

OBJECTIVE

The average time from symptom onset to a diagnosis of narcolepsy is more than 10 years, leading to diminished quality of life, functional impairment, and risk for accidental injury.¹ The delay in diagnosis seems to be related to mildness of initial symptoms, gradual onset, lack of recognition, or mistaken diagnosis. Patients are often misdiagnosed with other disorders of sleepiness, such as sleep deprivation or obstructive sleep apnea, and psychiatric disorders, such as attention-deficit/hyperactivity disorder or depression.^{1,2} A study was conducted to determine if an online educational intervention could improve neurologists' knowledge and competence in diagnosing narcolepsy based on criteria in the third edition of the International Classification of Sleep Disorders (ICSD-3) and the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5).

METHODS

The effectiveness of an online educational intervention focusing on the diagnosis of narcolepsy was analyzed using a pre-assessment/post-assessment study design.

INSTRUCTIONAL METHOD:

- The instruction format consisted of a 30-minute audio lecture with 25 synchronized slides for the target audience of neurologists.³
- Slides included bullet points, figures, graphics, and/or still images that summarized key points from the ICSD-3 and DSM-5 criteria for diagnosing narcolepsy.
- The lecture also included interactive, multiple-choice, intra-activity questions to provide elements of engagement and feedback.
- For learners wishing to view the program off-line, a transcript and slides were made available for downloading/printing.
- The activities were available on the Medscape Mobile application, ensuring real-time access by the many clinicians who rely on mobile devices for education.

Data Collection: The educational intervention launched online on June 18, 2014, and data were collected through August 18, 2014 (61 days).

ASSESSMENT METHOD:

- This study design compared participants' responses to questions before exposure to educational content (pre-assessment measurement) with the same participants' responses to the same questions placed after the educational content (post-assessment measurement).
- Linking pre-assessment and post-assessment participants allows learners to serve as their own controls. A paired 2-tailed t-test was used to assess whether the mean pre-assessment score was different from the mean post-assessment score.
- McNemar's χ^2 statistic was used to measure changes in responses to individual questions.
- P values were calculated for both t-test and χ^2 statistics to determine significance level (α). P values less than .05 are statistically significant.
- Cohen's d was used to calculate the effect size of the intervention. Effect sizes greater than 0.8 are large, between 0.8 and 0.4 are medium, and less than 0.4 are small.
- Categories of participant responses are defined in Table 1.

TABLE 1: Participant Response Categories

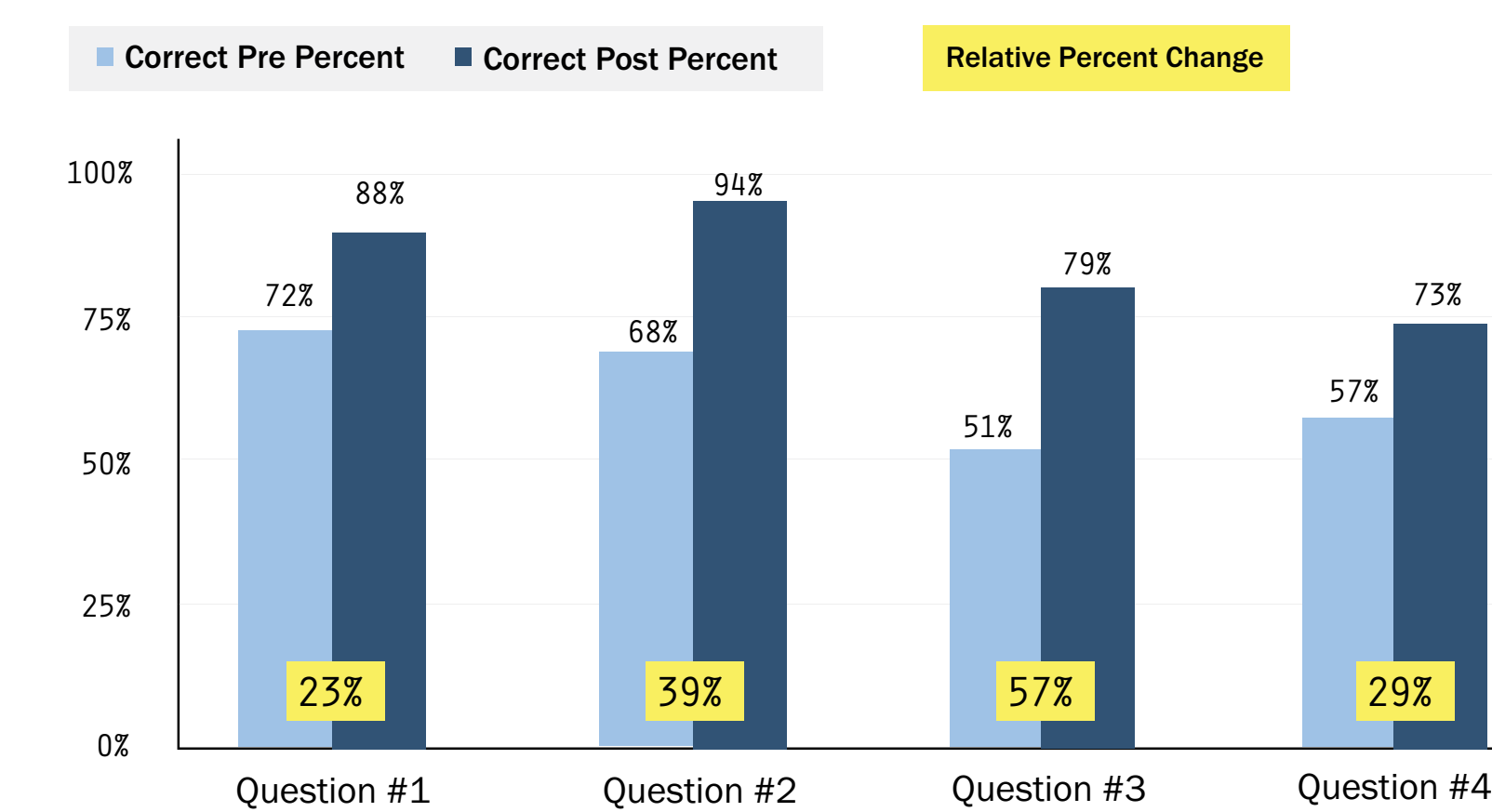
CATEGORY	DEFINITION
IMPROVED LEARNERS (green in pie chart)	Any incorrect response on pre-assessment, correct response on post-assessment
REINFORCED LEARNERS (blue in pie chart)	Correct response on both pre-assessment and post-assessment
UNAFFECTED LEARNERS (purple in pie chart)	Any incorrect response on post-assessment (with either correct or incorrect response on pre-assessment)

Please note that learners who answered the post-assessment correctly include those in both the "Improved Learners" and "Reinforced Learners" groups.

RESULTS

- For neurologists who participated in the online activity, comparison of assessment questions related to ICSD-3 and DSM-5 criteria for diagnosing narcolepsy demonstrated statistically significant improvements (n=188; $P < .05$) and a large effect ($d=0.883$). (Figure 1)

FIGURE 1: Percentage of participants with correct response by question and summary statistics.



Metric	Pre-Assessment	Post-Assessment
Sample Size	188	188
Mean (Correct Answers)	2.468	3.351
Standard Error	0.085	0.062
Median (Correct Answers)	3	4
Standard Deviation	1.172	0.849
Sample Variance	1.373	0.721
Effect Size	—	0.883
P Value	—	<.05

- As a result of participating in this educational program, significant improvements ($P < .05$) were observed in several specific areas:
 - Identification of cataplexy as a symptom virtually diagnostic of narcolepsy (23% improvement) (Figure 2)
 - Identification of common characteristics or symptoms associated with narcolepsy (39% improvement) (Figure 3)
 - Diagnosing narcolepsy type 2 (57% improvement) (Figure 4)
 - Use of diagnostic sleep studies for the differential diagnosis of narcolepsy (29% improvement) (Figure 5)

FIGURE 2: Linked learning education effect for question 1.

QUESTION 1:
Which of the following symptoms is virtually diagnostic of narcolepsy?
(Correct answer is highlighted in yellow.)

Pre- and Post-assessment Answer Responses: Overall Counts and Percentages			
	Neurologists (n = 188)	Pre-assessment % (n)	Post-assessment % (n)
A	Excessive daytime sleepiness	13% (25)	9% (16)
B	Sleep paralysis	9% (17)	3% (5)
C	Cataplexy	72% (135)	88% (166)*
D	Hypnagogic hallucinations	6% (11)	1% (1)

* $P < .05$

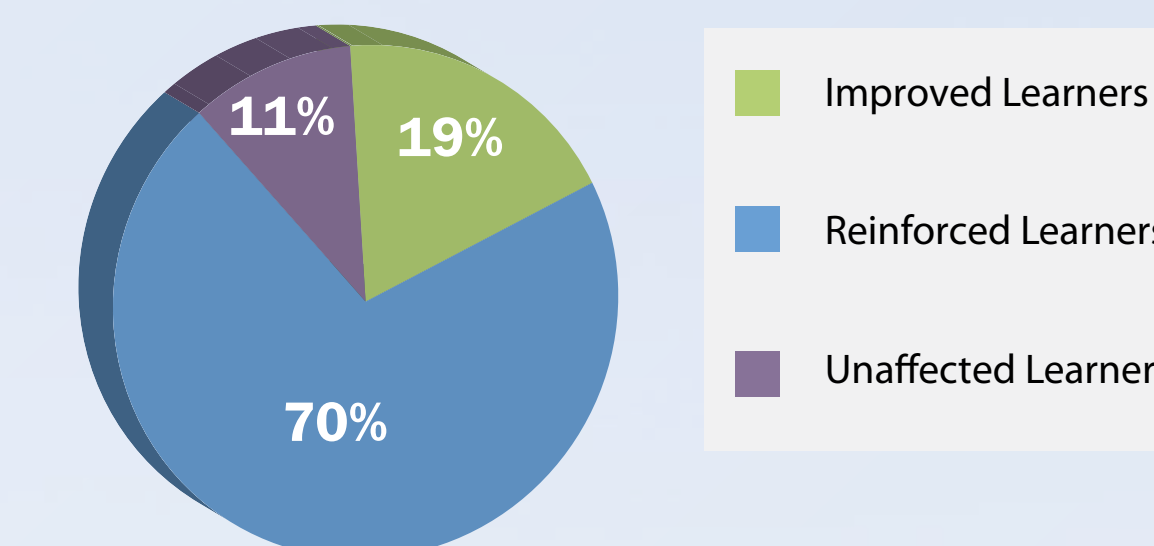


FIGURE 3: Linked learning education effect for question 2.

QUESTION 2:
Three of the following are common characteristics or symptoms associated with narcolepsy. Which one is not? (Correct answer is highlighted in yellow.)

Pre- and Post-assessment Answer Responses: Overall Counts and Percentages			
	Neurologists (n = 188)	Pre-assessment % (n)	Post-assessment % (n)
A	Nocturnal sleep disturbance	3% (6)	1% (1)
B	Weight loss within 6 months of symptom onset	68% (127)	94% (177)*
C	Increased frequency of obstructive sleep apnea	23% (43)	4% (8)
D	Restorative daytime naps	6% (12)	1% (2)

* $P < .05$

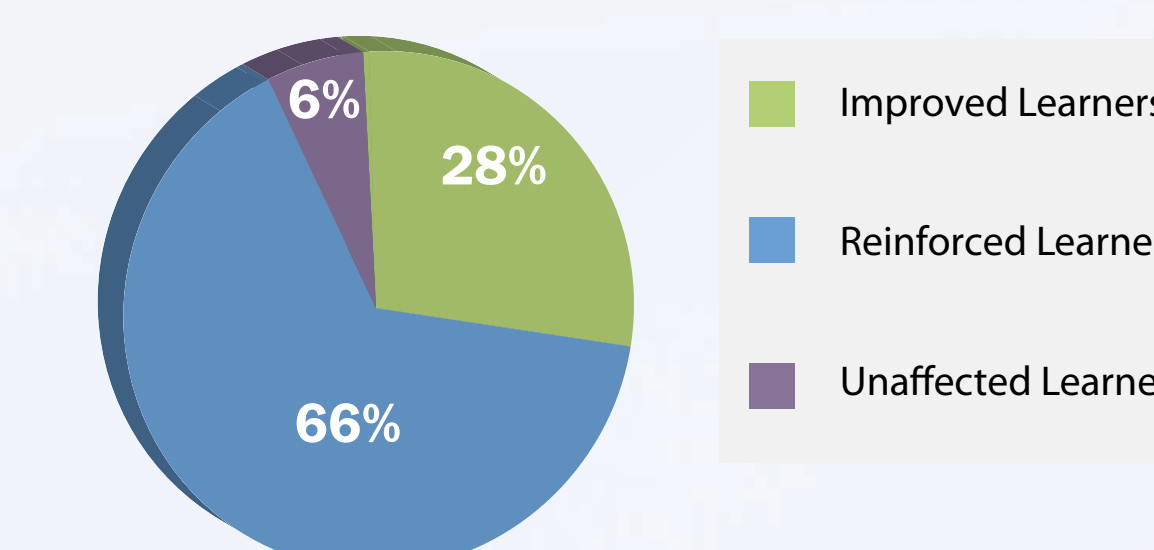


FIGURE 4: Linked learning education effect for question 3.

QUESTION 3:
Marco is a 22-year-old student with a history of daily irrepresible daytime sleep episodes. He generally gets to bed by midnight and awakens at about 7:00 to 8:00 AM. He also reports vivid dreams, particularly just as he is falling asleep. He denies experiencing sleep paralysis or cataplexy. Overnight sleep study is not remarkable except for a REM latency of 8 minutes. The MSLT shows a mean sleep latency of 4.5 minutes and 2 sleep-onset REM periods. His cerebrospinal fluid hypocretin level is greater than 110 pg/mL.

Which of the following would be the most appropriate diagnosis for Marco?
(Correct answer is highlighted in yellow.)

Pre- and Post-assessment Answer Responses: Overall Counts and Percentages			
	Neurologists (n = 188)	Pre-assessment % (n)	Post-assessment % (n)
A	Narcolepsy type 1	31% (59)	11% (20)
B	Narcolepsy type 2	51% (95)	79% (149)*
C	Idiopathic hypersomnia	13% (25)	7% (14)
D	Insufficient sleep	5% (9)	3% (5)

* $P < .05$

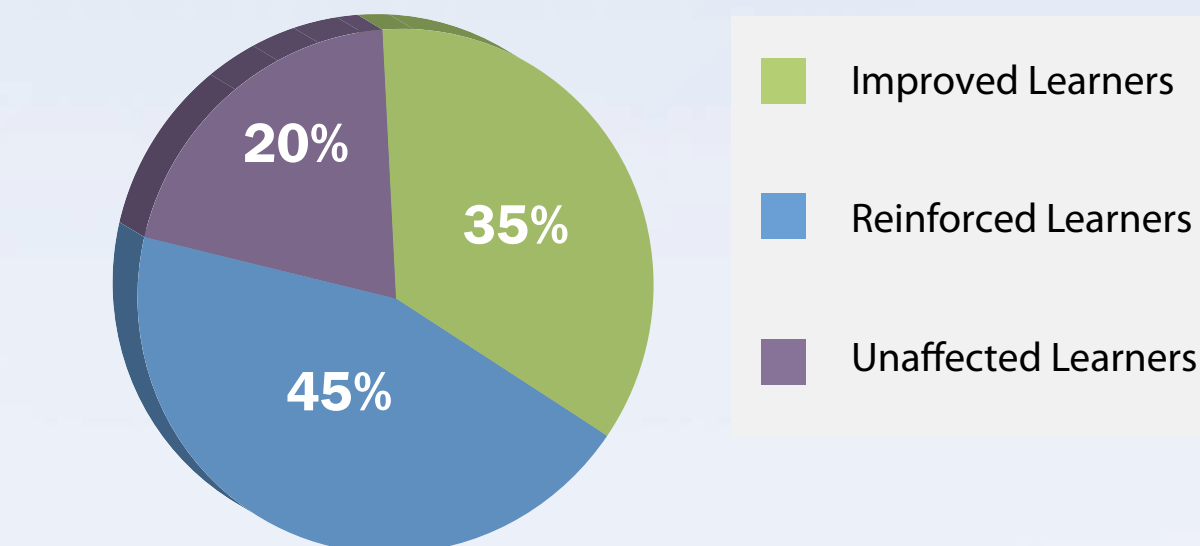
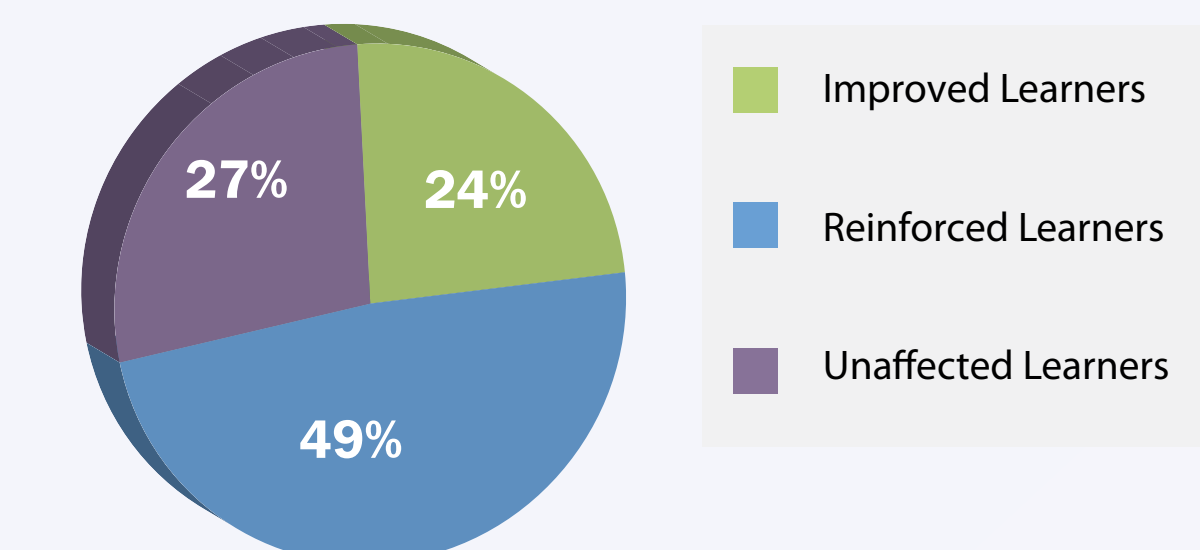


FIGURE 5: Linked learning education effect for question 4.

QUESTION 4:
The differential diagnosis of narcolepsy includes idiopathic hypersomnia, obstructive sleep apnea, circadian rhythm sleep-wake disorder, and insufficient sleep. In the absence of the ability to obtain hypocretin levels, sleep studies are essential to the diagnosis. Three of the following statements about diagnostic sleep studies are true. Which one is not? (Correct answer is highlighted in yellow.)

Pre- and Post-assessment Answer Responses: Overall Counts and Percentages			
	Neurologists (n = 188)	Pre-assessment % (n)	Post-assessment % (n)
A	Sleep logs and actigraphy for 1 to 2 weeks before MSLT are strongly recommended to rule out circadian effects and sleep deprivation	15% (28)	9% (16)
B	Overnight PSG must precede MSLT with a goal of documenting at least 7 hours of sleep	15% (29)	10% (19)
C	Screening for effects of medications or drug use is essential because MSLT results may be skewed by drug effects, making interpretation difficult	13% (24)	8% (15)
D	Because sleepiness may present differently in young children and their descriptions of related symptoms may be compromised, MSLT results are a reliable method for diagnosing narcolepsy in this population	57% (107)	73% (138)*

* $P < .05$



CONCLUSIONS

This study demonstrated the success of a targeted educational intervention on improving the knowledge and competence of neurologists in the use of ICSD-3 and DSM-5 narcolepsy diagnostic criteria. These metrics, with statistically significant improvements in all areas covered in education, provide strong evidence that well-designed, online, audio/video-based instruction is a useful methodology for knowledge transfer.

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