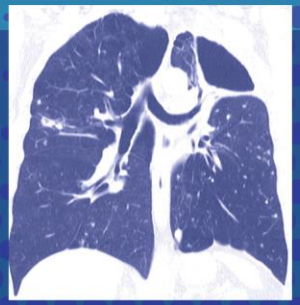
Personalized Medicine in Nontuberculous Mycobacteria:

Best Practices in Diagnosing and Managing NTM



CHEST Symposium Final Report

BEST HOSPITALS U.S.News NATIONAL PULMONOLOGY 2018-19

#1 in Respiratory Care

National Jewish Health®

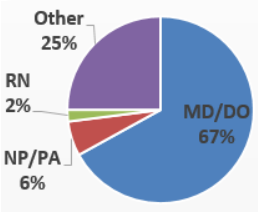
Breathing Science is Life.®

Personalized Medicine in Nontuberculous Mycobacteria: Best Practices in Diagnosing and Managing NTM

Program Dashboard: Live and Online

Total Participation Online and Live

283 live + 5,010 online = 5,293



>70,000 patients impacted per year

By specialty:
54% Pulmonary
14% Internal Medicine
13% Infectious Disease
19% Other

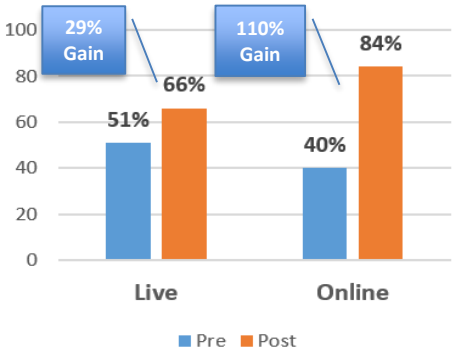
73%
Prescribers

Satisfaction

95% of respondents indicated that the activity improved ability to treat patients
97% of respondents indicated that the activity reinforced or improved current skills

"Great presentation! I wish MY infectious disease MD had practiced by these standards...I have MAC-intracellulare and none of what was presented today was done for me."

Educational Impact Summary



69% relative knowledge gain for live and online combined.

NARROWING THE GAPS BY LEARNING OBJECTIVE

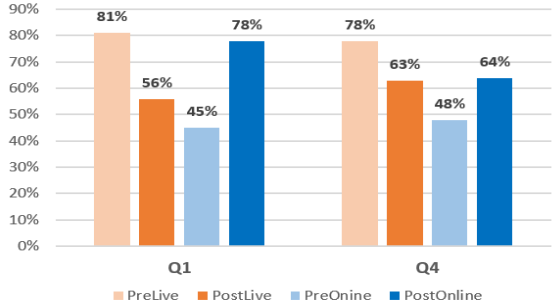
Identify personalized treatment goals in NTM	**80%** increase in knowledge from pre to post test
Review recent evidence, guidelines, and best practices	**56%** increase in knowledge from pre to post test
Describe strategies for patient adherence and treatment completion	**275%** increase in knowledge from pre to post test

Performance

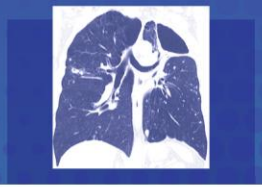
90% indicated that they Intended to make the following changes to practice:

- Identify specific species involved
- Review treatment approach
- Treat with inhaled amikacin

Persistent Gaps/Learning Needs



A potential gap persists related to the initial treatment of MAC (Q1) and identifying factors associated with improved outcomes for patients with M. abscessus (Q4)



Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

National Jewish Health®
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Qualitative Educational Impact Summary Live and Online

Participants

592
Total Completers

Who see
1,465
Patients with NTM per week

Which translates to
70,320
NTM Patient Visits Annually

Educational Impact

Knowledge and Competence Change

- Increased ability **to identify personalized treatment goals in NTM therapies** by **80%**
- Increased knowledge of **recent evidence, guidelines and best practices in treating NTM** by **56%**
- The ability to **identify the most important drug for macrolide-based MAC treatment regimens for preventing the emergence of macrolide resistance** had a relative knowledge gain of **176%**
- Understanding the **different subspecies where there is evidence that shorter durations of IV therapy may be acceptable for patients with NTM** had a relative knowledge gain of **373%**

Practice Change

71%
Reported changing their practice at 6 week follow-up

57%
Have modified their treatment plans

93%
Said this activity increased their knowledge of practice changes that may improve gaps in patient care within their health care system

Final Report: Faculty Presenters

Shannon H. Kasperbauer, MD (Program Director)
Assistant Professor of Medicine
Division of Mycobacterial and Respiratory Infections
National Jewish Health

Charles Daley, MD
Chief, Division of Mycobacterial and Respiratory Infections
Professor of Medicine
National Jewish Health

David E. Griffith, MD
Professor of Medicine
WA and EB Moncrief Distinguished Professor
Pulmonary Infectious Disease Section Chief
University of Texas Health Science Center

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Final Report – CHEST Symposium: Live Activity

Program Background & Objectives

Background

The innovative and multimedia live educational program was held as an adjunct symposium to the American College of Chest Physicians Annual Meeting (CHEST 2018). The goal was to improve the awareness, knowledge, and competency of **pulmonologists and infectious disease physicians** in the diagnosis, management, and treatment of NTM.

Target Audience: Pulmonologists and Infectious Disease Physicians are the primary target audience.

Objectives

- ✓ Identify personalized treatment goals in NTM according to patient's clinical presentation.
- ✓ Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.
- ✓ Describe strategies for patient adherence and treatment completion to improve patient outcomes.

Final Report – CHEST Symposium: Live Activity

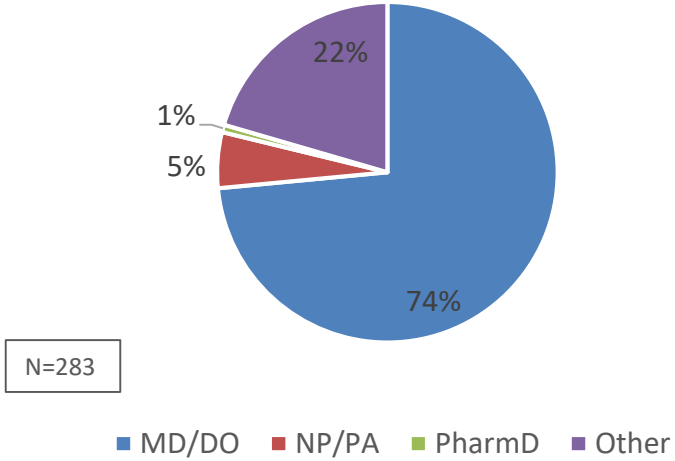
Outcomes Strategy

Outcomes Strategy:

Outcomes were measured via pre- and post-tests that contained one or more case-based questions that were distributed to measure the participant's knowledge and competence in the topics covered during this educational initiative. Evaluations were collected to understand participant's engagement in the activity, intention to change, and appropriateness of the learning modalities and content to achieve Moore's Level 4 outcomes.

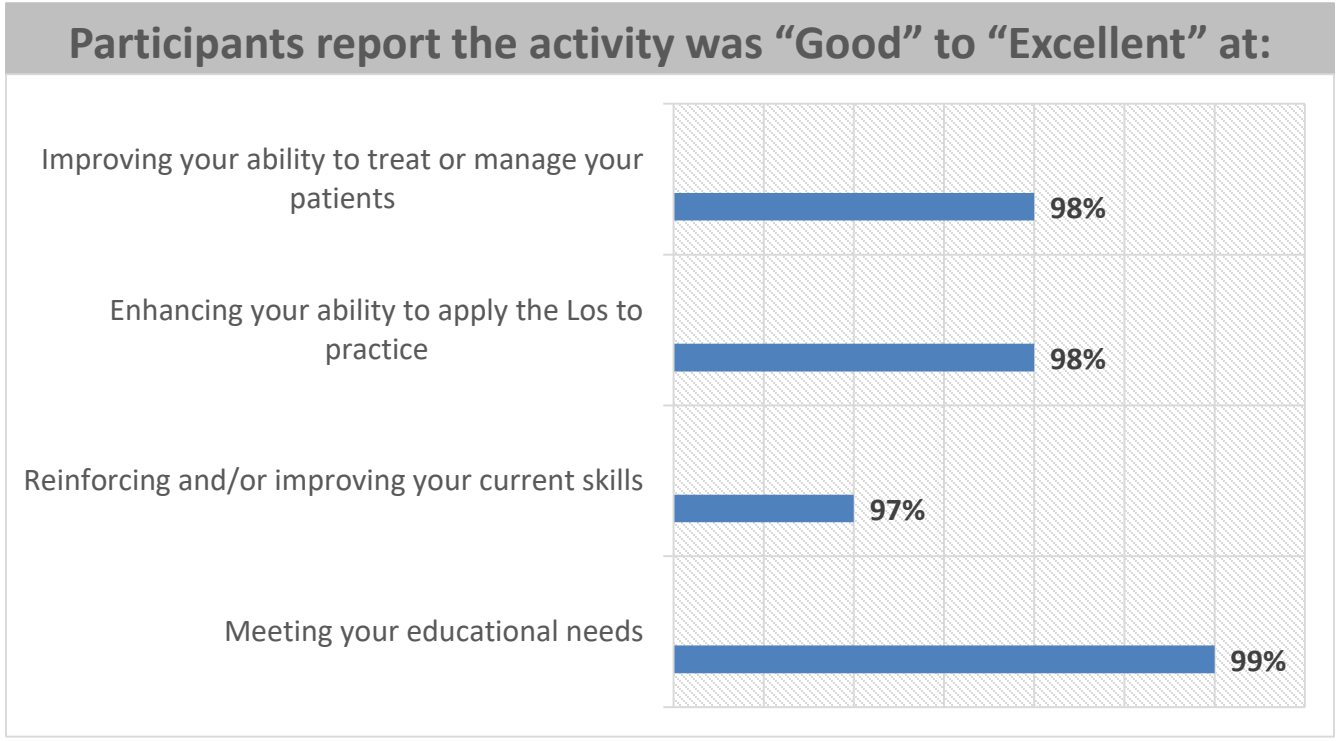
Final Report – CHEST Symposium: Live Activity

Level 1 Outcomes: Participation



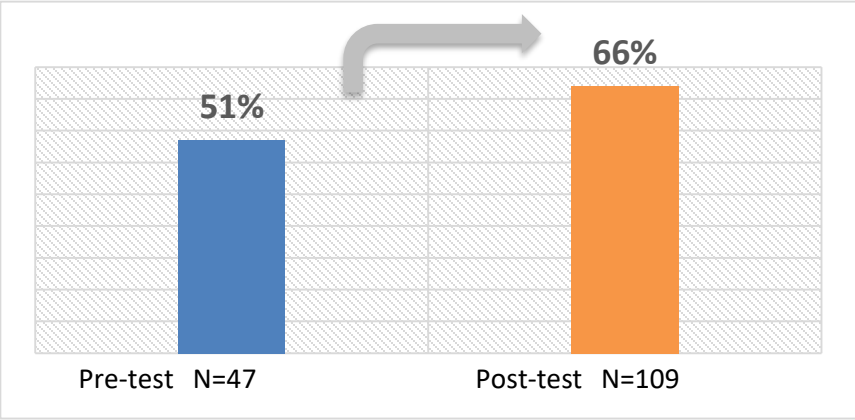
79% of learners are prescribers
94% of learners designated their specialty as pulmonology

Final Report – CHEST Symposium: Live Activity
Level 2 Outcomes: Learning & Satisfaction



N = 105

Final Report – CHEST Symposium:
Level 3&4 Outcomes: Knowledge/Competence (Pre-Test/Post-Test)



Level 3 and 4 outcomes were measured by comparing pre-and post-test answers. Attendees' responses to these questions demonstrated that **participants gained knowledge as a result of the activity.**

Overall relative knowledge gain from pre- to post activities

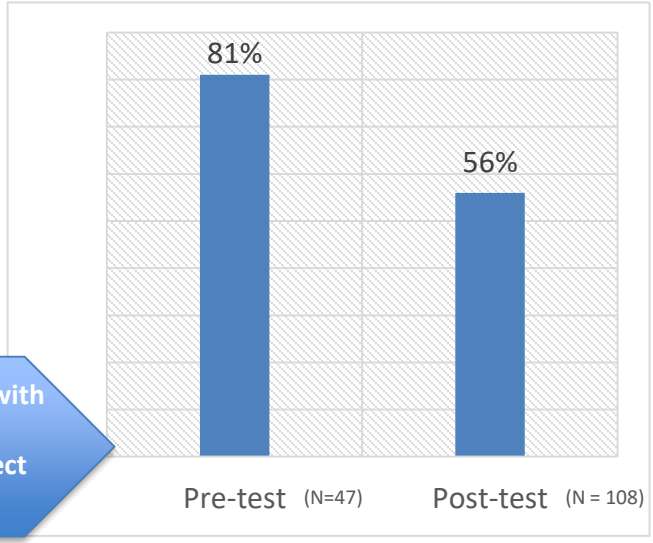
29%

Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 1)

Learning Objective: *Identify personalized treatment goals in NTM according to patient's clinical presentation.*

Q1: A thin, non-smoking, 60-year-old female presents with mild cough and multiple sputum specimens which are culture positive for MAC with subtle radiographic changes. She is active and her weight is stable. Would you:

A. Begin three times weekly multidrug therapy
B. Begin daily multidrug therapy
C. **Follow the patient without antibiotic therapy to evaluate the symptomatic and objective impact of MAC lung disease ✓**
D. Treat with clarithromycin or azithromycin mono-therapy

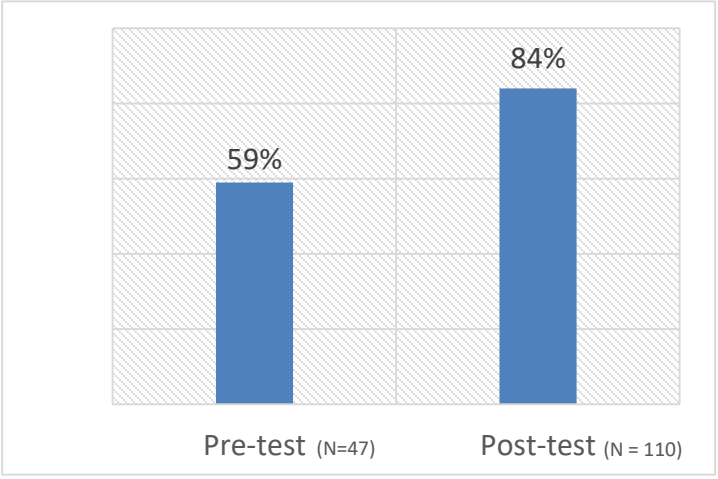


Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 2)

Learning Objective: *Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.*

Q2: In vitro susceptibility results for which of the following antibiotics predicts treatment response in MAC lung disease?

A. Ethambutol
B. Rifampin
C. Clarithromycin ✓
D. Clofazimine
E. Rifabutin

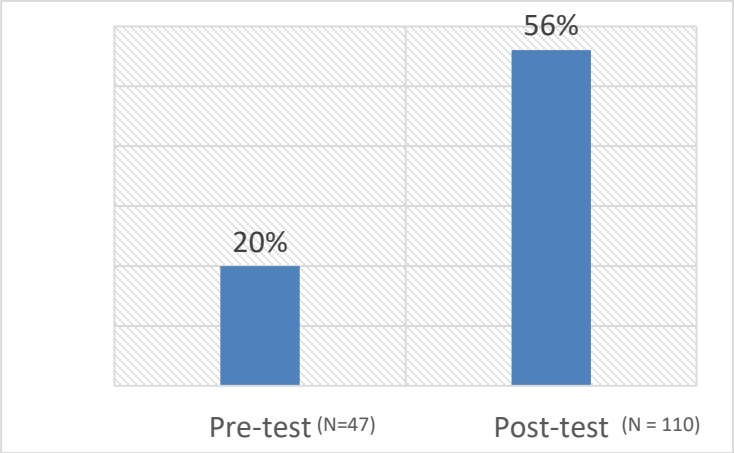


Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 3)

Learning Objective: *Identify personalized treatment goals in NTM according to patient's clinical presentation.*

Q3: A 58-year-old woman with pulmonary MAC has remained culture positive for 12 months despite treatment with azithromycin, rifampin, and ethambutol administered three times a week. She has nodular bronchiectatic disease without cavitation on her chest CT scan. Which of the following interventions has been associated with an increase in culture conversion?

A. Change her to daily therapy
B. Add clofazimine to the regimen
C. Add moxifloxacin to the regimen
D. Add inhaled liposomal amikacin
E. All of the above ✓



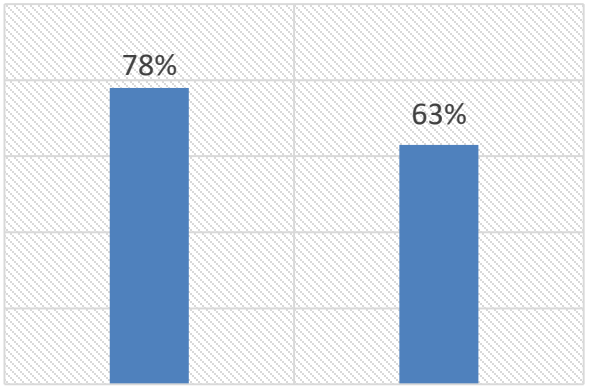
Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 4)

Learning Objective: *Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.*

Q4: Regarding M. abscessus pulmonary disease, which factor is associated with improved outcomes?

A. Younger age
B. Presence of M. abscessus subspecies bolletii
C. Isolated lingular infection
D. Clarithromycin susceptibility ✓

Persistent gap remains with 15% fewer respondents getting the answer correct in the post-test

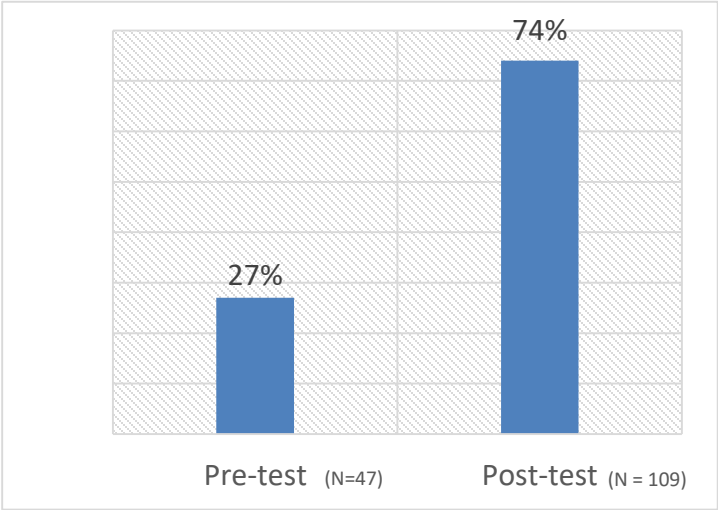


Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 5)

Learning Objective: *Describe strategies for patient adherence and treatment completion to improve patient outcomes.*

Q5: The most important drug in macrolide-based MAC treatment regimens for preventing the emergence of macrolide resistance is:

A. Rifampin
B. Ethambutol ✓
C. Clofazimine
D. Rifabutin

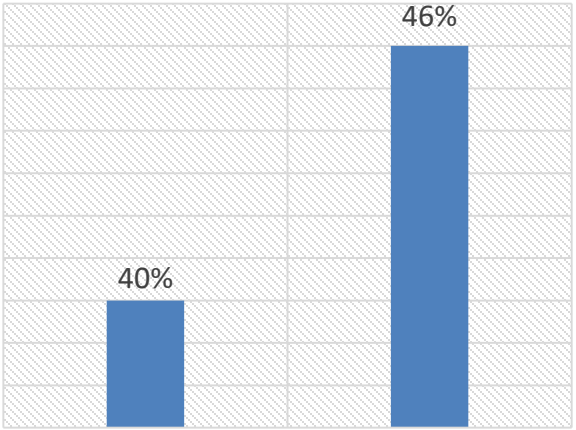


Final Report – CHEST Symposium:
Assessment: Pre-Test/Post-Test (Question 6)

Learning Objective: *Describe strategies for patient adherence and treatment completion to improve patient outcomes.*

Q6: There is evidence that shorter durations of IV therapy may be acceptable for which subspecies of M. abscessus?

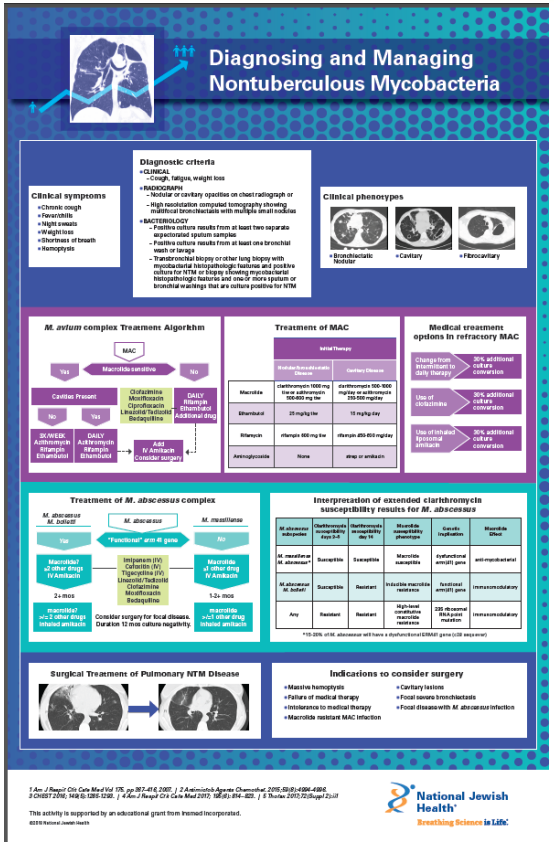
A. Abscessus
B. Massiliense ✓
C. Bolletii
D. All of the above



Final Report – CHEST Symposium: Learner Evaluation – Clinical Reference Aid

100% of respondents report that they are somewhat to extremely likely to use the clinical reference aid infographic in practice

N = 108



Final Report – CHEST Symposium: Learner Evaluation

- **97%** of respondents report that they **intend to make changes to practice as a result of the activity**
- **99%** of respondents report that the content presented was **evidence based and clinically relevant**
- **96%** of respondents report that the activity **addressed strategies for overcoming barriers to optimal patient care**
- **99%** of respondents report that the material was **presented in an objective manner and free of commercial bias**

N = 108

Key Lessons Learned

- Best practices for diagnosing
- Multi-drug therapy
- Current treatment approaches
- Modified treatment plans
- Treatment for M. abscessus
- Reinfection with NTM is common

Needs for Further Education

- Management of refractory M. abscessus disease
- Updates on therapies
- TB global treatments
- Inhaled amikacin

Final Report – CHEST Symposium: Accreditation

National Jewish Health is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

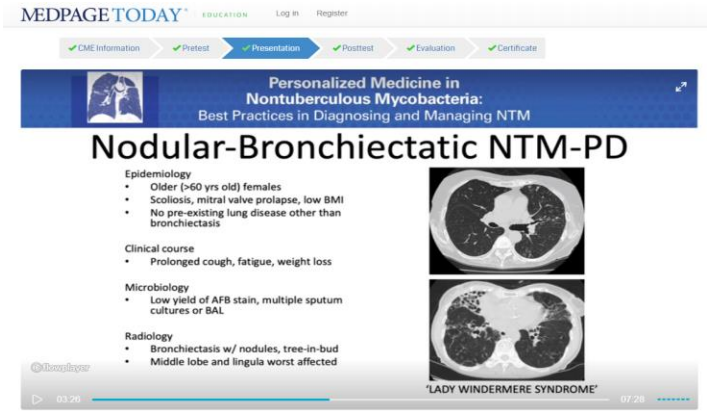
Accreditation Details: NJH designates this live educational activity for 1 AMA PRA Category 1 Credits™.

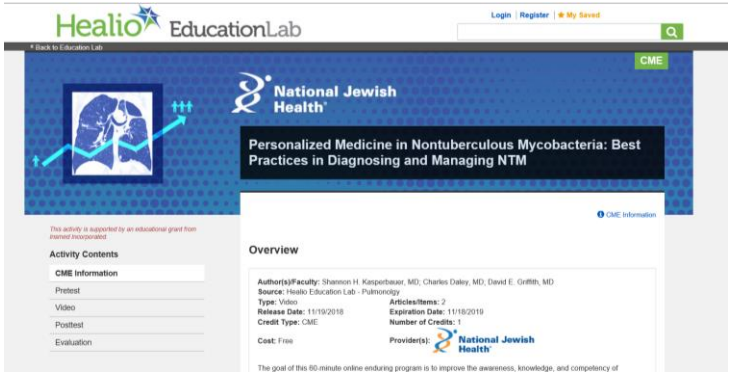
CHEST Symposium: Online Program

[Launched on myCME November 19, 2018]

Second distribution partner added to increase reach

[Launched on Healio May 30, 2019]





FINAL Dashboard Online

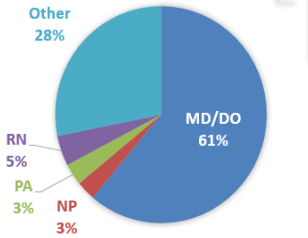
Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

National Jewish Health

Online Participation

5,010 total online learners accessed the educational content

Learner guarantee exceeded by 20%



309 certificates

N=309

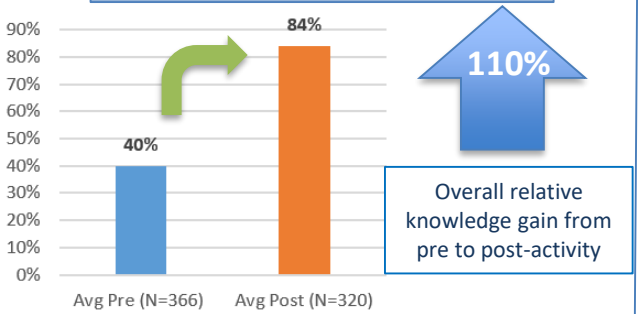
Data as of 11/30/2019

Satisfaction

"Good presentation of newest diagnosis and treatment of disease!"

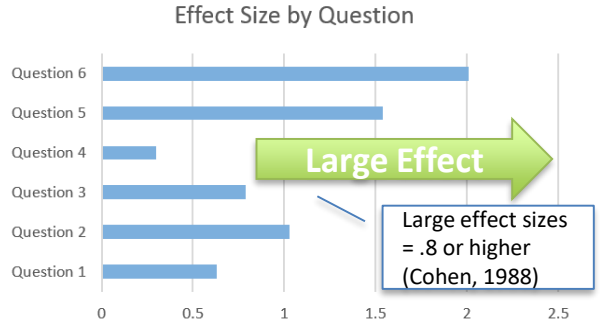
"As a TB clinician; I see increasing number of MAC diagnoses which I do not manage. This activity gave me a better understanding of MAC."

Educational Impact Summary: Online



Overall relative knowledge gain from pre to post-activity

In addition to descriptive statistics, levels of significant and effect size were calculated to demonstrate the impact of the activity.

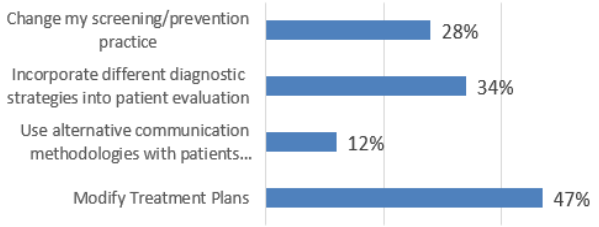


Large effect sizes = .8 or higher (Cohen, 1988)

*All were significant at p<.0001

Performance

86% of learners report that they are somewhat to extremely likely to make changes to their practice following the activity. Planned changed include:



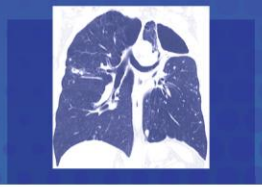
Persistent Gaps/ Learning Needs

Recommendations for future education:

- NTM Susceptibility testing
- Management of refractory M. abscessus
- Carbapenamase resistant enterobacteriacie

Similar to the live outcomes, online learners had difficulty with Q4.

Q4: Only 64% were able to identify clarithromycin susceptibility's role in improved outcomes



Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

ONLINE ACTIVITY

Background: The online activity is based on the content of the live meeting to extend reach to additional audiences. The presentation includes expert faculty; patient perspective videos; and a downloadable slide deck and infographic. The goal of the online initiative is to improve health care providers' knowledge, competence and self-reported performance to close gaps related to diagnosing and managing patients with Nontuberculous Mycobacteria (NTM).

Learning Objectives:

1. Identify personalized treatment goals in NTM according to patient's clinical presentation.
2. Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.
3. Describe strategies for patient adherence and treatment completion to improve patient outcomes.

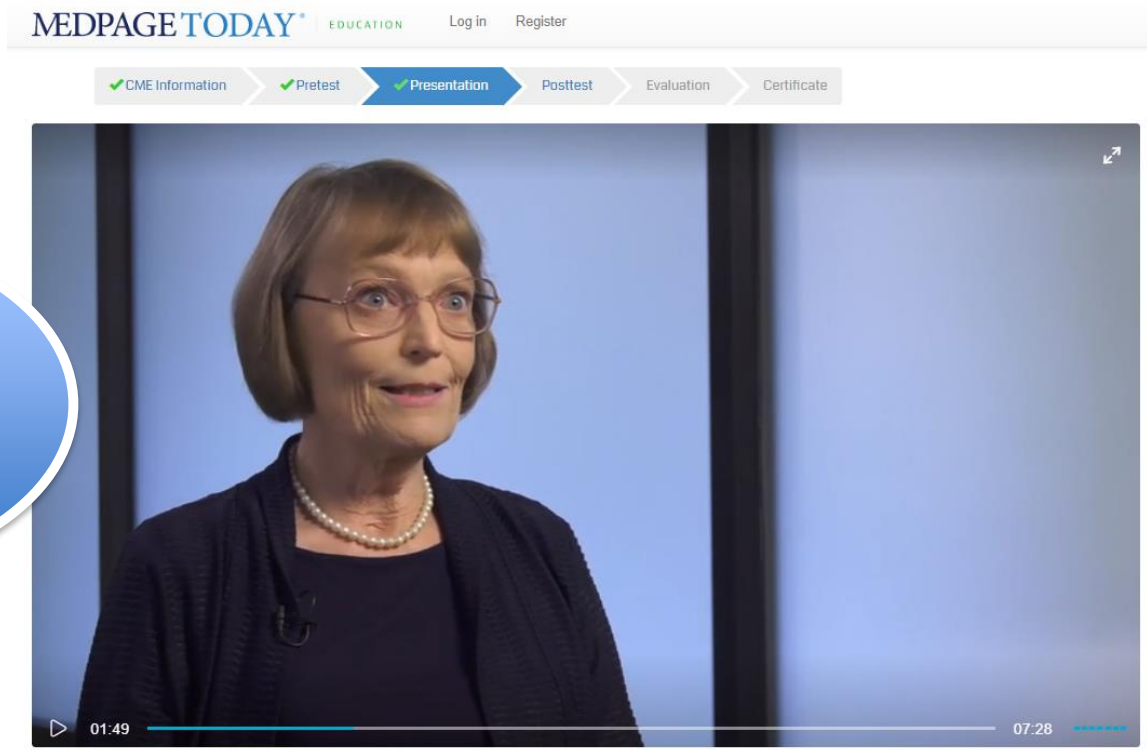
National Jewish Health®

Breathing Science is Life.®

Patient Perspective Videos

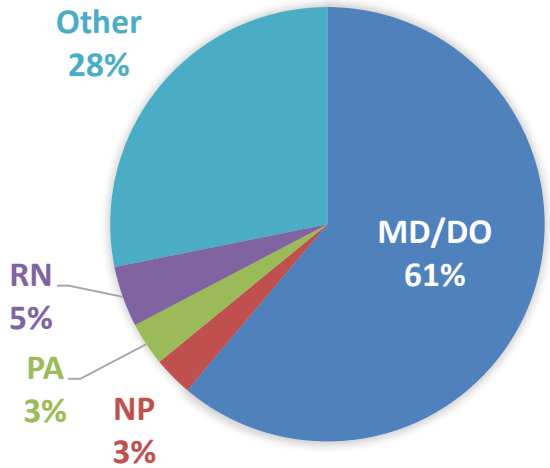
"Life is worth the battle…"

Online Activity

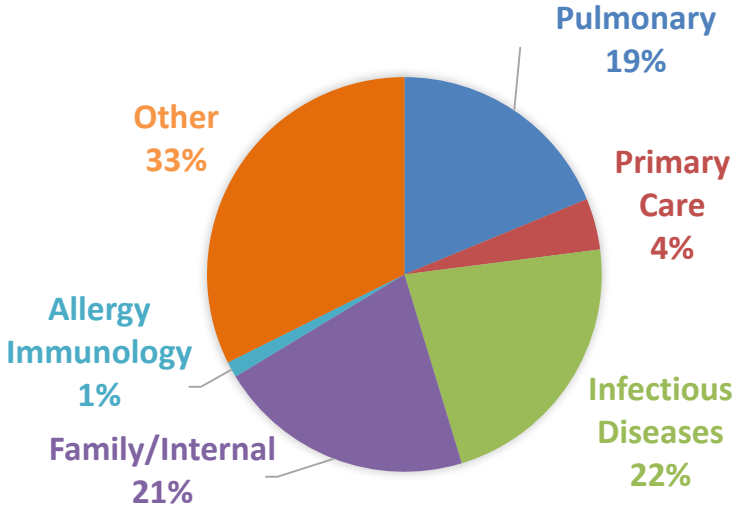


CHEST Symposium: Level 1 Outcomes Online Program Participation

COMPLETER BY DESIGNATION



COMPLETER BY SPECIALTY



N=309

Data as of 11/30/2019

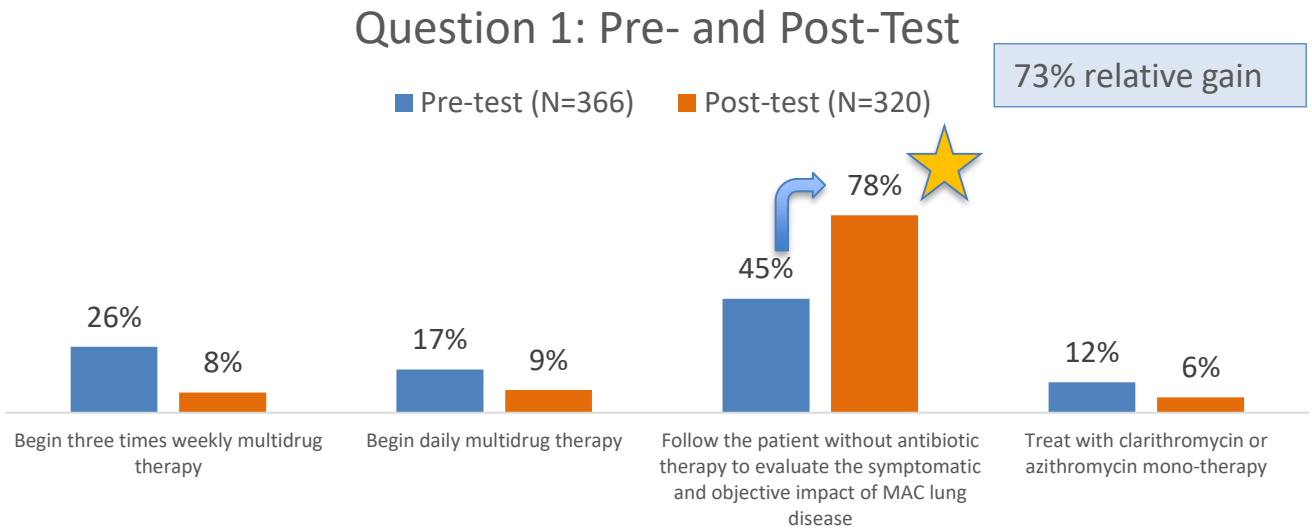
**41% of completers comprised the target audience with a 25% secondary audience of primary care/internal medicine*

Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Identify personalized treatment goals in NTM according to patient's clinical presentation.*

Q1: A thin, non-smoking, 60-year-old female presents with mild cough and multiple sputum specimens which are culture positive for MAC with subtle radiographic changes. She is active and her weight is stable. Would you:



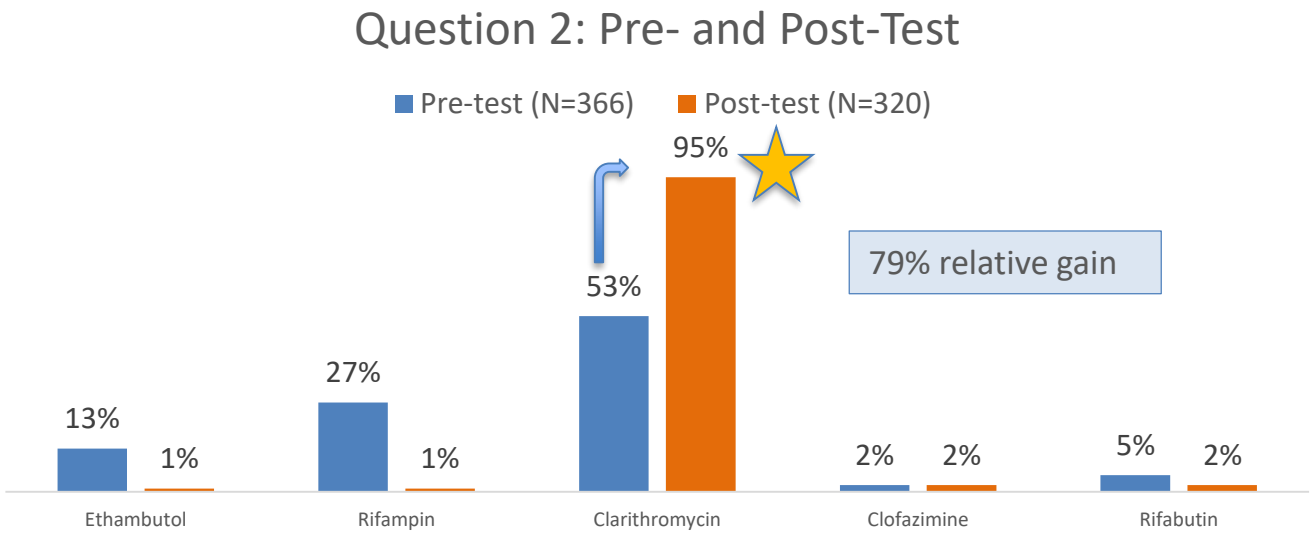
P value <.0001
Cohens d = 0.63
Medium Effect Size

Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.*

Q2: In vitro susceptibility results for which of the following antibiotics predicts treatment response in MAC lung disease?



P value <.0001
Cohens d = 1.03
Very Large Effect Size

Personalized Medicine in Nontuberculous Mycobacteria:
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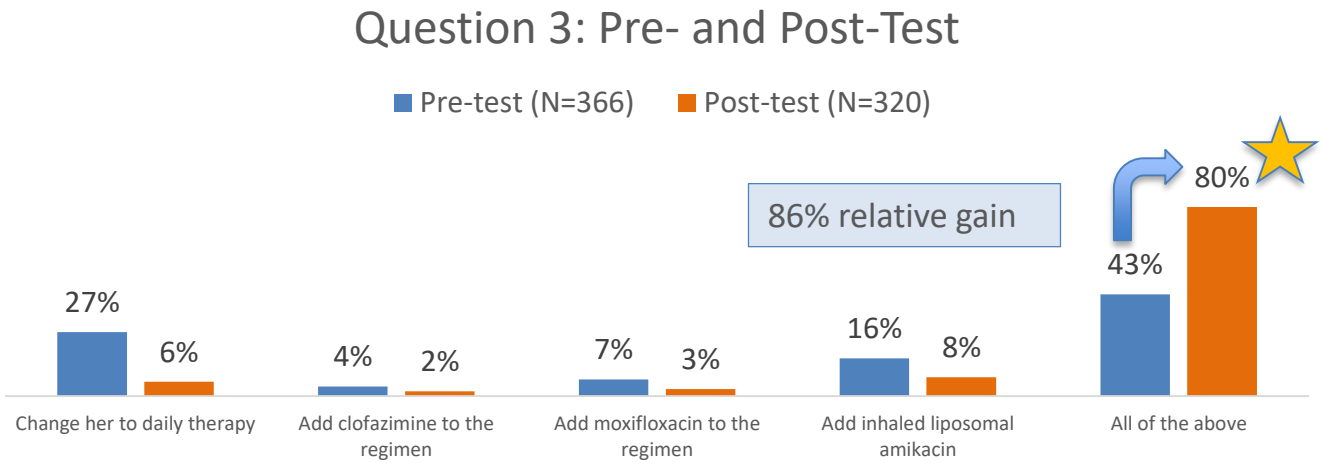
Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Identify personalized treatment goals in NTM according to patient's clinical presentation.*

Q3: A 58 year old woman with pulmonary MAC has remained culture positive for 12 months despite treatment with azithromycin, rifampin, and ethambutol administered three times a week. She has nodular bronchiectatic disease without cavitation on her chest CT scan. Which of the following interventions has been associated with an increase in culture conversion.



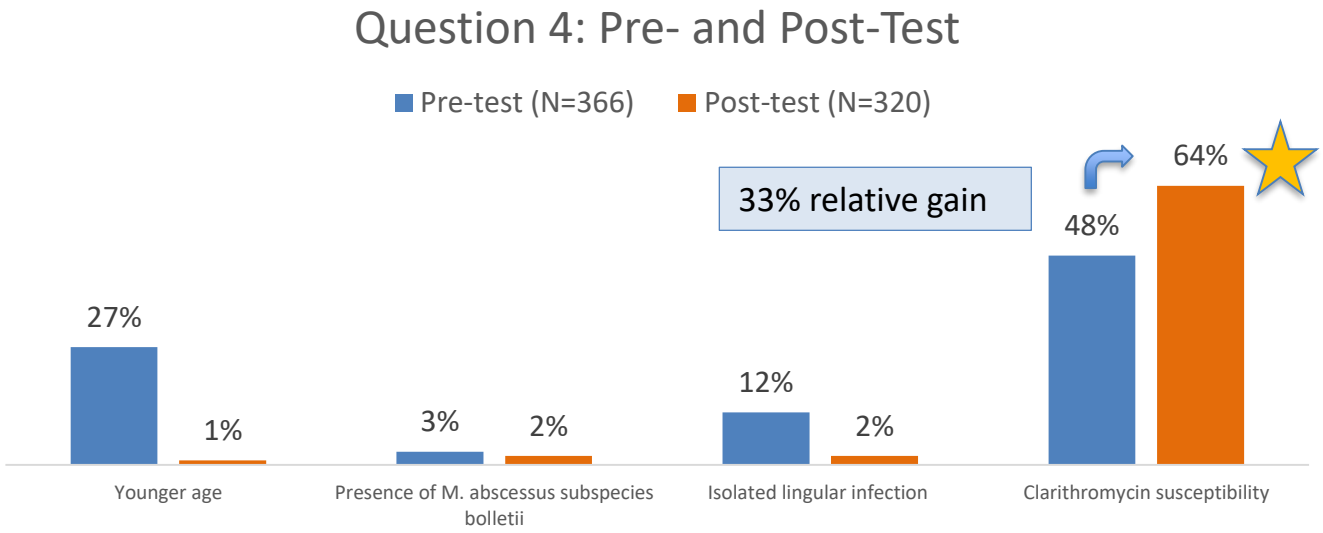
P value <.0001
Cohens d = 0.79
Large Effect Size

Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Review recent evidence, guidelines, and best practices in the treatment of NTM and management of adverse events.*

Q4: Regarding M. abscessus pulmonary disease, which factor is associated with improved outcomes?



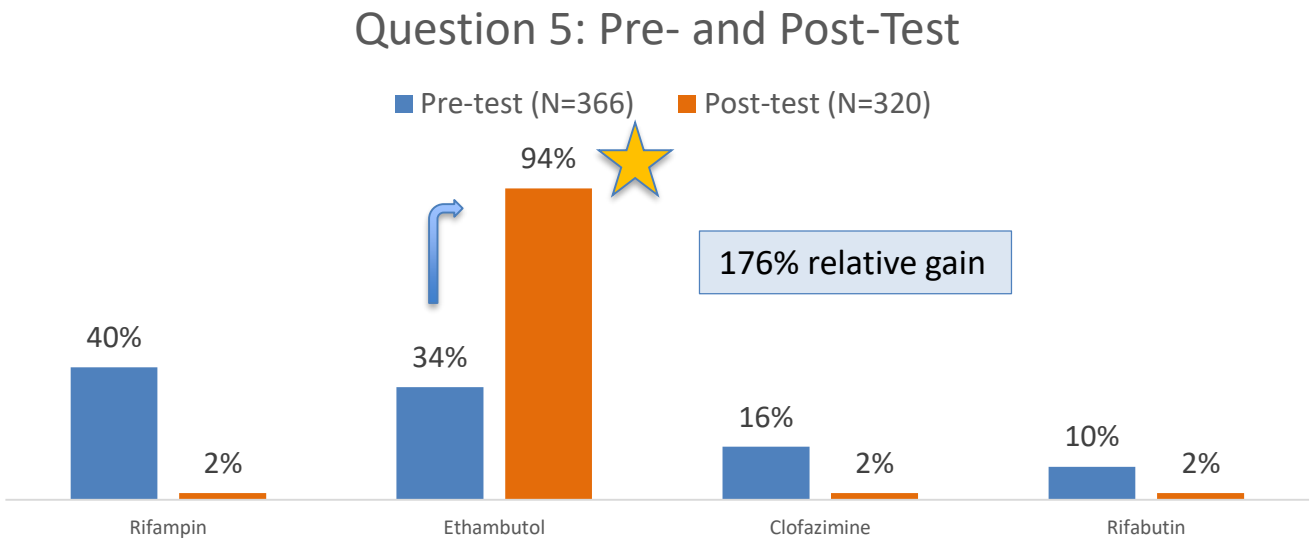
P value <.0001
Cohens d = 0.3
Small Effect Size

Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Describe strategies for patient adherence and treatment completion to improve patient outcomes.*

Q5: The most important drug in macrolide-based MAC treatment regimens for preventing the emergence of macrolide resistance is:

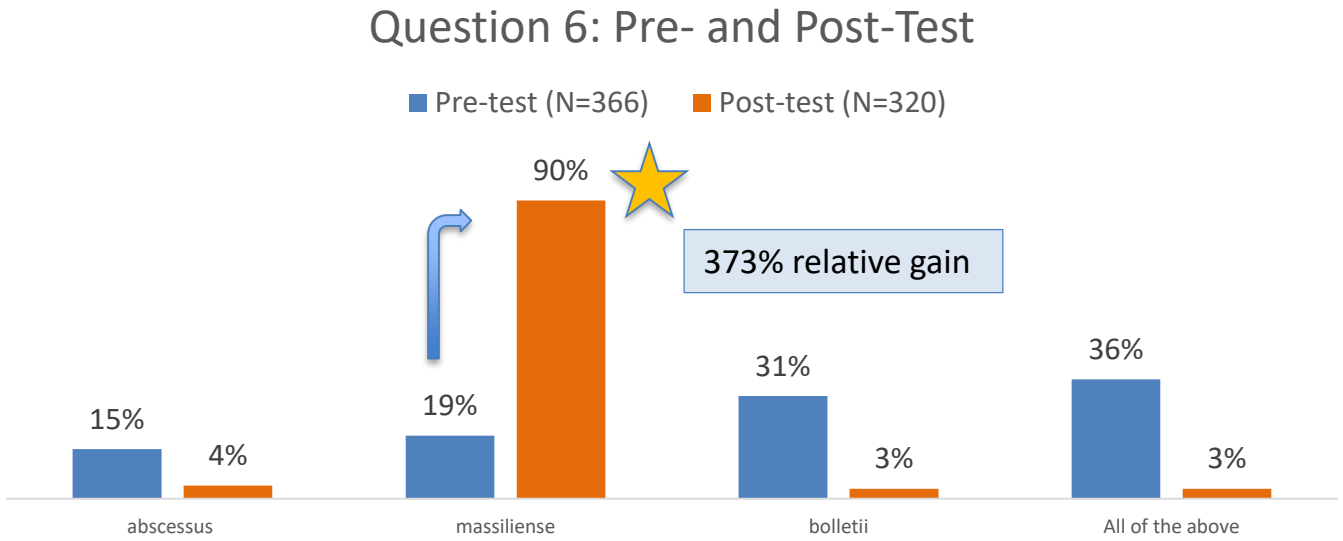


P value >.0001
Cohens d = 1.54
Very Large Effect Size

Final Report – Online Enduring Program:
Assessment: Question 1 (11/30/2019)

Learning Objective: *Describe strategies for patient adherence and treatment completion to improve patient outcomes.*

Q6: There is evidence that shorter durations of IV therapy may be acceptable for which subspecies of M. abscessus?



P value <.0001
Cohens d = 2.01
Very Large Effect Size

Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

ONLINE ACTIVITY

Intra-Activity Questions

- ✓ We asked questions within the online activity to gauge learners comfort level with adjusting and adding treatment
- ✓ These questions helped to engage online learners throughout the activity

A 68 year old woman with diffuse nodular/bronchiectatic MAC pulmonary disease remains culture positive after 6 months of daily three-drug therapy. Which of the following would be the most appropriate next step?

Response	Average	Total
Continue the current regimen for another six months	(11%)	28
Stop therapy because she has failed treatment	(2%)	4
Add inhaled amikacin to the treat regimen	(65%)	167
Refer for surgical resection	(9%)	22
Other/Unanswered	(14%)	37
		n = 258

The lab alerts you that a patient has an AFB + culture from a bronchoscopy. The identification from the lab is *M. chelonae/abscessus*. What species is responsible for this infection?

Response	Average	Total
M. chelonae	(24%)	62
M. abscessus, subs. bolletii	(25%)	65
M. abscessus, subsp. massiliense	(5%)	14
M. abscessus, subsp. abscessus	(31%)	79
Other/Unanswered	(15%)	38
		n = 258

Your patient was found to have *M. abscessus* subsp. *abscessus* pulmonary infection. She is an otherwise healthy 66 year old female with weight loss, night sweats and cough. Her CT is notable for multiple small cavities in the right upper lobe. What is the most appropriate therapy:

Response	Average	Total
Begin oral azithromycin, ethambutol and rifampin	(13%)	33
Begin IV amikacin, IV imipenem, oral clofazimine and oral azithromycin	(19%)	48
Begin oral azithromycin, ciprofloxacin and linezolid	(5%)	14
Recommend she have a right upper lobectomy	(48%)	125
Other/Unanswered	(15%)	38
		n = 258

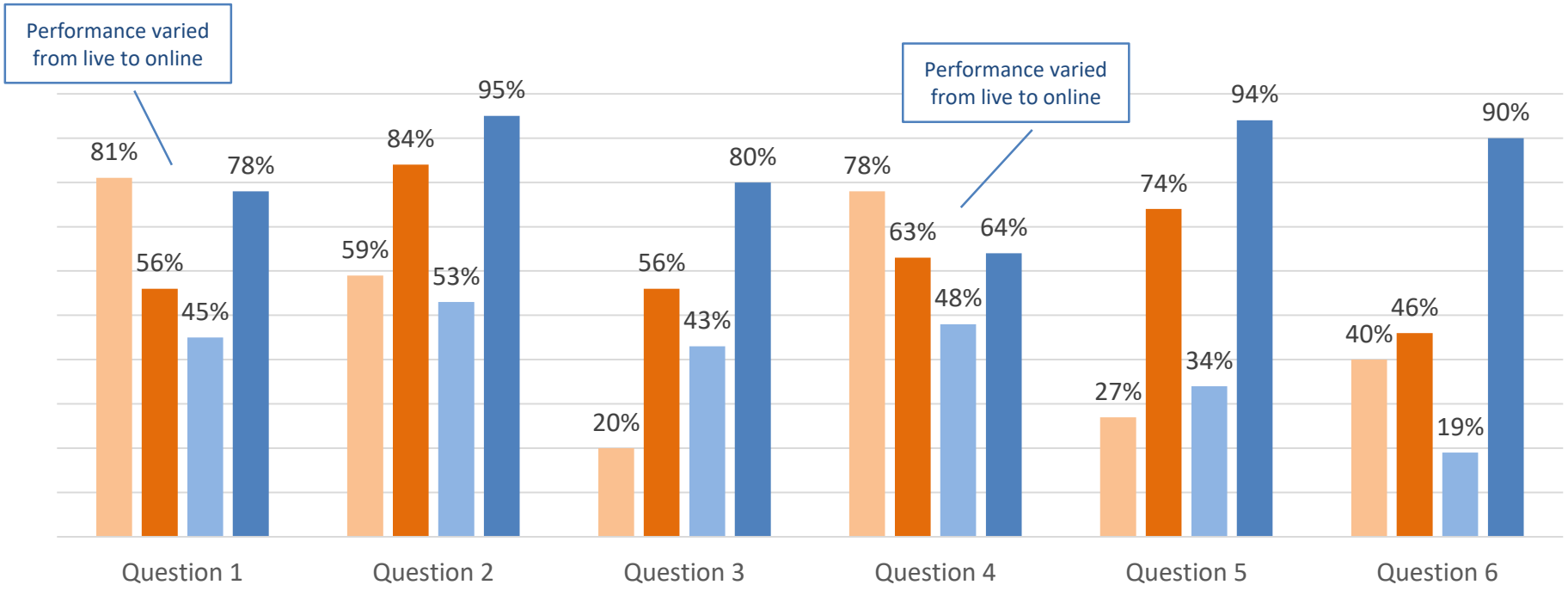
Online Activity

Level 4 Outcomes: Competence

83% plan to make changes to their practice as a result of what they learned (N=315)

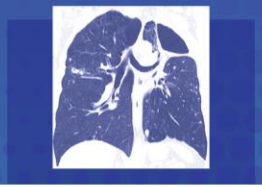
- Change screening/prevention practices
- Incorporate different diagnostic strategies into patient evaluation
- Use alternative communication methodologies with patients and families
- Modify Treatment Plans

Level 3 Outcomes - Live vs. Online Pre-test to Post-test



Average Live:
Pre-Test N=47
Post-Test N=109

Average Online:
Pre-Test N=366
Post-Test N=322



Personalized Medicine in Nontuberculous Mycobacteria:
Best Practices in Diagnosing and Managing NTM

Key Lessons Learned

- Complex disease
- Difference treatment options
- Identifying subspecies important
- Modified treatment plans
- Treatment for M. abscessus
- Reinfection with NTM is common
- Use of antibiotic and new drug options

Needs for Further Education

- Drug resistance
- Bronchiectasis
- More information on subspecies
- Inhaled amikacin
- TB

Program Highlights

- Proposed attendees in live program exceeded by **283%**
- Proposed online learners exceeded by **20%**
- Overall knowledge gain for online completers **> 100%**
- Intent to use infographic reference aid in practice **100%**
- Very large to large effect sizes for online questions **66%**
- Online questions representing a significant p-value **100%**

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ONLINE ACTIVITY

Accreditation Details: The online educational initiative is accredited for 1.0 AMA PRA Category 1 Credits™.

Target Audience: Pulmonologists and Infectious Disease Physicians.

Educational Outcomes Strategy: NJH provides outcomes on Moore's Outcome Levels 1-4: Participation, Satisfaction, Knowledge and Competence. Pre-tests and post-tests were distributed to measure the participants' change in knowledge on the topics covered during this educational initiative, and evaluations will be collected to understand participants' engagement in the activity, intention to change (competence), and appropriateness of the learning modality and content. The outcomes evaluation data will assist in identifying additional gaps for future educational initiatives.

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Thank you for your support of this educational initiative!