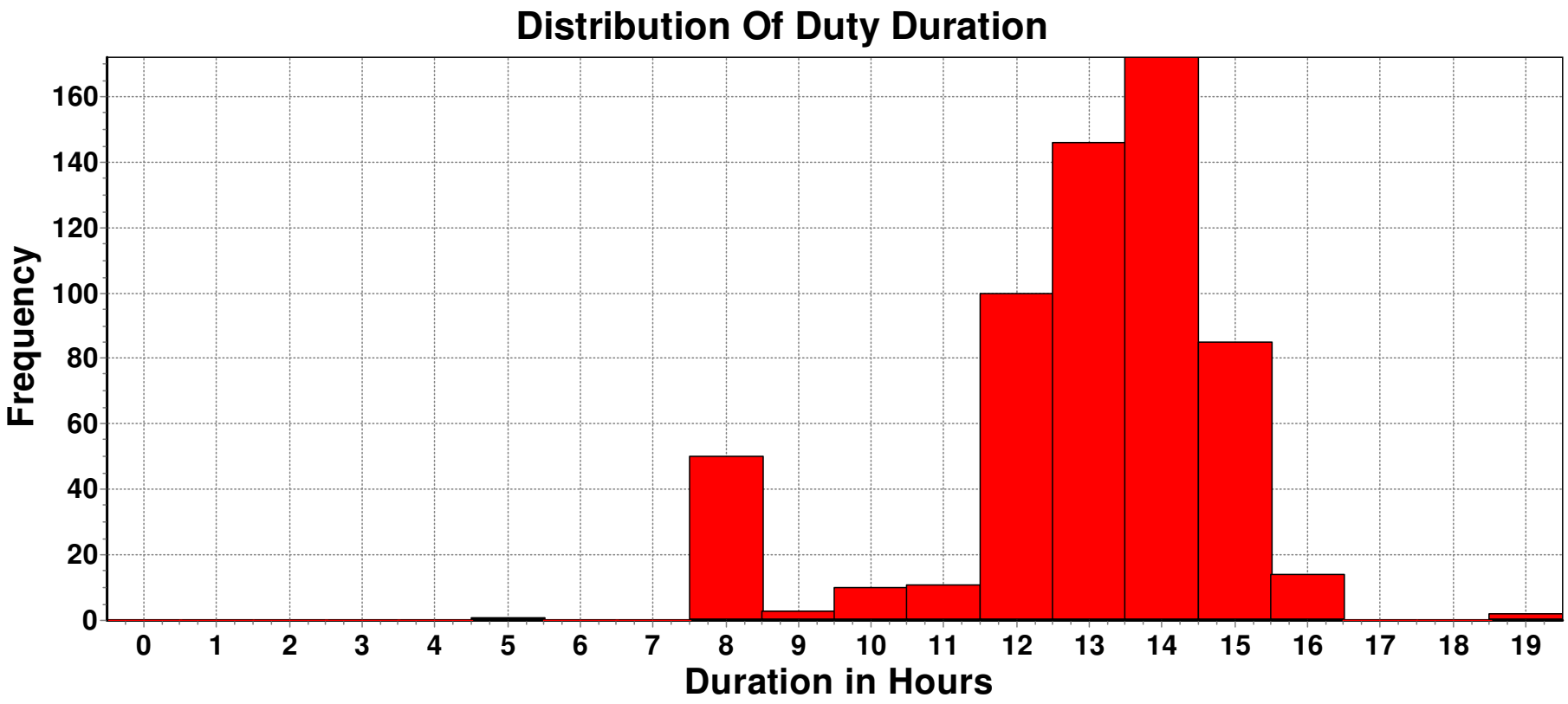
Fatigue Score= 40.28

1) Total Work Hours



2) Sleepiness Risk on Duty

CAS Modelling- Identifying Schedule Features



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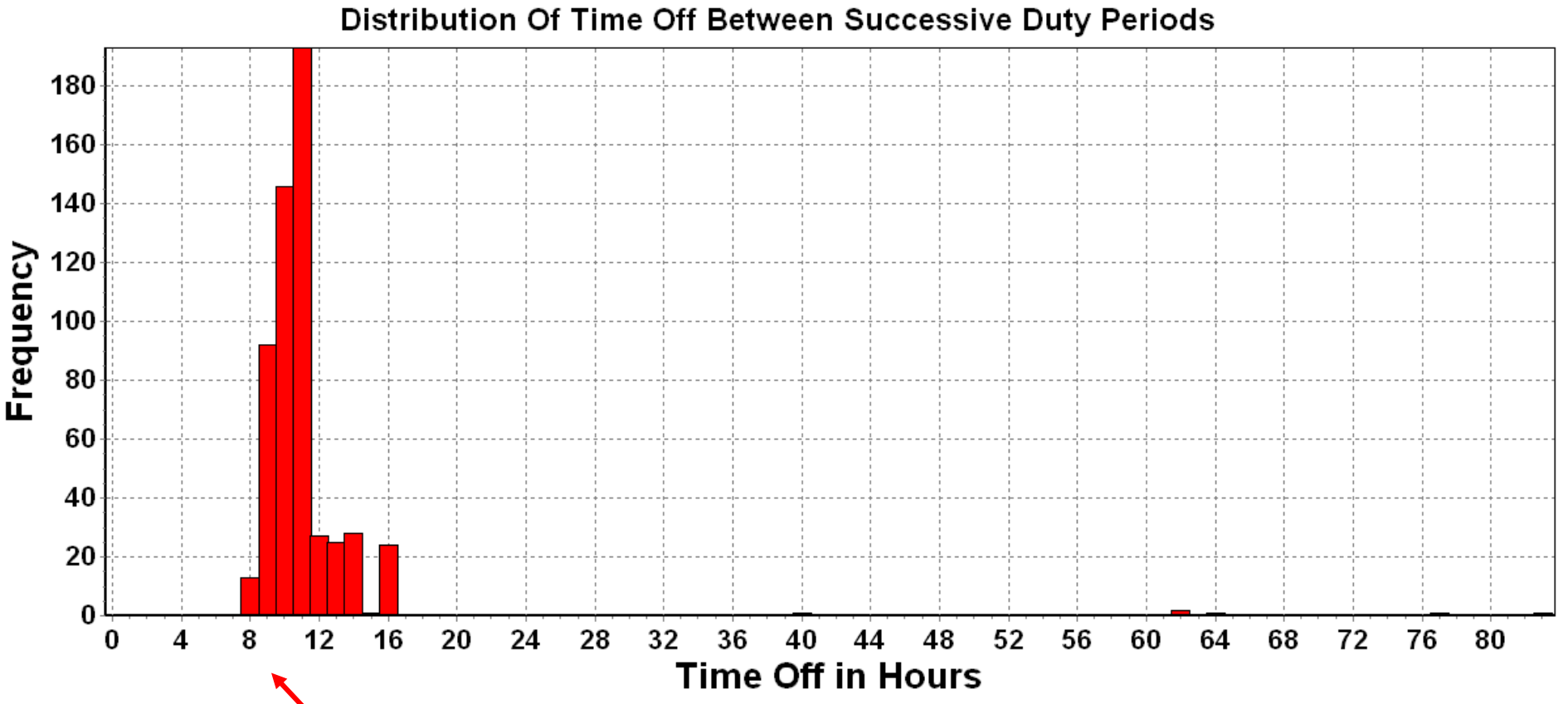

3 Recommendations & Future Directions

1) Strong safety management policies on schedule and shift practices
   - ❖ Time between shifts
   - ❖ Night shift crews
   - ❖ Driving and sleep environments

2) Bench mark fatigue
   - ❖ Identify high risk groups
   - ❖ Record schedule deviations

3) Conduct fatigue root cause investigation
   - ❖ Annual accident, near misses, injury reports

4) Training and Education
   - ❖ Techniques and strategies to improve sleep
   - ❖ Fatigue mitigation tips
   - ❖ Signs and tips to recognize and prevent fatigue

BRITISH COLUMBIA

A Guide to Managing Fatigue and Sleep in Wildland Firefighting

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Conclusions

1) Poor performance at beginning of shift

2) Gradual increase in fatigue and sleepiness
   - ❖ Appears rest period not utilized to fully recover

3) Total sleep time was 6.6 hours over 17 days
   - ❖ Consistent with studies

4) Schedule had low/moderate CAS fatigue risk
   - ❖ Upper limit of duty hours
   - ❖ Maintain comprehensive fatigue plan

Special Thanks

- WMB
- Darren Warburton
- WorkSafeBC
- UBC
- Firefighters

References

1) Ministry of Forests, Land and Natural Resource Operations. (2013).*Wildfire Management Branch 2013 Annual Safety Report.* Acquired privately.

2) Aisbett, B., Wolkow, a., Sprajcer, M., & Ferguson, S. a. (2012). " Awake, smoky, and hot" : Providing an evidence-base

3) www.circadian.com/advantage-disadvantages12hrshifts