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

CHEST Symposium Final Report
Educational Impact: Live Dashboard

**Total Participation Online and Live**

- 283 live + 5,010 online = 5,293
- >70,000 patients impacted per year
- 73% Prescribers

By specialty:
- 67% MD/DO
- 6% NP/PA
- 19% Other
- 5% RN
- 2% Other

**Educational Impact Summary**

- 29% Gain
- 66% Gain
- 40% Gain
- 84% Gain

69% relative knowledge gain for live and online combined.

**Educational Impact**

- Identify personalized treatment goals in NTM
- Review recent evidence, guidelines, and best practices
- Describe strategies for patient adherence and treatment completion

**NARROWING THE GAPS BY LEARNING OBJECTIVE**

- 80% increase in knowledge from pre to post test
- 56% increase in knowledge from pre to post test
- 275% increase in knowledge from pre to post test

**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."

**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)

**Program Dashboard: Live and Online**

- 69% relative knowledge gain for live and online combined.
- Pre vs. Post: Q1: 45%, Q2: 78%, Q3: 78%, Q4: 64%

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

">70,000 patients impacted per year"
### Participants

<table>
<thead>
<tr>
<th>Total Completers</th>
<th>592</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who see</td>
<td>1,465 Patients with NTM per week</td>
</tr>
<tr>
<td>Which translates to</td>
<td>70,320 NTM Patient Visits Annually</td>
</tr>
</tbody>
</table>

### 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
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.
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

- Participation: 74%
- MD/DO: 22%
- NP/PA: 5%
- PharmD: 7%
- Other: 22%

N=283

79% of learners are prescribers
94% of learners designated their specialty as pulmonology
Final Report – CHEST Symposium: Live Activity
Level 2 Outcomes: Learning & Satisfaction

Participants report the activity was “Good” to “Excellent” at:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Satisfaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving your ability to treat or manage your patients</td>
<td>98%</td>
</tr>
<tr>
<td>Enhancing your ability to apply the Los to practice</td>
<td>98%</td>
</tr>
<tr>
<td>Reinforcing and/or improving your current skills</td>
<td>97%</td>
</tr>
<tr>
<td>Meeting your educational needs</td>
<td>99%</td>
</tr>
</tbody>
</table>

N = 105
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.
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

![Graph showing pre-test and post-test results](image)
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

![Bar chart showing pre-test and post-test results.](image-url)
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 ✓

Pre-test (N=47)  Post-test (N = 110)

- Change her to daily therapy: 20%
- Add clofazimine to the regimen: 56%
- Add moxifloxacin to the regimen: 20%
- Add inhaled liposomal amikacin: 0%
- All of the above: 56%
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

Pre-test (N=47)
Post-test (N=109)
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

Pre-test (N=47)  
- 40%  

Post-test (N = 109)  
- 46%
100% of respondents report that they are somewhat to extremely likely to use the clinical reference aid infographic in practice.
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
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
In addition to descriptive statistics, levels of significant and effect size were calculated to demonstrate the impact of the activity.

**Effect Size by Question**

- Question 6
- Question 5
- Question 4
- Question 3
- Question 2
- Question 1

**Large Effect**

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

0 0.5 1 1.5 2 2.5

**Persistent Gaps/ Learning Needs**

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

**Recommendations for future education:**
- NTM Susceptibility testing
- Management of refractory M. abscessus
- Carbapenamase resistant enterobacteriaceae

**Performance**

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

- Change my screening/prevention practice
- Incorporate different diagnostic strategies into patient evaluation
- Use alternative communication methodologies with patients...
- Modify Treatment Plans

**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.”

**Net Impact Summary: Online**

- Overall relative knowledge gain from pre to post-activity
- Similar to the live outcomes, online learners had difficulty with Q4.

**86%**

- Learners report they are somewhat to extremely likely to make changes to their practice following the activity.

**5,010** total online learners accessed the educational content.

**309 certificates**

**3,010** total online learners accessed the educational content.

Learner guarantee exceeded by 20%
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.
“Life is worth the battle...”
CHEST Symposium: Level 1 Outcomes Online Program Participation

COMPLETER BY DESIGNATION

- MD/DO: 61%
- Other: 28%
- RN: 5%
- PA: 3%
- NP: 3%

COMPLETER BY SPECIALTY

- Pulmonary: 19%
- Infectious Diseases: 22%
- Family/Internal: 21%
- Other: 33%
- Allergy Immunology: 1%
- Primary Care: 4%

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

Data as of 11/30/2019

N=309
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:

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

Question 1: Pre- and Post-Test

<table>
<thead>
<tr>
<th>Option</th>
<th>Pre-test (N=366)</th>
<th>Post-test (N=320)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin three times weekly multidrug therapy</td>
<td>26%</td>
<td>8%</td>
</tr>
<tr>
<td>Begin daily multidrug therapy</td>
<td>17%</td>
<td>9%</td>
</tr>
<tr>
<td>Follow the patient without antibiotic therapy to evaluate the symptomatic and objective impact of MAC lung disease</td>
<td>45%</td>
<td>78%</td>
</tr>
<tr>
<td>Treat with clarithromycin or azithromycin mono-therapy</td>
<td>12%</td>
<td>6%</td>
</tr>
</tbody>
</table>

73% relative gain

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

- Ethambutol: 13% pre-test, 1% post-test
- Rifampin: 27% pre-test, 1% post-test
- Clarithromycin: 53% pre-test, 95% post-test
- Clofazimine: 2% pre-test, 2% post-test
- Rifabutin: 5% pre-test, 2% post-test

79% relative gain

P value < .0001

Cohens d = 1.03

Very Large Effect Size
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.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Pre-test (N=366)</th>
<th>Post-test (N=320)</th>
<th>86% relative gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change her to daily therapy</td>
<td>27%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add clofazimine to the regimen</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add moxifloxacin to the regimen</td>
<td>2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add inhaled liposomal amikacin</td>
<td>7%</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>All of the above</td>
<td>3%</td>
<td>8%</td>
<td></td>
</tr>
</tbody>
</table>

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

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

**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?**

**Question 4: Pre- and Post-Test**

- **Pre-test (N=366) vs. Post-test (N=320)**
  - Younger age: 27% vs. 1%
  - Presence of M. abscessus subspecies bolletii: 3% vs. 2%
  - Isolated lingular infection: 12% vs. 2%
  - Clarithromycin susceptibility: 48% vs. 64%

- **33% relative gain**

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

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:

**Question 5: Pre- and Post-Test**

- **Pre-test (N=366):**
  - Rifampin: 40%
  - Ethambutol: 34%
  - Clofazimine: 16%
  - Rifabutin: 2%

- **Post-test (N=320):**
  - Rifampin: 2%
  - Ethambutol: 16%
  - Clofazimine: 10%
  - Rifabutin: 2%

*176% relative gain*

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

Question 6: Pre- and Post-Test

<table>
<thead>
<tr>
<th>Subspecies</th>
<th>Pre-test (N=366)</th>
<th>Post-test (N=320)</th>
</tr>
</thead>
<tbody>
<tr>
<td>abscessus</td>
<td>15%</td>
<td>4%</td>
</tr>
<tr>
<td>massiliense</td>
<td>19%</td>
<td>90%</td>
</tr>
<tr>
<td>bolletii</td>
<td>31%</td>
<td>3%</td>
</tr>
<tr>
<td>All of the above</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

373% relative gain

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

<table>
<thead>
<tr>
<th>Response</th>
<th>Average</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue the current regimen for another six months</td>
<td>(11%)</td>
<td>28</td>
</tr>
<tr>
<td>Stop therapy because she has failed treatment</td>
<td>(2%)</td>
<td>2</td>
</tr>
<tr>
<td>Add inhaled amikacin to the treat regimen</td>
<td>(65%)</td>
<td>167</td>
</tr>
<tr>
<td>Refer for surgical resection</td>
<td>(9%)</td>
<td>22</td>
</tr>
<tr>
<td>Other/Unanswered</td>
<td>(14%)</td>
<td>37</td>
</tr>
</tbody>
</table>

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?

<table>
<thead>
<tr>
<th>Response</th>
<th>Average</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. chelonae</em></td>
<td>(24%)</td>
<td>62</td>
</tr>
<tr>
<td><em>M. abscessus, subs. bolleti</em></td>
<td>(25%)</td>
<td>65</td>
</tr>
<tr>
<td><em>M. abscessus, subs. massiliense</em></td>
<td>(5%)</td>
<td>14</td>
</tr>
<tr>
<td><em>M. abscessus, subs. abscessus</em></td>
<td>(31%)</td>
<td>79</td>
</tr>
<tr>
<td>Other/Unanswered</td>
<td>(15%)</td>
<td>38</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Response</th>
<th>Average</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Begin oral azithromycin, ethambutol and rifampin</td>
<td>(13%)</td>
<td>33</td>
</tr>
<tr>
<td>Begin IV amikacin, IV imipenem, oral cefazidine and oral azithromycin</td>
<td>(19%)</td>
<td>46</td>
</tr>
<tr>
<td>Begin oral azithromycin, ciprofloxacin and linezolid</td>
<td>(5%)</td>
<td>14</td>
</tr>
<tr>
<td>Recommend she have a right upper lobectomy</td>
<td>(46%)</td>
<td>125</td>
</tr>
<tr>
<td>Other/Unanswered</td>
<td>(15%)</td>
<td>38</td>
</tr>
</tbody>
</table>

*n = 259*
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 (28%)
- Incorporate different diagnostic strategies into patient evaluation (34%)
- Use alternative communication methodologies with patients and families (12%)
- Modify Treatment Plans (47%)
Level 3 Outcomes - Live vs. Online Pre-test to Post-test

Performance varied from live to online

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

Average Online:
Pre-Test N=366
Post-Test N=322
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%
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.
Thank you for your support of this educational initiative!