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Impact of Sleep on Adolescents' Pain and Recovery after Surgery

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**38TH
ANNUAL
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Disclosures

- Consult on pediatric trial design for Pacira Pharmaceuticals (not discussed in this presentation)
- This presentation does not contain off-label or investigational use of drugs or products

Objectives

1. Illustrate the role of sleep in recovery after surgery
2. Discuss the impact of surgery on sleep
3. Identify treatment approaches to improve perioperative sleep and pain

Outline



Recovery model: factors influencing postsurgical pain and recovery



CLINICAL CASE



Chief Complaint: Brittney, 15 y/o girl, presents to pain clinic with complaints of ongoing back pain.

HPI: S/p spine fusion for scoliosis 8 months ago. Initially had problems with pain in the hospital and at home. At last follow up, pain was improving; discharged from ortho clinic with plan for routine follow up at 1 year.

ROS: Mild depression and trouble sleeping, sees a counsellor.

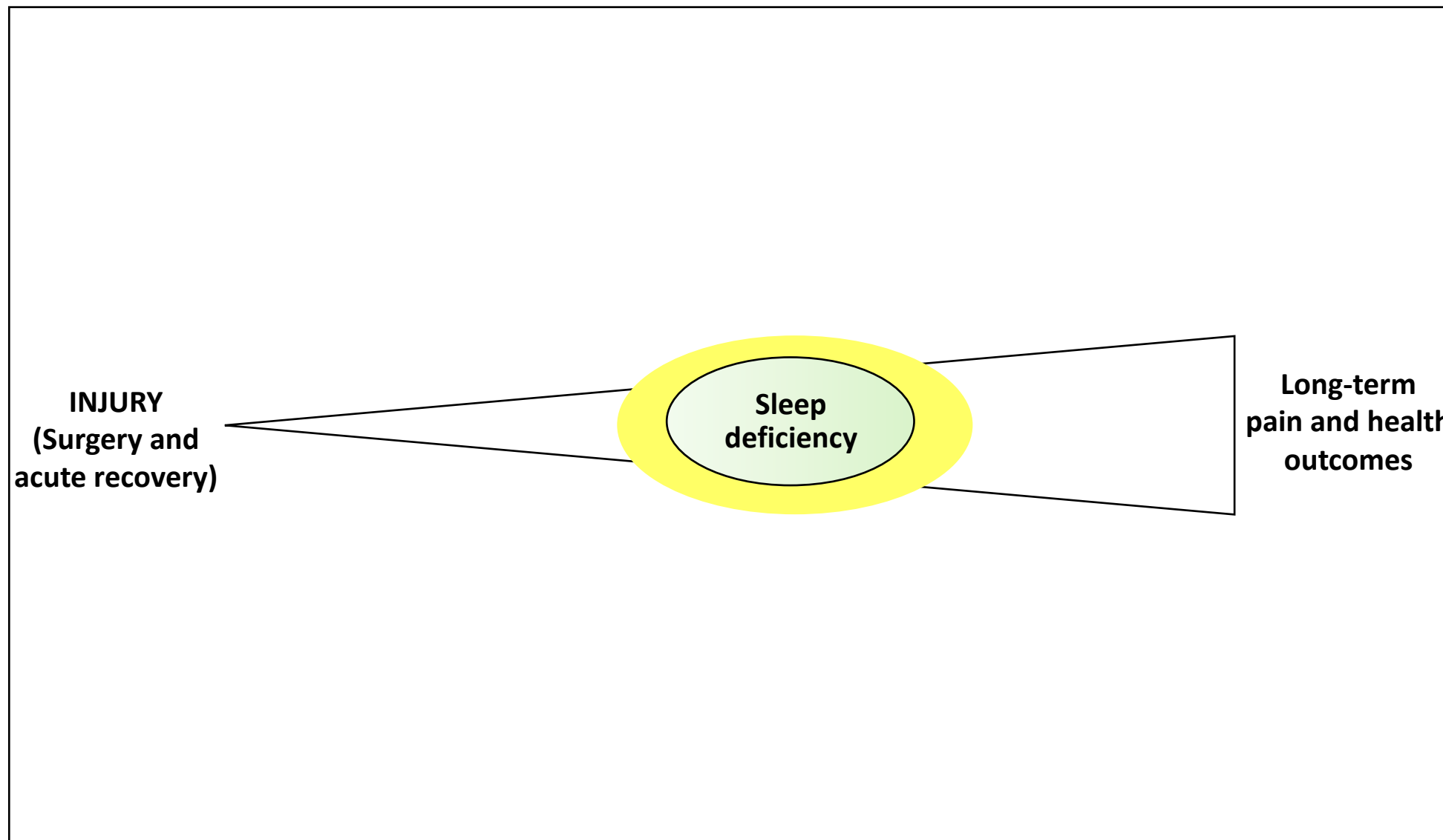
Social History: Family having trouble coping. Brittney missing a lot of school due to pain. Has not resumed track or soccer.

Physical Exam: Well healed scar, no inflammation. Otherwise normal systems exam.



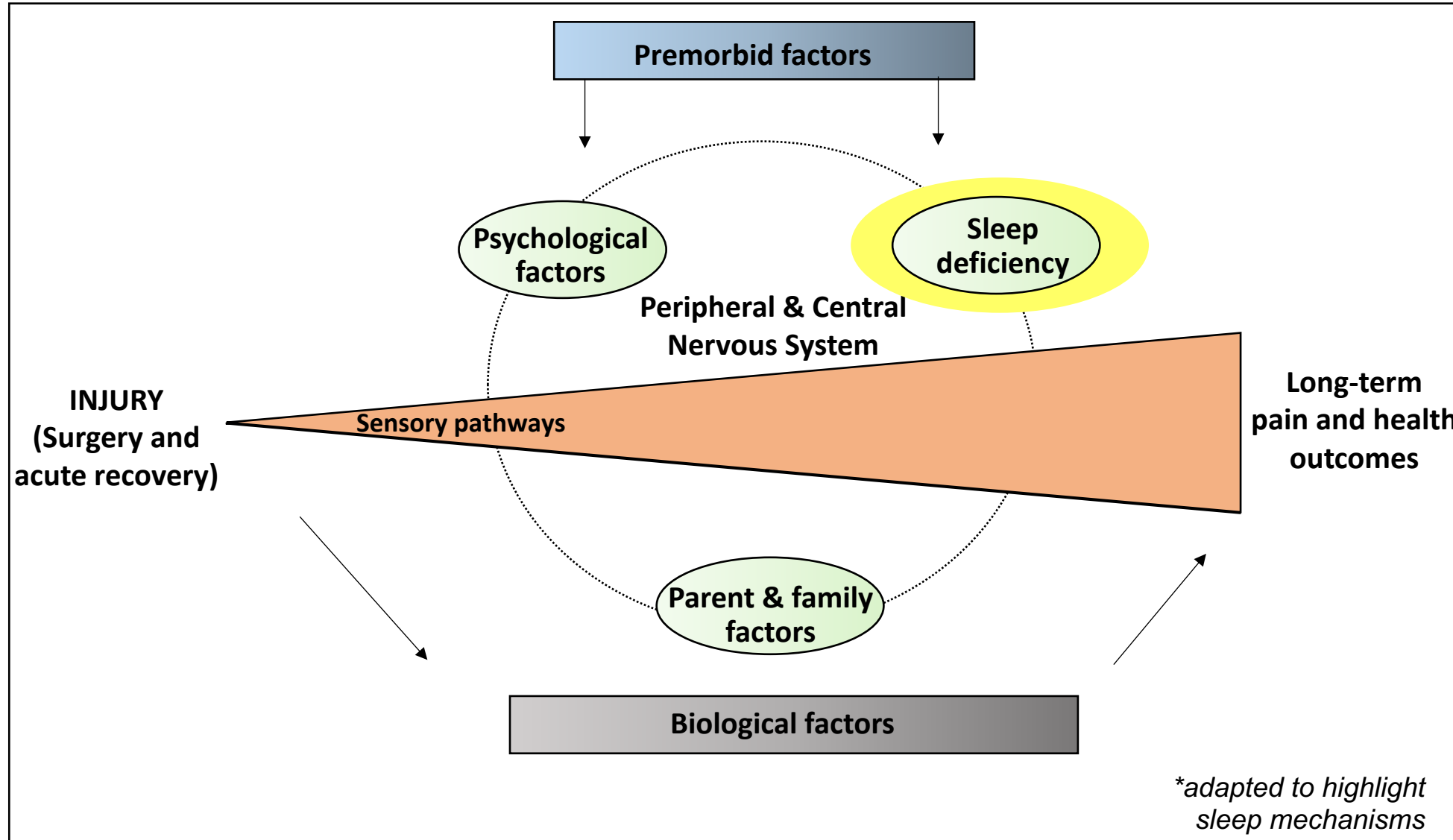
Pain and recovery after surgery

- 1 million youth undergo inpatient surgery each year in U.S.
 - 80% of adolescents experience high pain and impaired quality of life at 2-weeks following major surgery
 - 20% of adolescents report chronic pain after major surgery
- Identifying factors driving poor recovery is critical to improving short- and long-term postsurgical outcomes



Rabbitts et al.
J Pain Research
24(13):3071-
3080, 2020

Figure 1. Conceptual model of biopsychosocial factors influencing postsurgical pain and recovery in children and adolescents.



Rabbitts et al.
J Pain Research
24(13):3071-
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Elman & Borsook,
Neuron 2016

Katz & Seltzer,
Expert Rev
Neurother 2009

Figure 1. Conceptual model of biopsychosocial factors influencing postsurgical pain and recovery in children and adolescents.



Perioperative sleep deficiency

Insufficient quantity and quality of sleep

- Pre-existing sleep disturbance
- Postoperative sleep disturbance

Biological and Psychosocial Changes affecting Adolescent Sleep

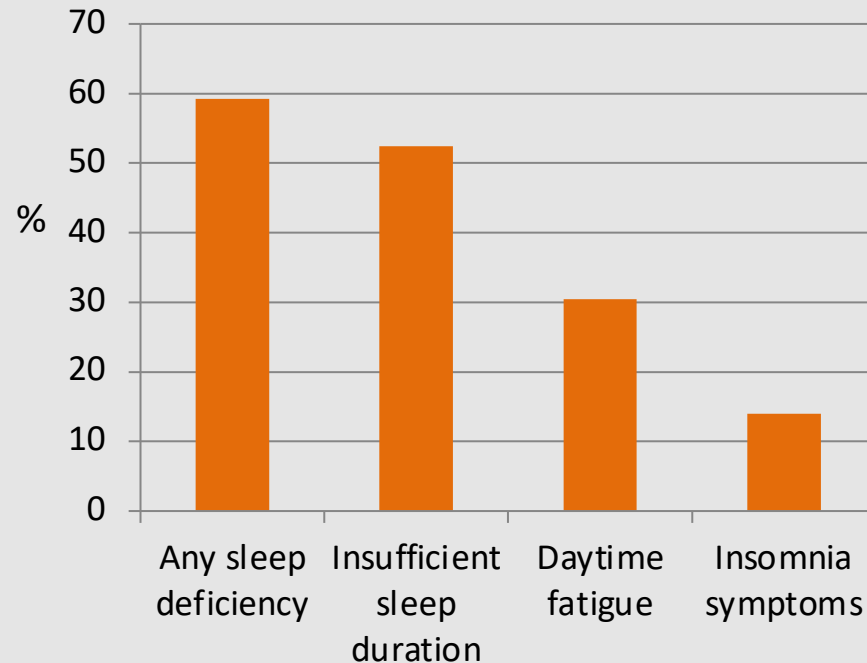
- Circadian process = delayed phase (with puberty) ~2 hrs
- Evening activities
- Academic demands
- Early school start times
- Increased independence
- Cultural values re sleep
- Electronics and social media
- “Social jet lag”

Jenni, et al. Sleep. 2005;28(11):1446-54;
Hansen et al. Pediatrics. 2005;115(6):1555-61.
Baiden et al, Psych res 2019;281:112586.



Common Behavioral Sleep Problems

National Longitudinal Study of Adolescent to Adult Health
(n = 12,213)



- Inadequate duration of sleep for age
- Difficulty initiating sleep
- Difficulty maintaining sleep
- Poor sleep habits/sleep hygiene

Often a combination of these problems

What about after surgery?

- Impacted by anesthesia, pain, opioids, and hospitalization
- Anesthesia and surgery acutely delays onset of nocturnal melatonin secretion
- Tightly linked to autonomic and immune pathways
- Insufficient sleep alters pain sensitivity and pain modulation

Sivertsen et al, Pain 2015

Finan et al, J Pain 2013

Kärkelä et al, Acta Anaesth Scand 2002



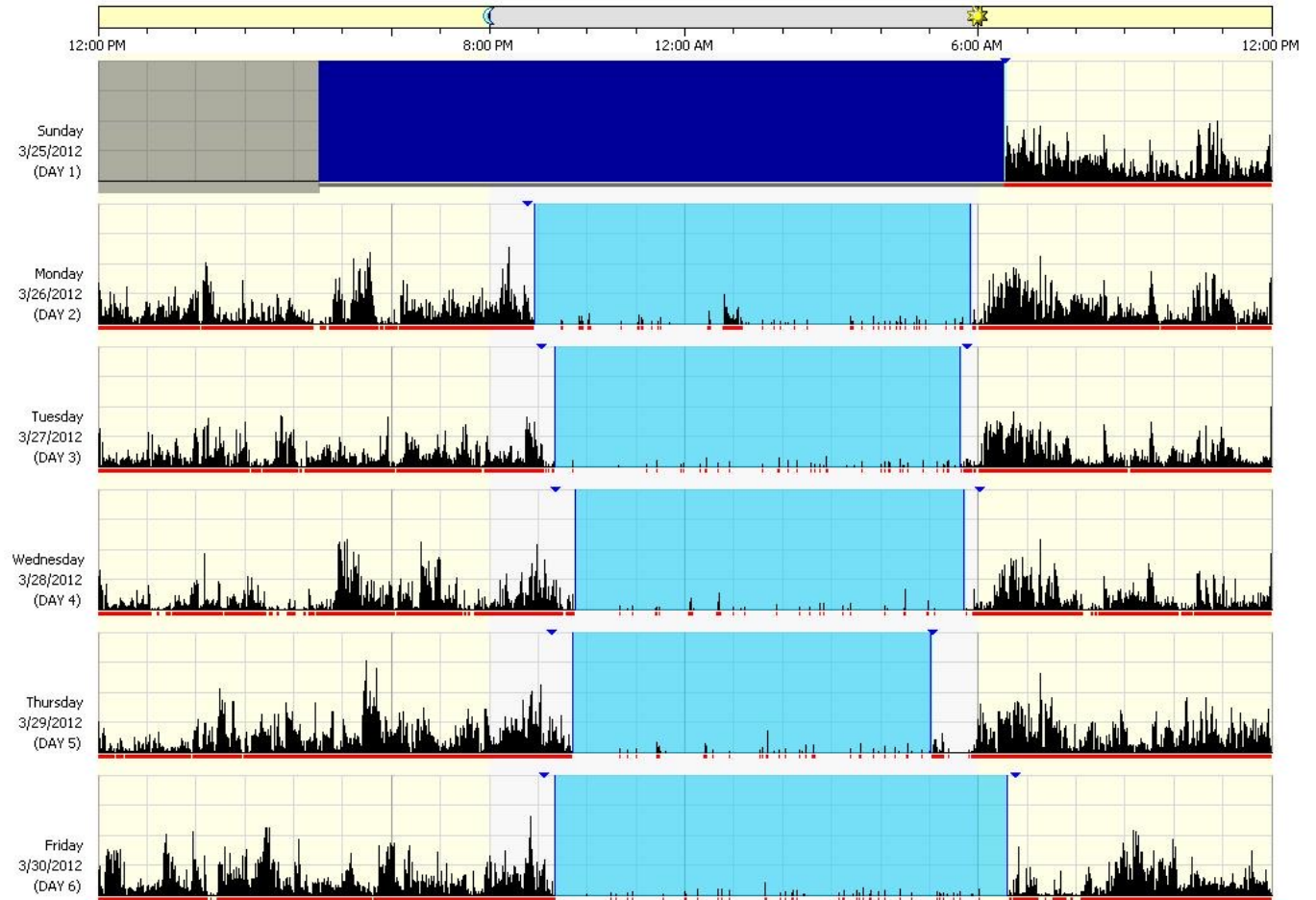
How do we assess sleep?

- Sleep quality
- Measures
 - Insomnia symptoms
 - Nocturnal behaviors
 - Daytime behaviors
 - Sleep habits and physical environment
- Sleep patterns (actigraphy)
 - Sleep time
 - Sleep continuity



Actigraphy

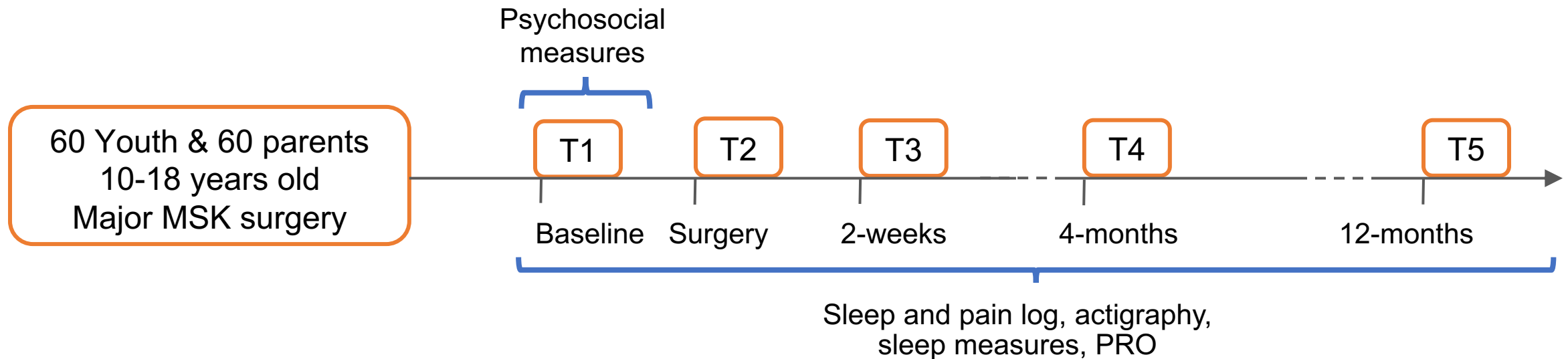
- Records movement, is generally worn on the wrist
- Continuous recording
- Common measurements: sleep time, sleep efficiency
- 91-97% agreement with PSG sleep in adolescents



Data Generated - Actogram

Presurgical Psychosocial Predictors of Acute Postsurgical Pain and Quality of Life in Children Undergoing Major Surgery

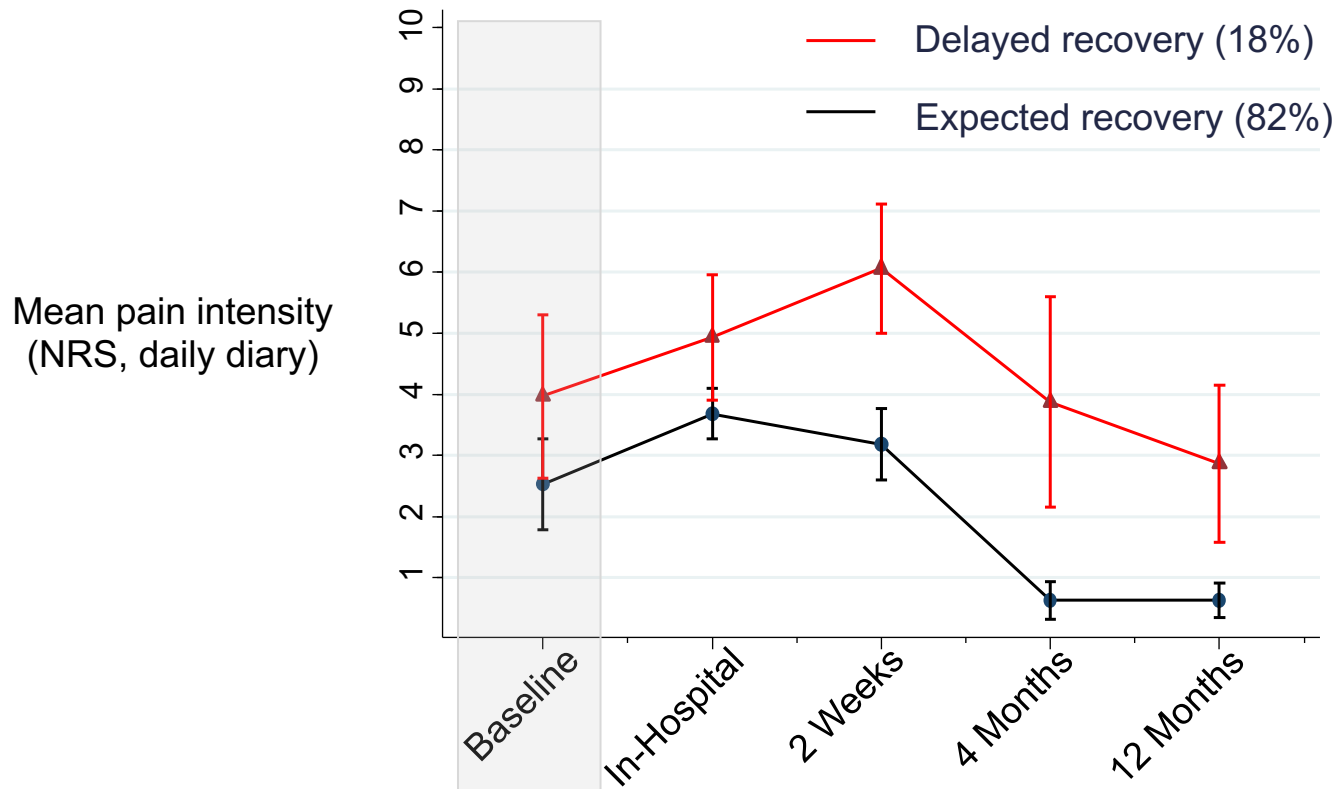
Jennifer A. Rabbitts,^{*,†} Cornelius B. Groenewald,^{*,†} Gabrielle G. Tai,[†]
and Tonya M. Palermo^{*,†}



- 80% of youth experience moderate-severe **acute** pain and poor QOL
- **Sleep deficiency** before surgery predicts poorer acute pain outcomes

Trajectories of postsurgical pain in children: risk factors and impact of late pain recovery on long-term health outcomes after major surgery

Jennifer A. Rabbitts^{a,b,*}, Chuan Zhou^{c,d}, Cornelius B. Groenewald^{a,d}, Lindsay Durkin^d, Tonya M. Palermo^{a,c,d}



Higher functional disability
Lower activity levels (actigraphy)
Poorer HRQOL
Higher healthcare costs



Sleep disruption drives pain persistence

Longitudinal and Temporal Associations Between Daily Pain and Sleep Patterns After Major Pediatric Surgery



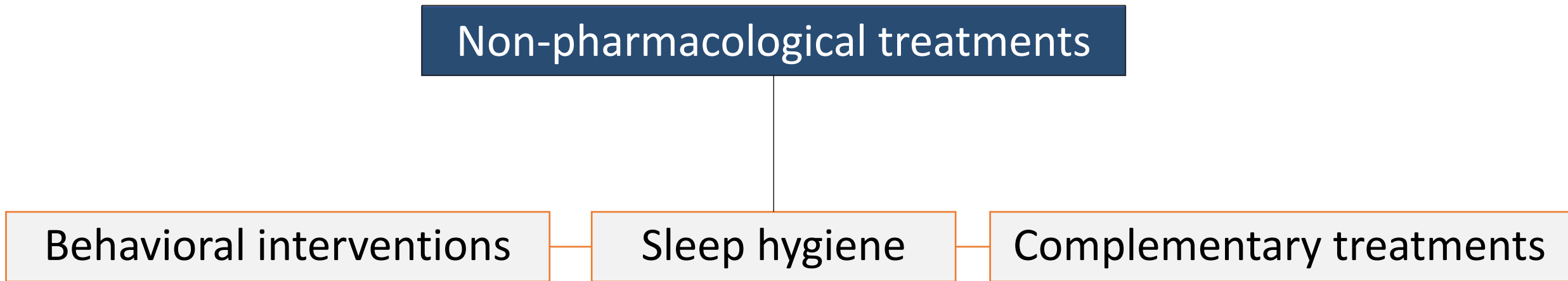
Jennifer A. Rabbitts,^{*,†} Chuan Zhou,^{‡,§,¶} Arthi Narayanan,^{||} and Tonya M. Palermo^{*,†,¶}

- 2/3 reported insomnia symptoms after surgery
- Sleep quality and efficiency reduced at 2-weeks

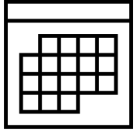


Figure. Nighttime sleep predicts next day pain over the 4 months following surgery

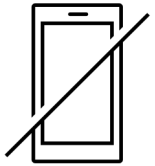
Treatment of behavioral sleep disturbances



Example of Sleep Hygiene Interventions



Make a schedule to allow for 9 hours of nightly sleep



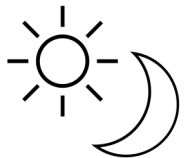
Remove television and electronics from bedroom



Establish positive bedtime routine and waking routine



Use alarm clock to awaken in the a.m.

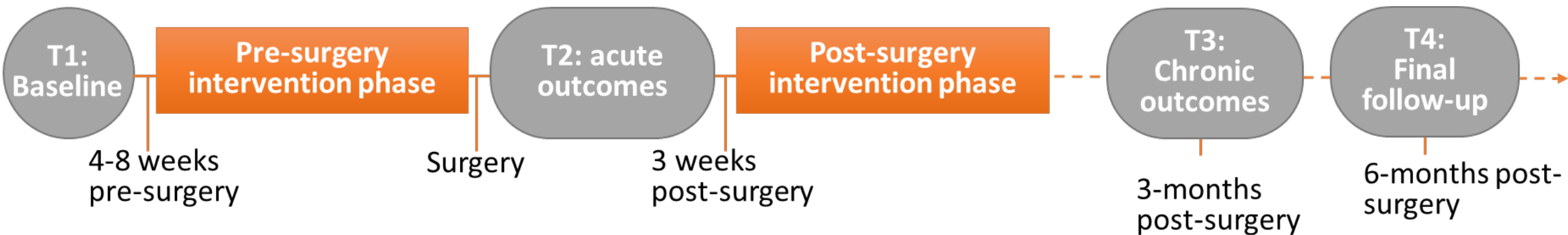


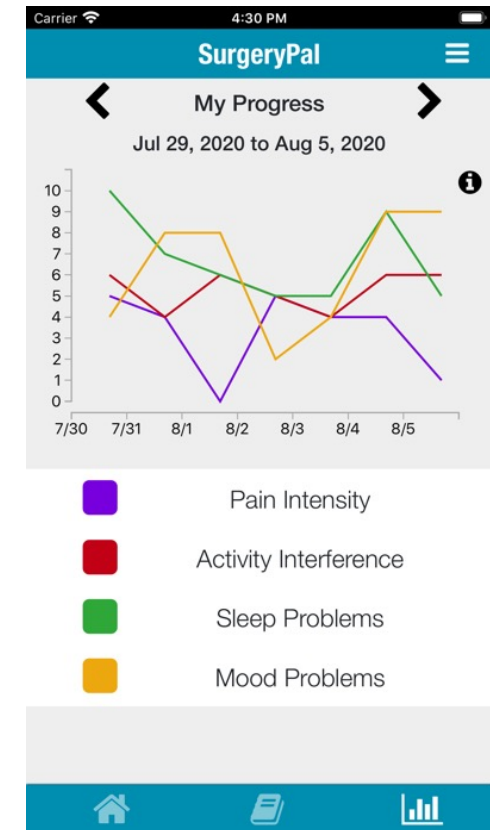
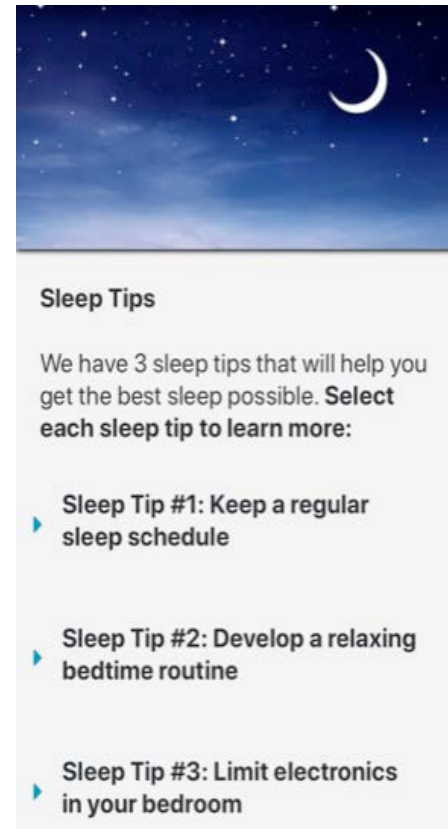
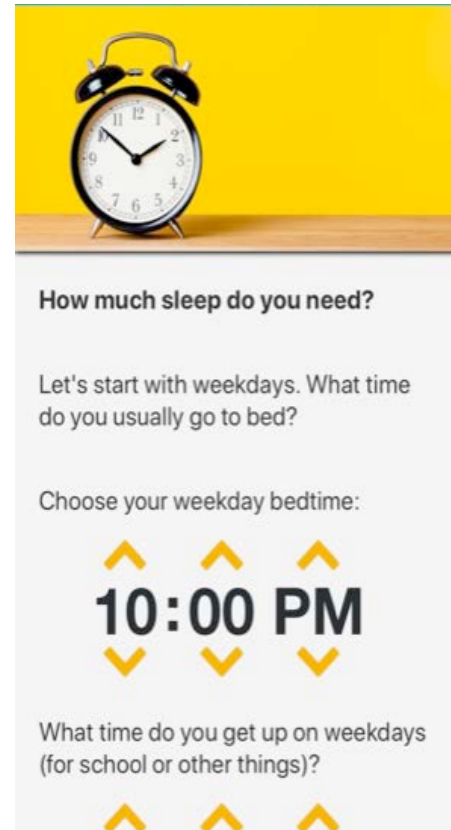
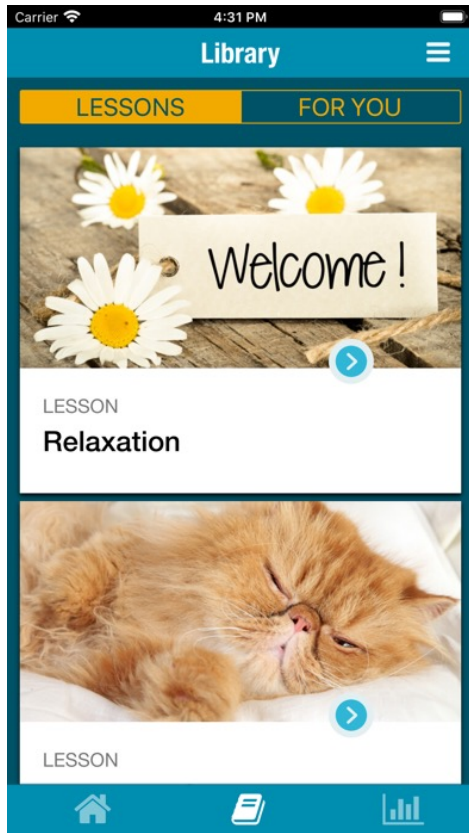
Keep a consistent weekend/weekday sleep schedule
(≤ 1 -2 hr variation)



Study Design: Multisite RCT testing mHealth behavioral intervention targeting sleep, anxiety, pain self-management (SurgeryPal) in 500 adolescents undergoing spinal fusion surgery

Objective: Examine effectiveness of SurgeryPal to improve acute and chronic pain and health outcomes





Mobile App Behavioral Program for Adolescents

Acute Phase Outcomes

- **Primary:** Recovery trajectory of pain intensity and interference over 14 days
- **Secondary:** Opioid use

Chronic Phase Outcomes

- **Primary:** Daily pain intensity and interference at 3 and 6 months
- **Secondary:** Prevalence of CPSP; Quality of life; psychosocial distress; sleep quality



Implications



Sleep deficiency is common in adolescents and may be exacerbated after surgery.



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Pediatric Pain and Sleep Innovations Lab

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Acknowledgments



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Health research throughout the lifespan

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NIAMS

NIH National Institute of Arthritis, Musculoskeletal
and Skin Disease (NIAMS) R01AR073780 (PI- Rabbitts)



NIH NICHD & Helping to End Addiction Long-term
(HEAL) and NICHD: UG3HD102038 and UH3HD102038-
02S1 (SurgeryPal RCT; MPI- Rabbitts, Palermo)



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