

Environmental Factors Causing Fatigue in Equipment Operators during Winter Operations

Paul Albritton

Technical Training Coordinator

Iowa Local Technical Assistance Program (LTAP)

Institute For Transportation (InTrans)

Iowa State University



Environmental Factors Causing Fatigue in Equipment Operators during Winter Operations

Matthew C. Camden

Alejandra Medina-Flintsch

Jeffrey S. Hickman

James Bryce

Gerardo Flintsch

Richard Hanowski



Research for winter highway maintenance



Project 99084/CR11-05 April 2014

Pooled Fund #TPF-5(218) www.clearroads.org

Background

Fatigue has been shown to adversely impact;

- Changes in performance
- Impaired reasoning and decision making
- Reduced situational awareness
- Poor assessment of risk
- Failure to appreciate the consequences of certain actions.

“This paper will use the word “fatigue” hereafter to refer to a person’s propensity to feel sleepy, regardless of its genesis.”

Background

- Research has shown that fatigue impairs and degrades driving performance by changing the behavior of the driver.
- Previous research has shown fatigue to be the primary cause or a contributing factor in up to 31 percent of truck crashes. (Federal Motor Carrier Safety Administration, 2006; Knippling and Wang, 1994)
- Much from CMV drivers can be applied to winter maintenance personnel.

Project Summary

- The goal of the project was to develop a series of cost effective, realistic recommendations for reducing or eliminating fatigue in equipment operators during winter emergency operations.

Project Summary cont.

Three data collection efforts

1. Literature Review
2. Collection of naturalistic driving and actigraph data
3. Collection of qualitative information from winter maintenance operators and management personnel

Project Summary cont.

Three data collection efforts

1. Literature Review
2. Collection of naturalistic driving and actigraph data
3. Collection of qualitative information from winter maintenance operators and management personnel

Participants

- Four winter maintenance operators from the Virginia Department of Transportation (VDOT) were recruited in the naturalistic driving study.
- All four drivers completed three months of participation in the study (January 24, 2013, to April 29, 2013)

Participants

More than 368 driving hours of valid, on-road data

- 24 days of winter emergency operations resulted in the collection of more than 338 hours of winter emergency operations data.
- Approximately 30 hours of data were collected during non-winter emergencies.

Data Reduction

- Divided into Seven Safety-Critical Events (SCE's)
 - Crash
 - Low Hanging Branch
 - Tire Strike - Avoidable
 - Tire Strike - Unavoidable
 - Near Crash
 - Crash Relevant Conflict
 - Illegal Maneuver

Results

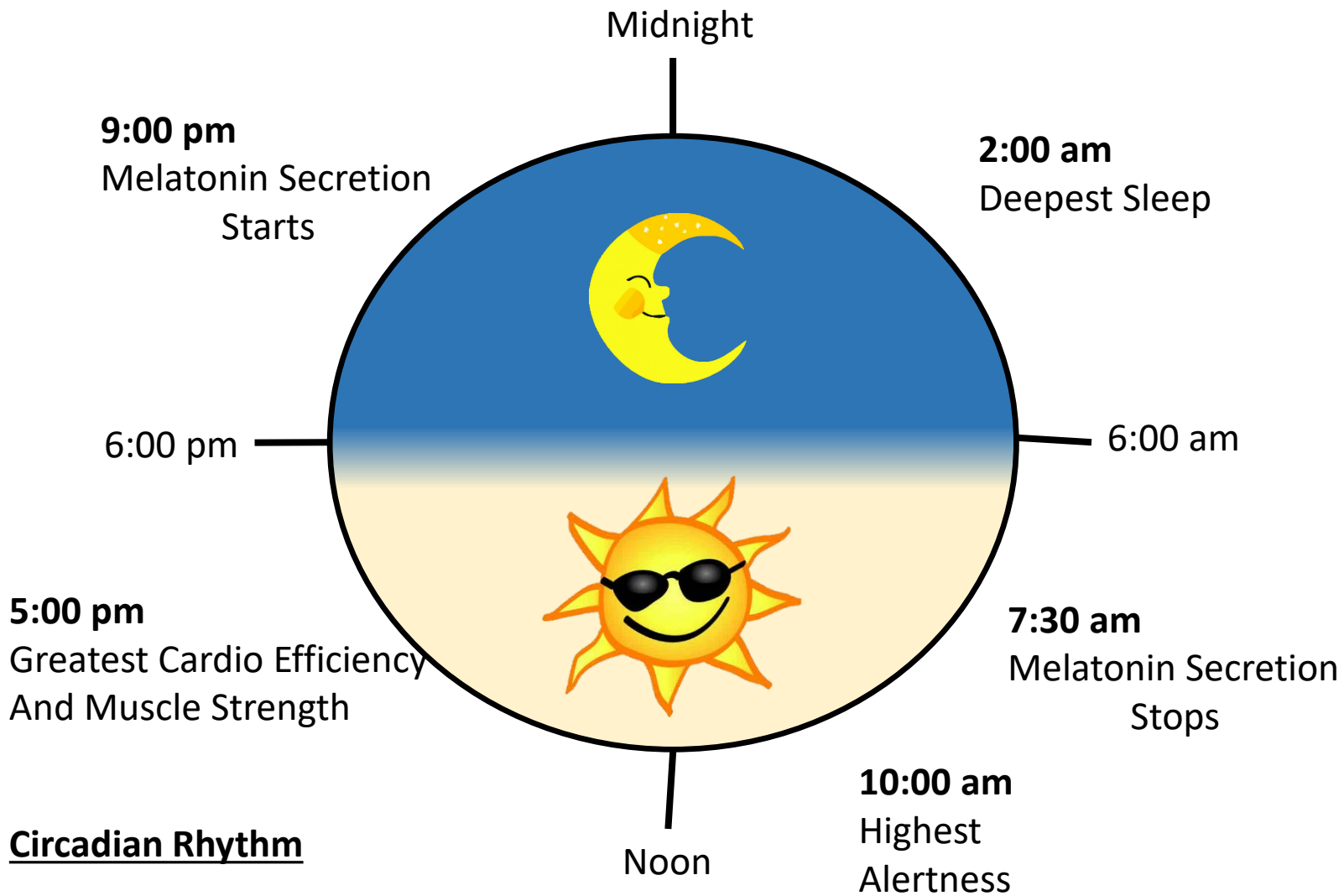
- Ninety-two SCE's observed during 3 months
 - 3.26 percent were crashes
 - 17.39 percent were crashes with low hanging branches covered with snow/ice.
 - 3.26 percent were avoidable curb strikes
 - 22.83 percent were near crashes *
 - 53.26 percent were crash relevant conflicts *
 - 97.8 percent occurred during a winter emergency
- * = 76.09 percent**

Note; (76.09 percent)

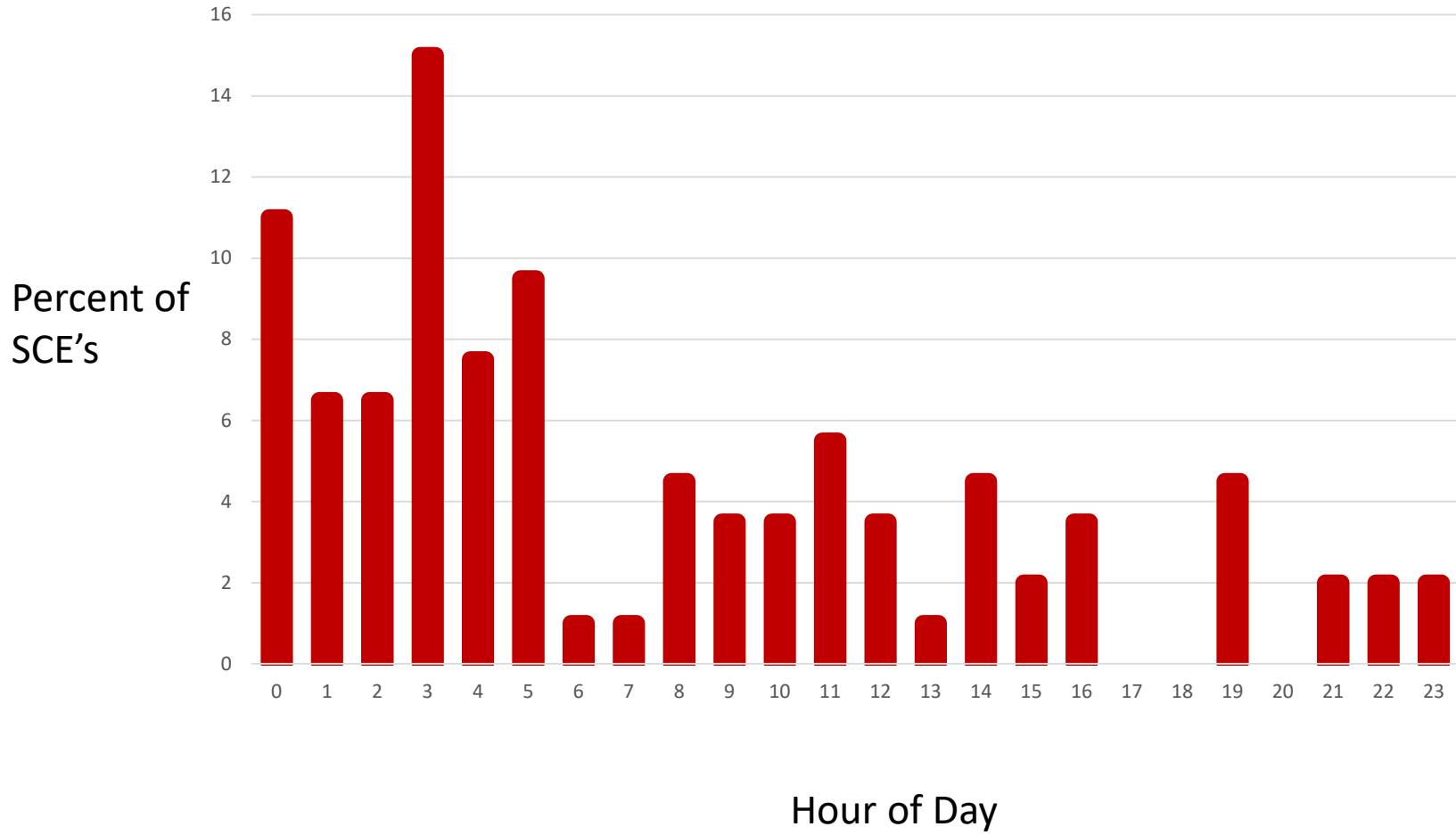
Near-Crash	Any circumstance that requires a rapid, evasive maneuver (e.g., hard braking, steering) by the subject vehicle or any other vehicle, pedestrian, cyclist, or animal to avoid a crash.
Crash-Relevant Conflict	Any circumstance that requires a crash avoidance response on the part of the Subject Vehicle or any other vehicle, pedestrian, cyclist, or animal that was less severe than a rapid evasive maneuver (as defined above) but greater in severity than a normal maneuver. A crash avoidance response can be braking, steering, accelerating, or any combination of control inputs.

Results

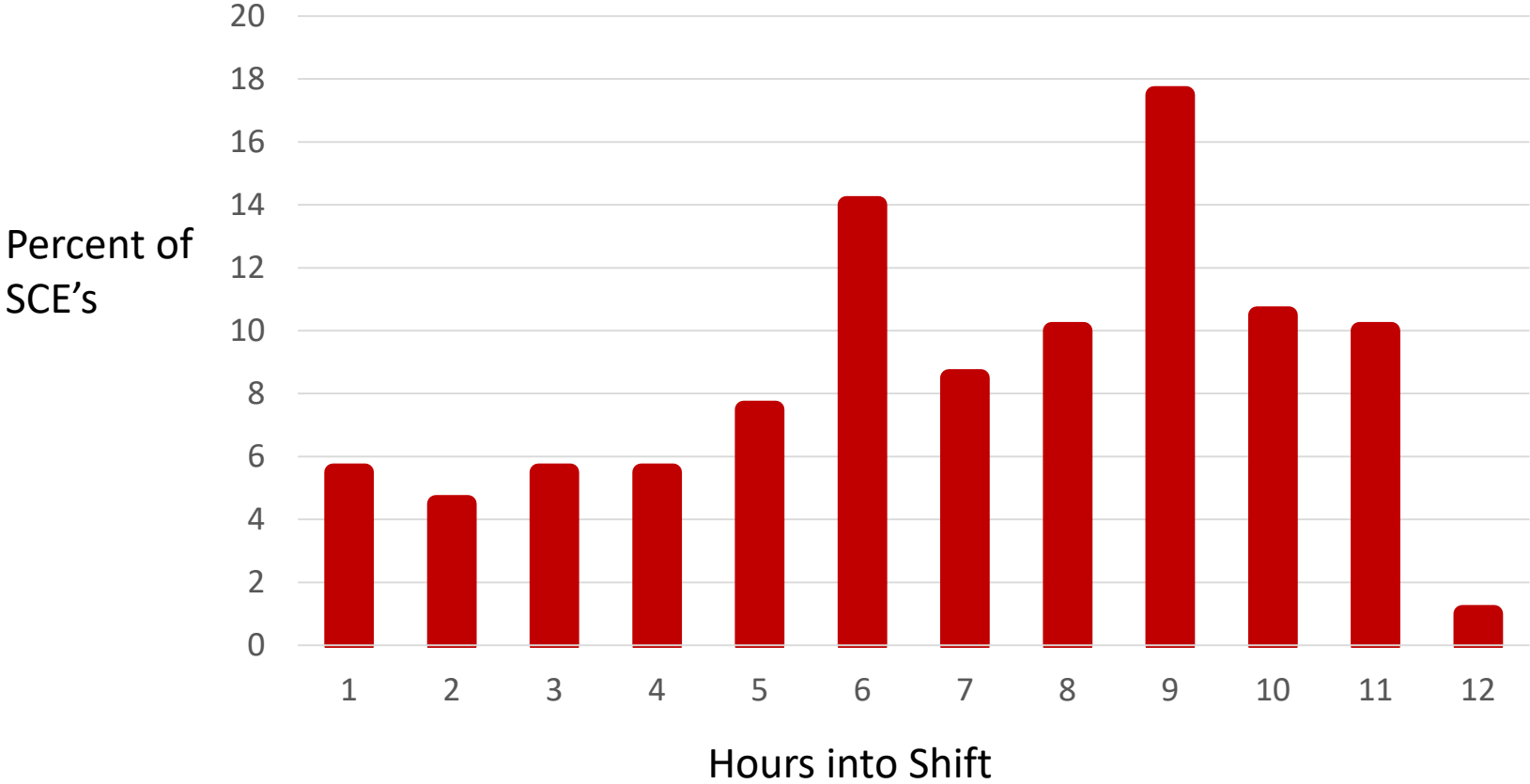
- Drivers were at least moderately drowsy during 35.9 percent of the SCE's
- The majority of the drowsy driving SCE's (63.6 percent) occurred in the circadian low between 2:00 am – 6:00 am.



SCE's by Hour of Day



SCE's by Number of Hours into Shift



Project Summary cont.

Three data collection efforts

1. Literature Review
2. Collection of naturalistic driving and actigraph data
3. Collection of qualitative information from winter maintenance operators and management personnel

Questionnaire Results

- A total of 1,043 winter maintenance operators and 453 managers from 24 Clear Roads member states completed questionnaires. (95 percent state DOT's)

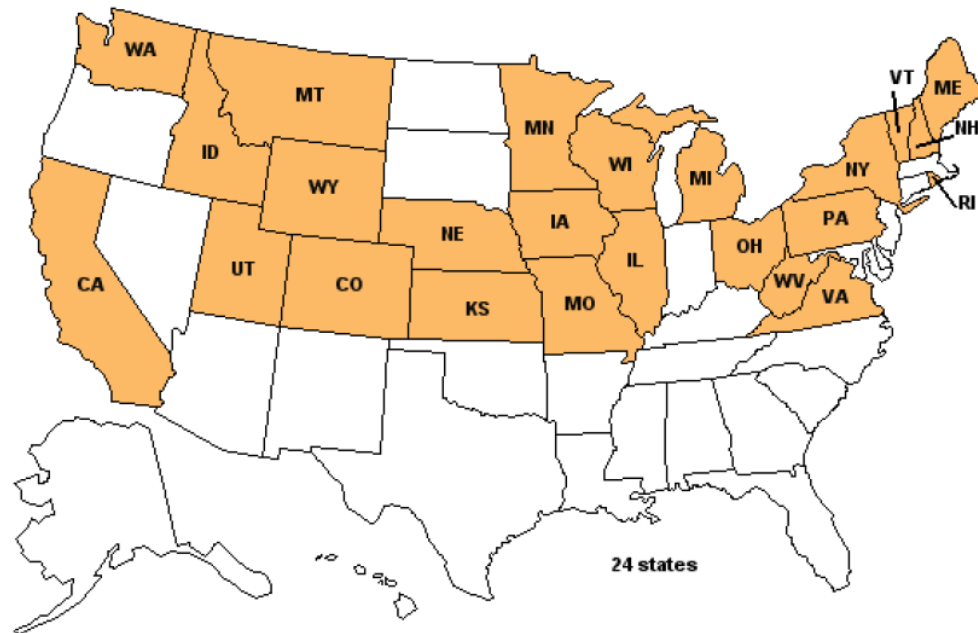


Figure 19. Participating States

Questionnaire Results

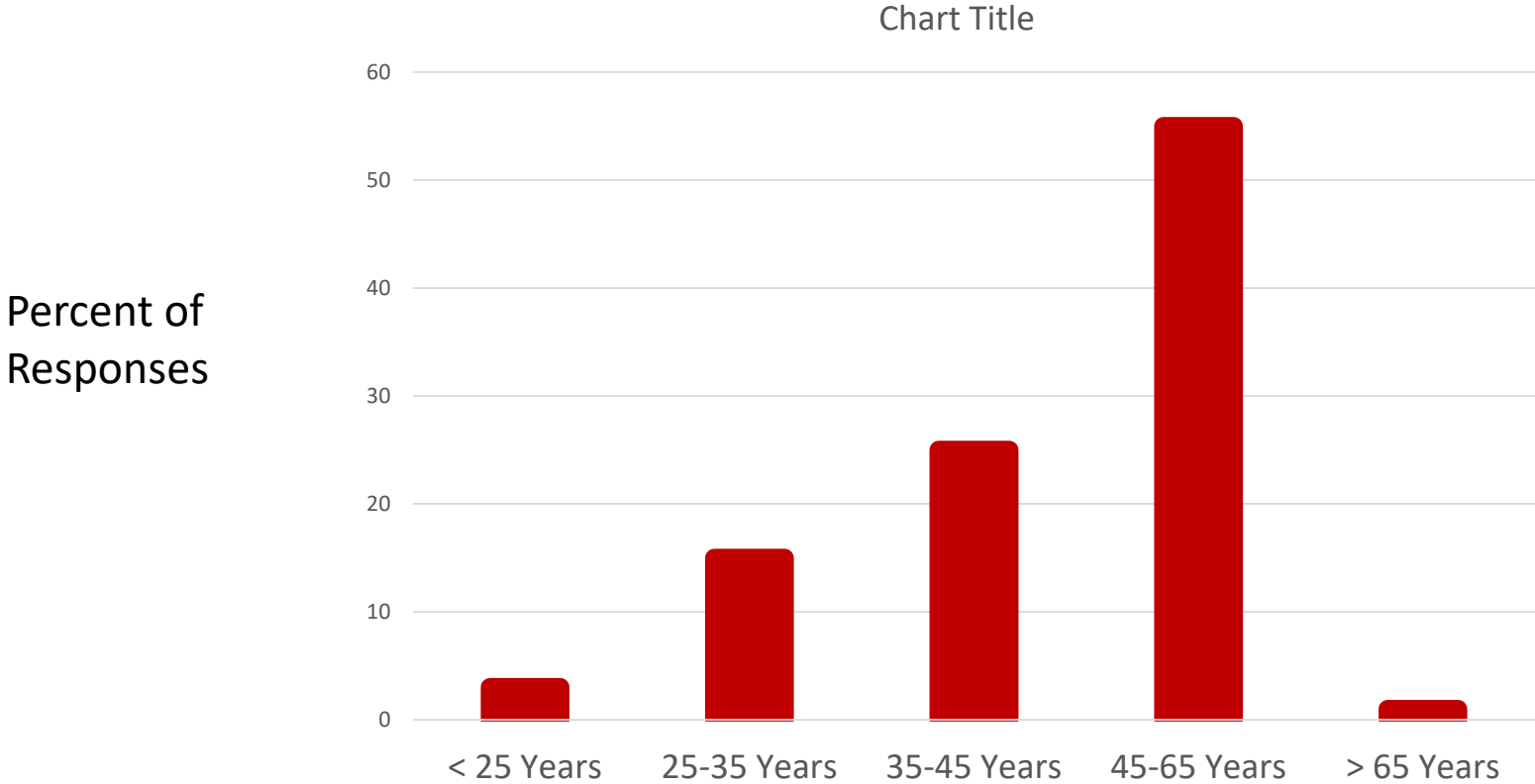


Figure 21: Age Distribution of Winter Maintenance Operators

Questionnaire Results

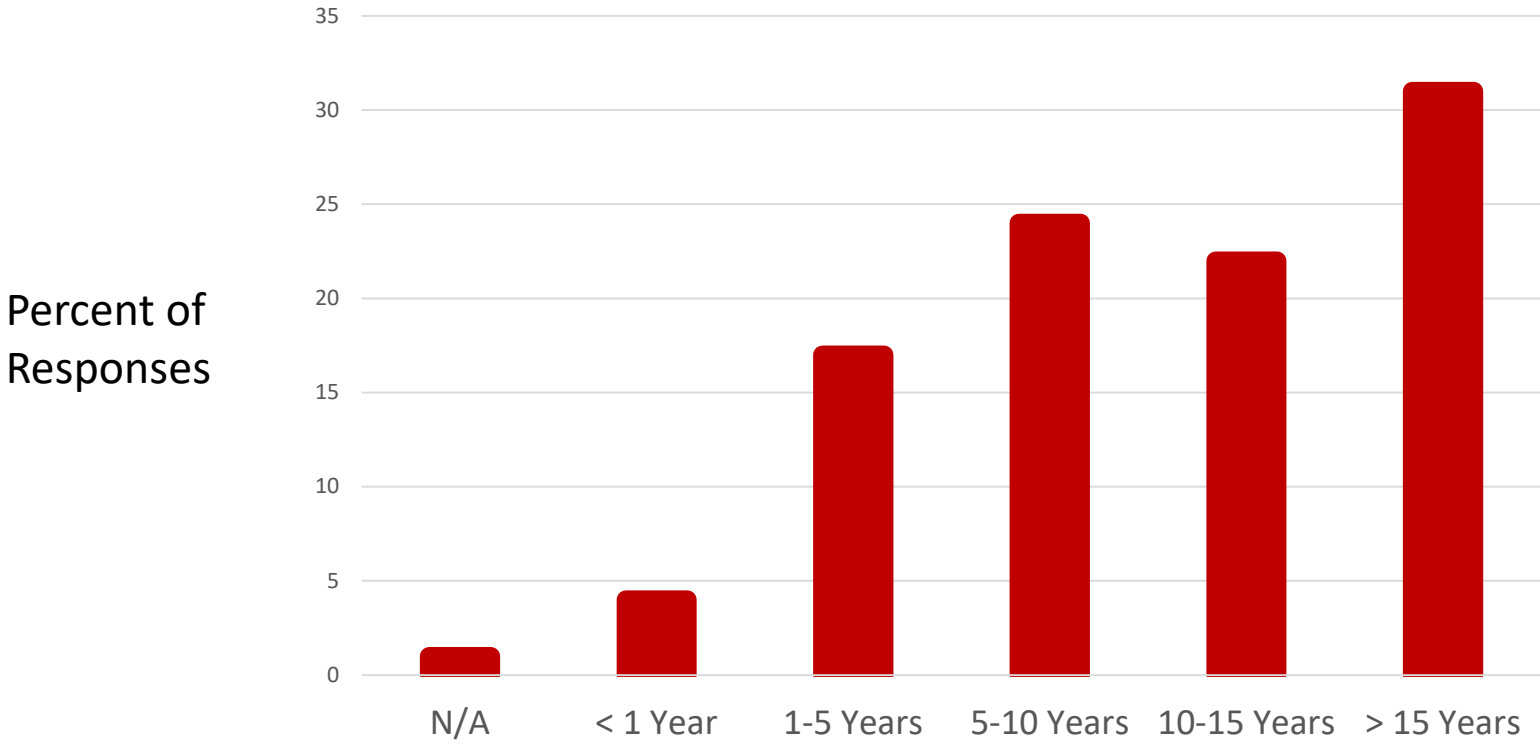


Figure 22. Winter Maintenance Operators' Experience in Winter Operations

Questionnaire Results

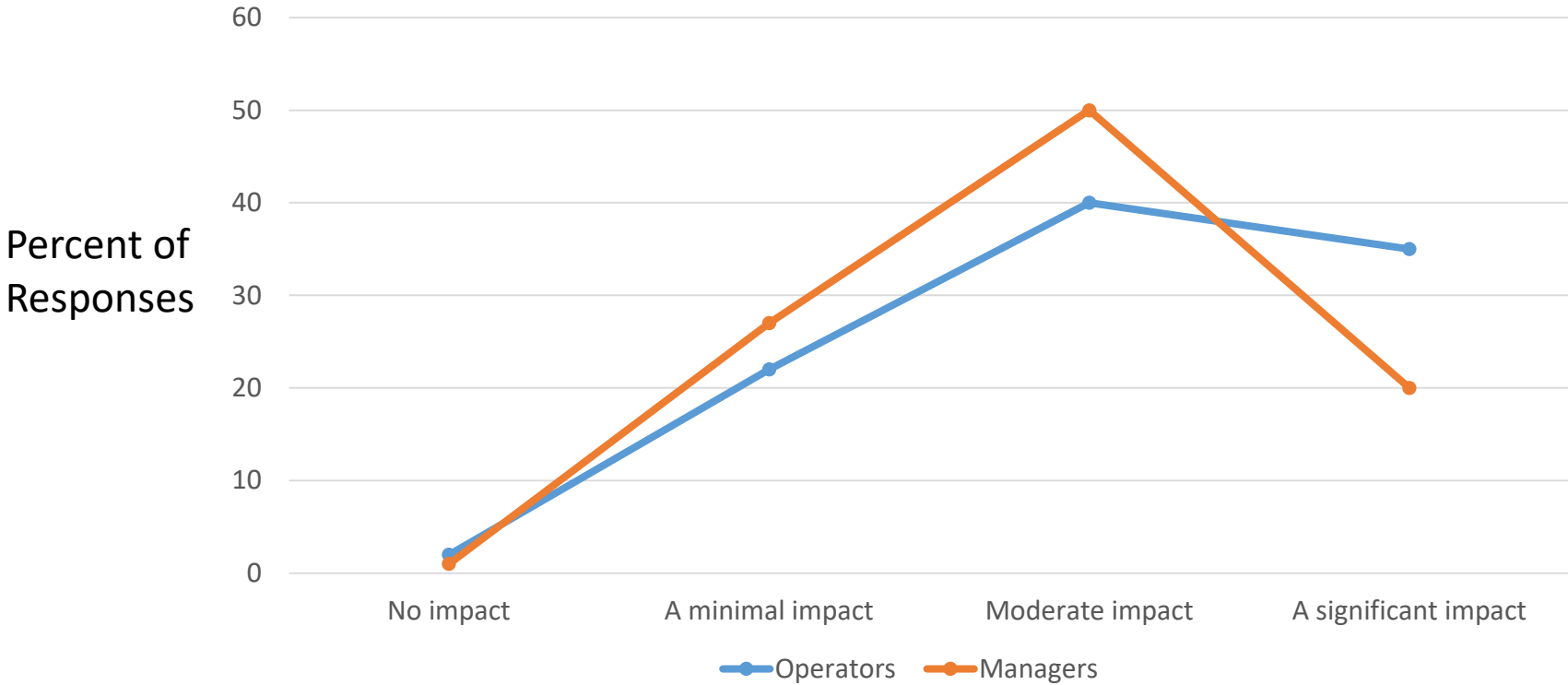


Figure 26. Impact of Fatigue on the Operation of a Snow Plow during Winter Operations

Questionnaire Results



Figure 91. Response to the Statement, “Snow plow operators are able to take breaks whenever they need to.”

Questionnaire Results

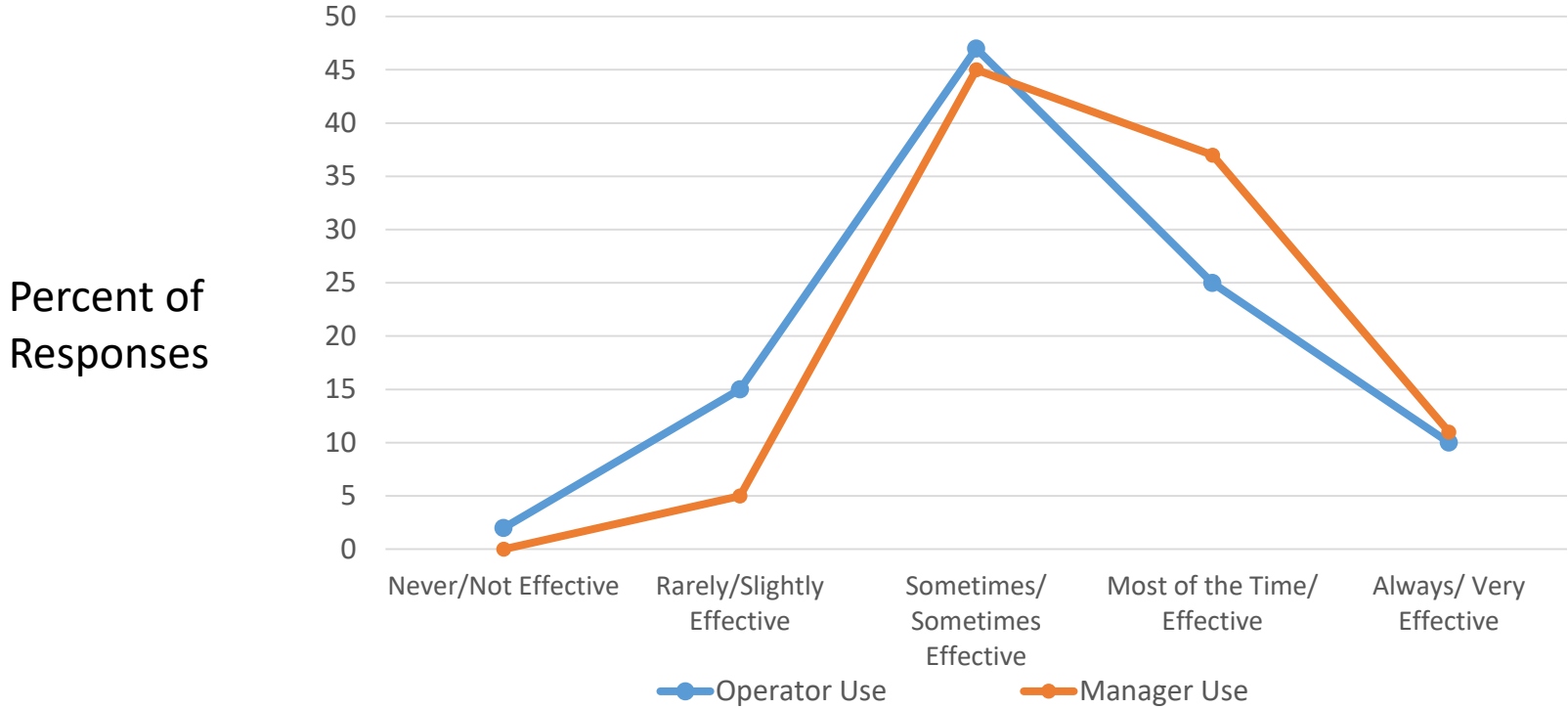


Figure 34. Use and Effectiveness of Breaks in Reducing Fatigue

Questionnaire Results

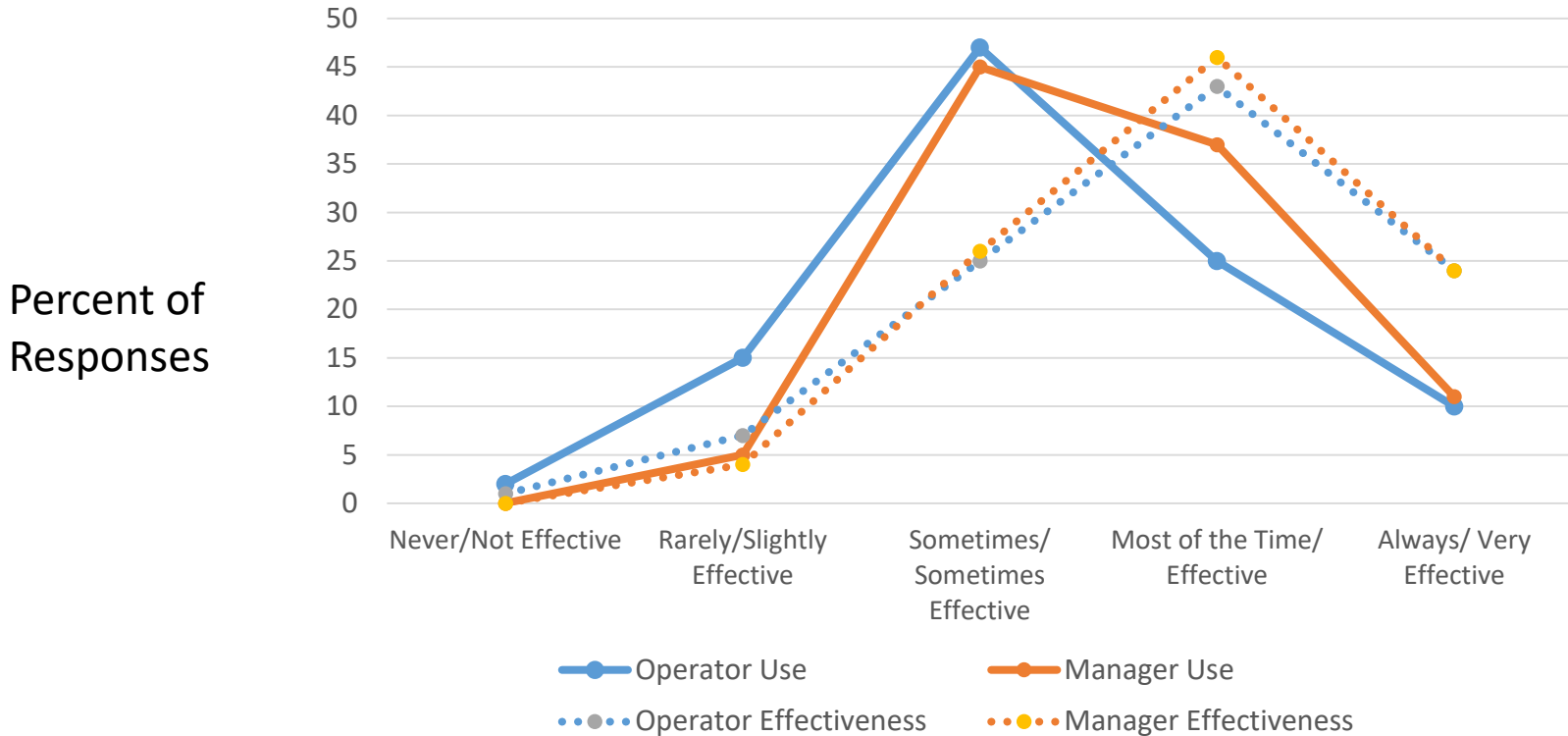


Figure 34. Use and **Effectiveness** of Breaks in Reducing Fatigue

Questionnaire Results

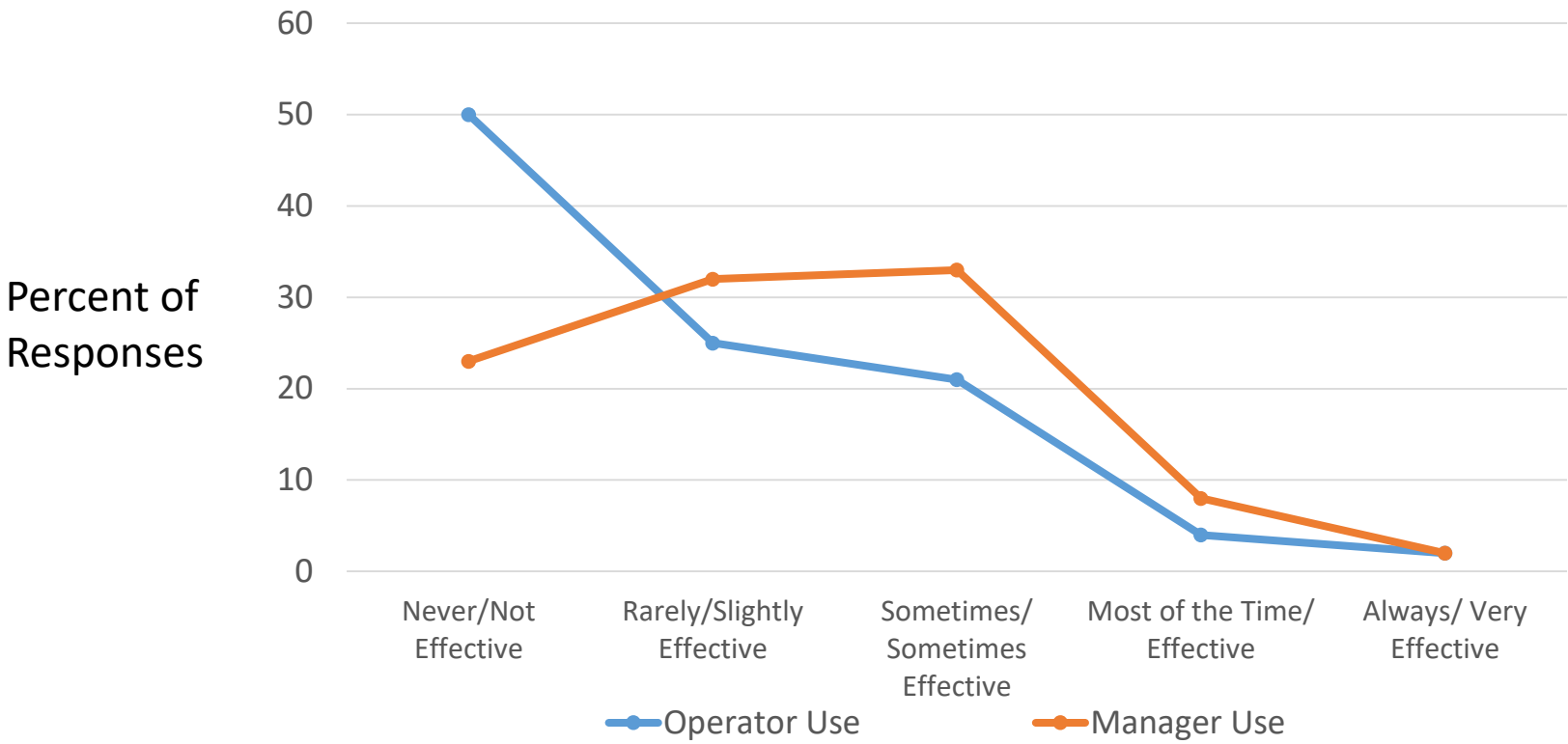


Figure 37. Use and Effectiveness of a Quick Nap in Reducing Fatigue

Questionnaire Results

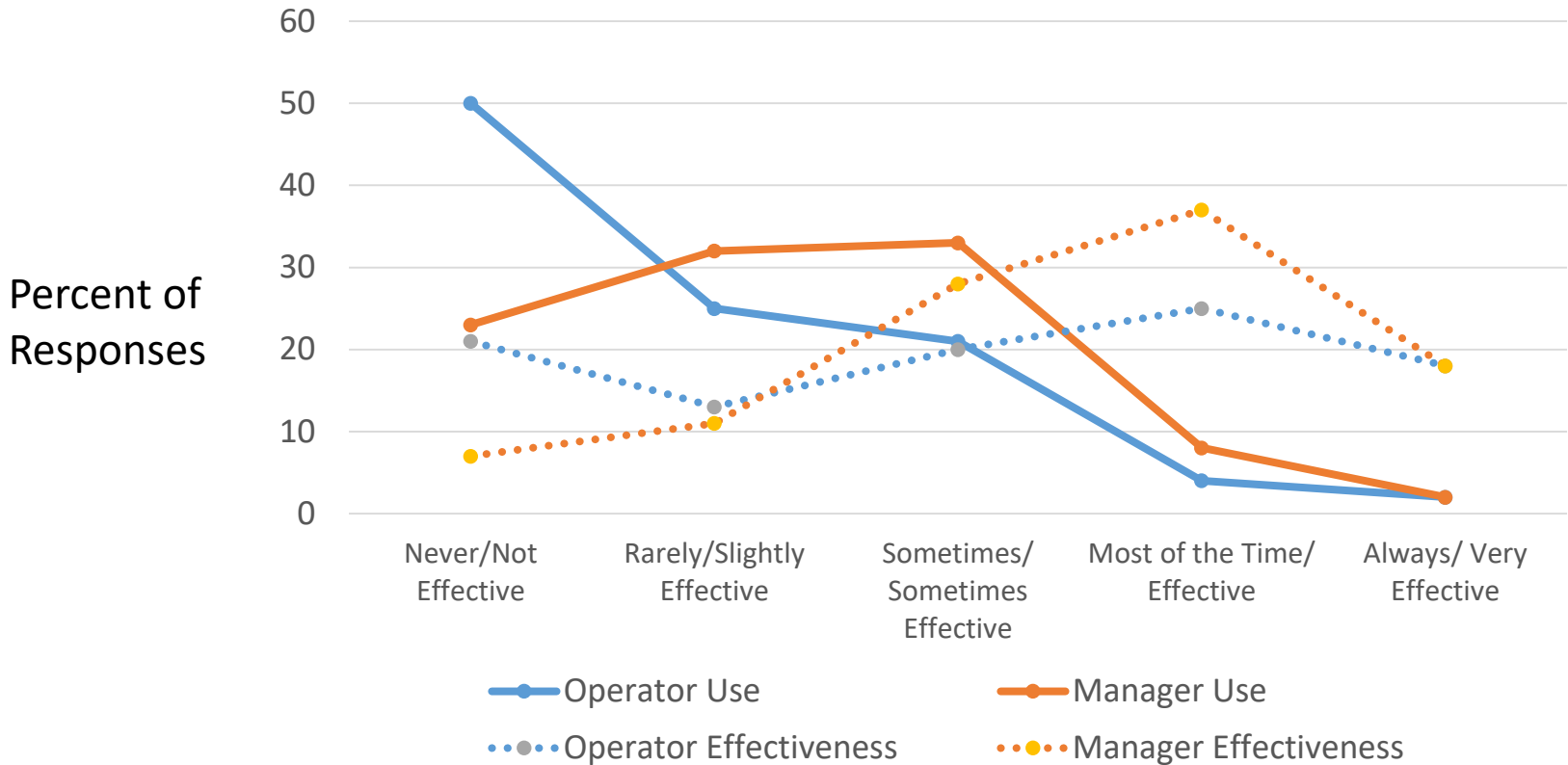


Figure 37. Use and **Effectiveness** of a Quick Nap in Reducing Fatigue

Questionnaire Results

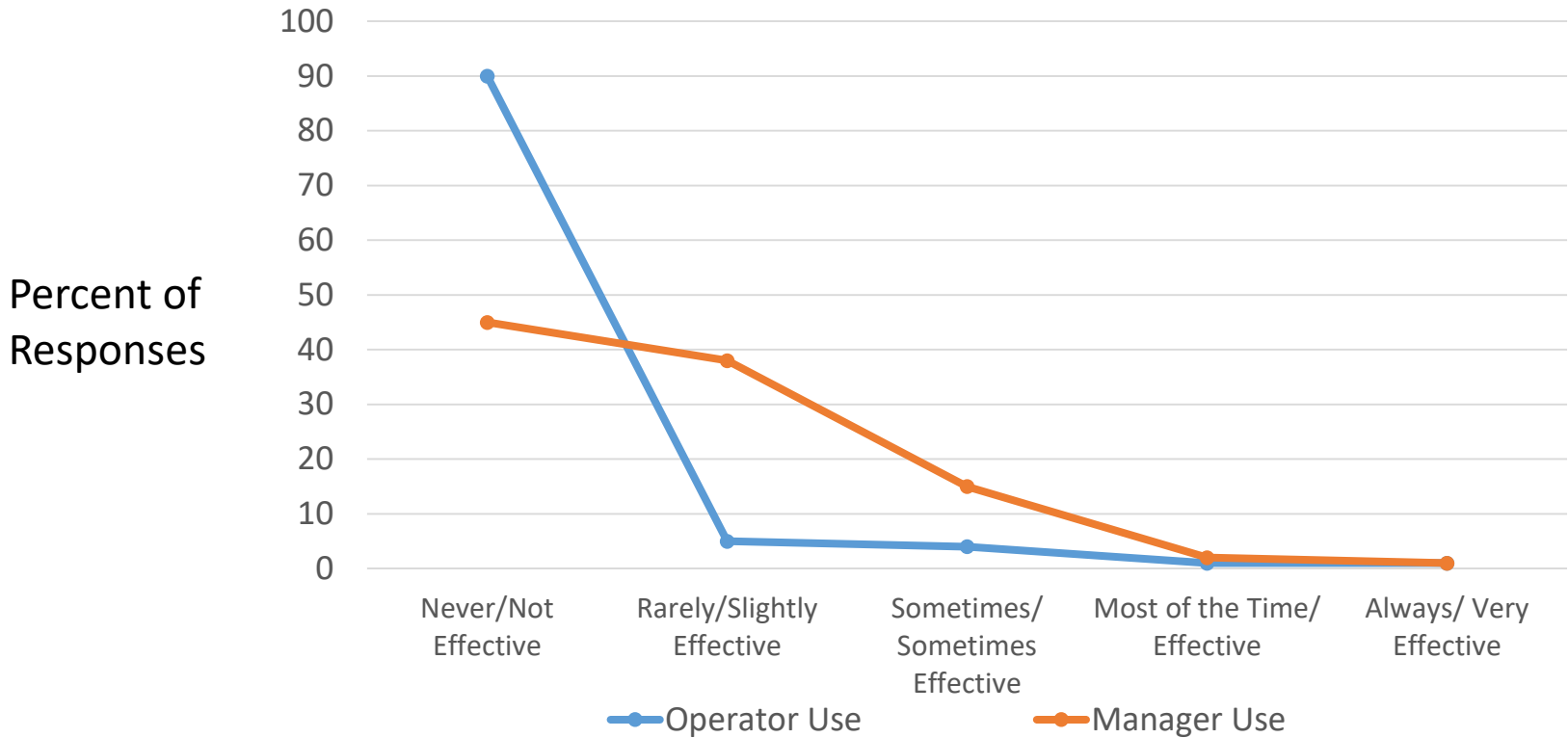


Figure 38. Use and Effectiveness of Over-the-counter Stimulants Reducing Fatigue

Questionnaire Results

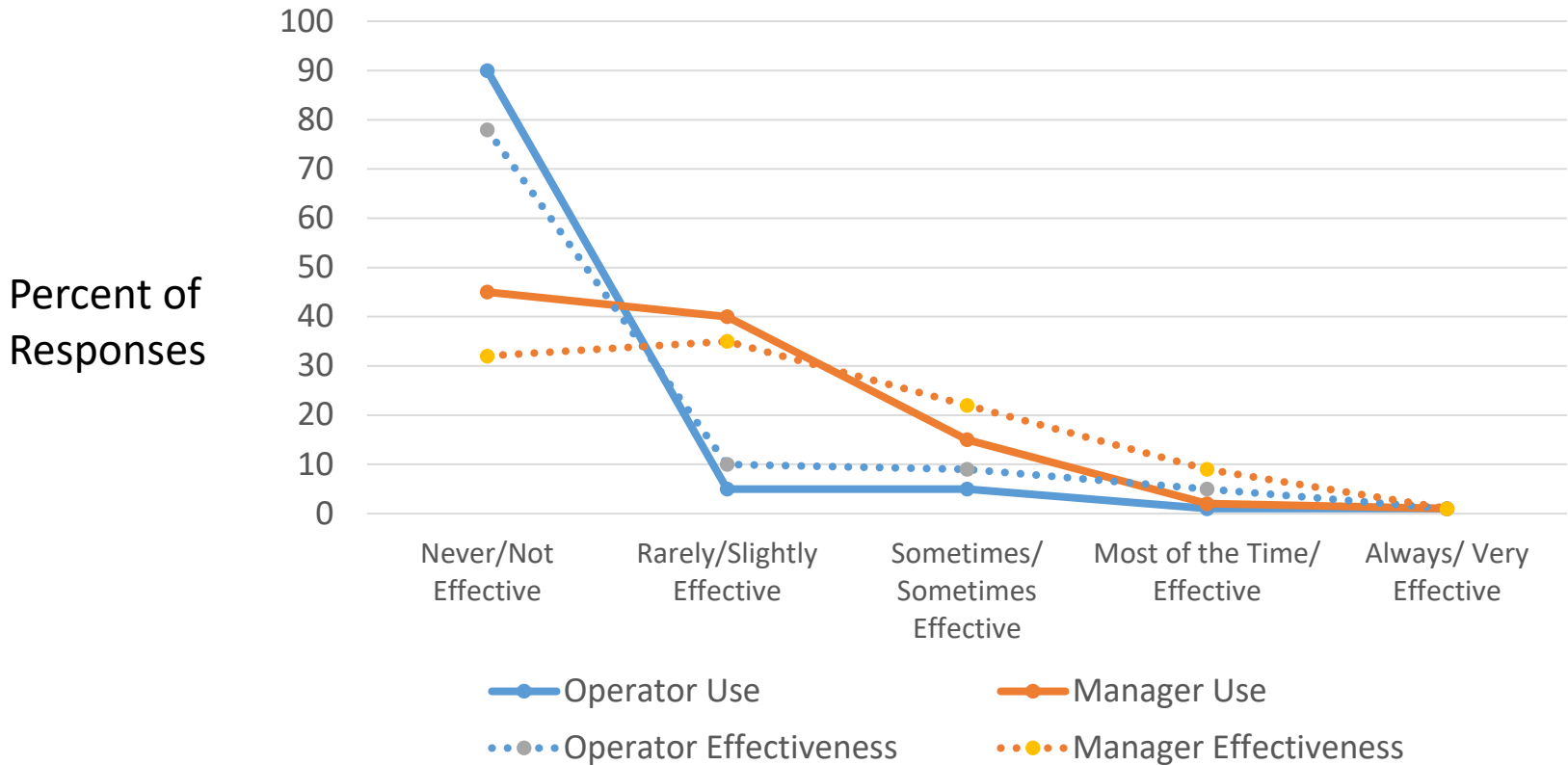


Figure 38. Use and **Effectiveness** of over-the-counter Stimulants in Reducing Fatigue

Questionnaire Results

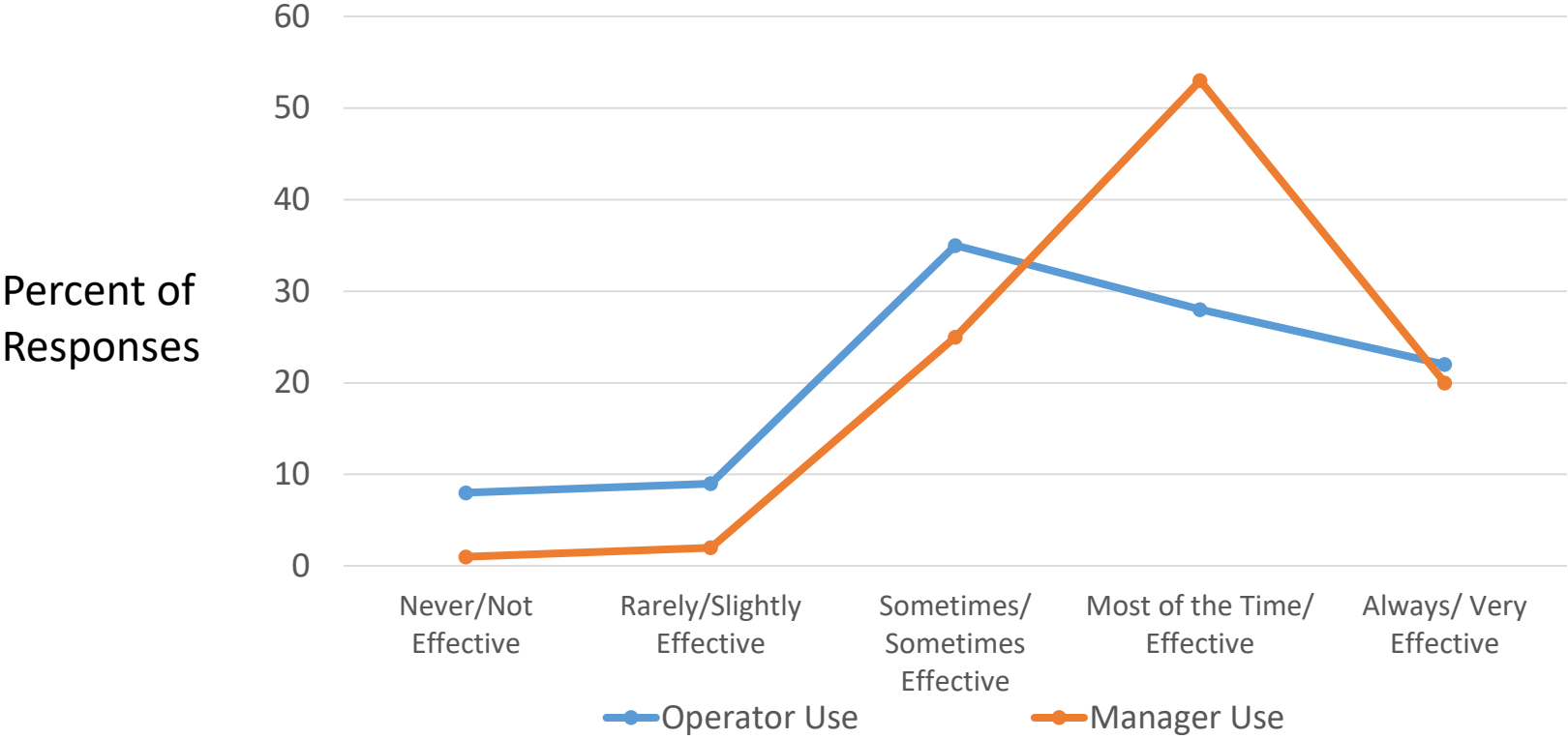


Figure 39. Use and Effectiveness of Caffeine in Reducing Fatigue

Questionnaire Results

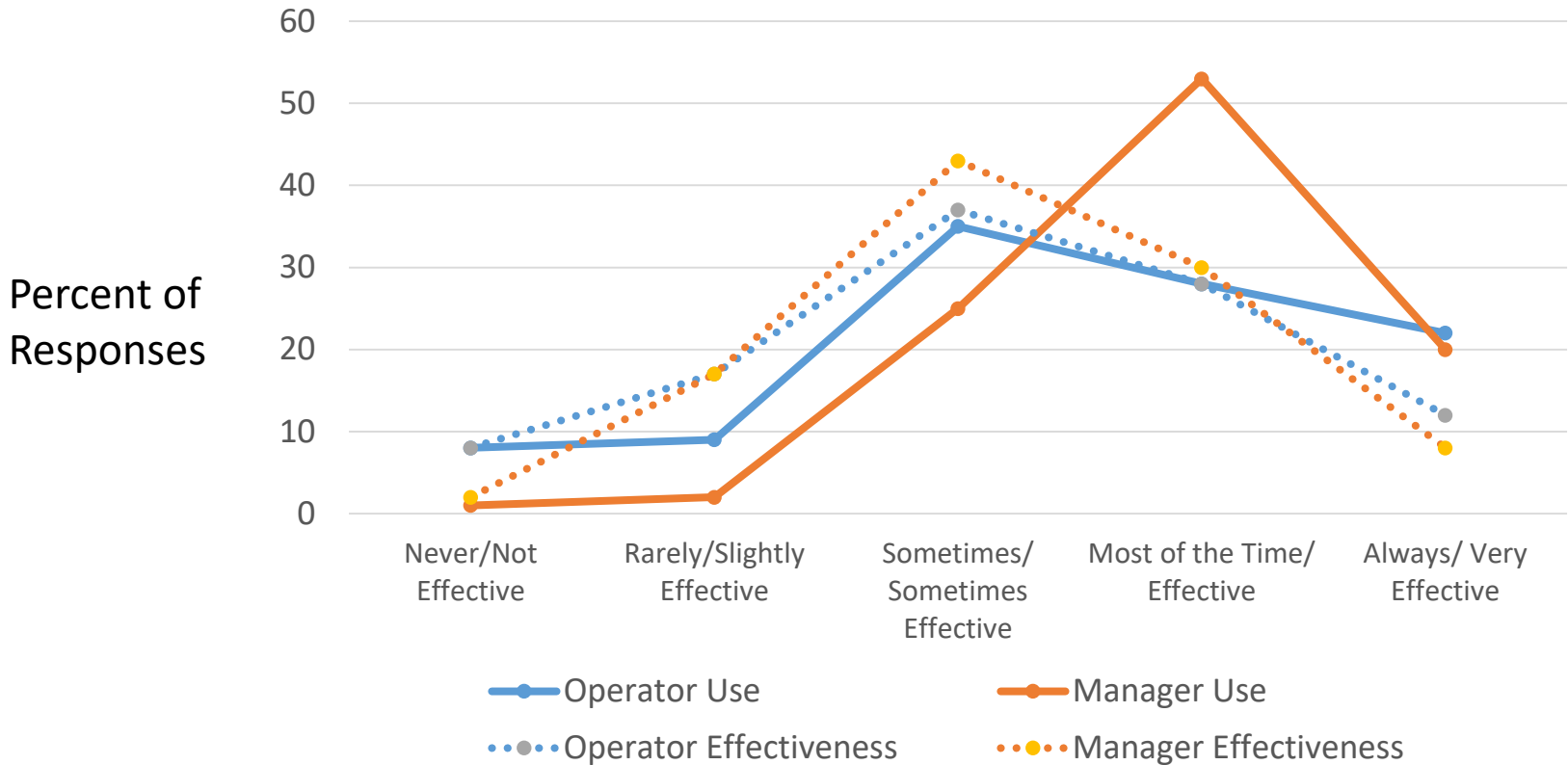


Figure 39. Use and **Effectiveness** of Caffeine in Reducing Fatigue

Some Recommendations

- Encourage use of breaks/naps
- Encourage winter maintenance operator fatigue reporting
- Increased vehicle maintenance
- Investigate winter emergency shift start/end times

Some Recommendations cont.

- Offer shift options
- Involve winter maintenance operators in the decision making process
- Increase personal interactions with winter maintenance operators
- Free resources available

Other Recommendations?

- What works for you?
- Healthy Snacks?
- Stay away from
- Other “outside of the box” recommendations?

Snowplow Operation: Unique Issues in Fatigue Risk Management

Marlene Reimer¹, Adam Moscovitch¹, Ron
Heslegrave², Matthew Kealey¹

*1 Canadian Sleep Institute
Calgary, Alberta*

*2 Research Ethics Board
University Health Network
Toronto Ontario*

Snowplow Operation: Unique Issues in Fatigue Risk Management

There was little awareness of the impact of fatigue and cumulative sleep debt.

- In fact there was a certain heroic quality associated with how long operators could keep working.
- That attitude still prevails today as evidenced by headlines from the past three winters picked up while doing an internet search on snow clearing.
- The length of time that crews were out was seen as evidence of their dedication to the public good.

Snowplow Operation: Unique Issues in Fatigue Risk Management

- There was strong agreement among operators themselves and their supervisors that, when working in storm conditions,
- Operators were energized by adrenalin,
- Motivated by a sense of protecting people,
- Reinforced by pride in the job.

Snowplow Operation: Unique Issues in Fatigue Risk Management

- Thus the role under storm conditions was seen as having more similarities to other emergency operations than to the routine nature of most motor carrier operations.

Snowplow Operation: Unique Issues in Fatigue Risk Management

- Furthermore, their sense of protecting people was very personal.
- Because of a requirement that they live within 30 minutes of their base of operations, the people they were protecting were their friends and neighbors.
- Several operators made statements such as “it is my wife driving on that road”, “my kids are on that school bus” or “my neighbors who count on us for the roads to be safe.”

Snowplow Operation: Unique Issues in Fatigue Risk Management

- Operators often have responsibility for certain stretches of roads and take much personal pride in getting their stretch done well.

**A special message for all the men
and women working to keep us safe
through the storm:**



WE SALUTE YOU!



To Those Who
Plow

Thank You

Questions?

Paul Albritton

Technical Training Coordinator

Iowa Local Technical Assistance Program (LTAP)

Institute For Transportation (InTrans)

Iowa State University

palbritt@iastate.edu

515-294-1231

