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# Current Trials and Therapies for the Treatment of Amyotrophic Lateral Sclerosis and Frontotemporal Dementia

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This knowledge-based activity is targeted for all pharmacists and is acceptable for 1.0 hour (0.1 CEU) of continuing education credit. This course requires completion of the program evaluation and at least a 70 percent grade on the program assessment questions.

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## Objectives

After completion of this program, the reader should be able to:

1. Identify the symptoms of ALS and FTD.
2. Classify FTD subtypes based on patient presentation.
3. Recognize the most prominent gene mutations in ALS and FTD.
4. Describe various targets of ASO therapy.
5. List common and serious adverse effects of ISIS 333611.
6. Define the role of the pharmacist in the management of ALS and FTD.

## Abstract

An area of health care that provides many more questions than answers includes neurodegenerative disorders. Amyotrophic lateral sclerosis (ALS), commonly known as Lou Gehrig's disease, and frontotemporal dementia (FTD) are both diseases about which we know very little. However, ALS and FTD affect nearly 30,000 and 60,000 Americans respectively. Currently, there is not a cure for ALS or FTD and treatment options are aimed toward symptom management. Much of the pathophysiology of these diseases is unknown, but we do know there are genetic implications, specifically in SOD1, TARDBP and c9ORF72. These mutations lead to cognitive deficits, muscle weakness and, eventually, paralysis. The only U.S. Food and Drug Administration (FDA) approved treatment for ALS is riluzole (Rilutek®) which helps to slow the disease progression but still lacks a curative effect. An area of interest in the treatment of ALS and FTD is antisense oligonucleotide (ASO) therapy. Current trials examining ASOs as targets for SOD1 and c9ORF72 have shown promise. With these therapies still in preliminary trials, care for these patients is largely palliative. Pharmacists, as part of a multidisciplinary team, can play an integral role in the management of disease sequelae to improve the patient's quality of life.

## Key Terms

Amyotrophic Lateral Sclerosis; Antisense Oligonucleotides; Frontotemporal Dementia; Riluzole

## Introduction

Understanding neurodegenerative disorders, their prevalence and their current treatment options is critical for health care professionals. Most underlying pathologies of these disorders remain unknown. Therefore, these conditions often have high mortality rates. Amyotrophic lateral sclerosis (ALS) is one such disease that affects the motor neurons in the brain and spinal cord, leading to muscle weakness, atrophy and, eventually, paralysis in patients.<sup>1</sup> Frontotemporal dementia (FTD) describes a group of neurodegenerative diseases sharing physical manifestations in the loss of cerebral tissue in the frontal and temporal lobes. Frontotemporal dementia is classified into three major groups depending on patient presentation including behavioral, aphasic or motor disorder.<sup>2</sup> Amyotrophic lateral sclerosis affects about 30,000 Americans, primarily between 40 and 70 years of age, with approximately 5,600 new diagnoses each year.<sup>3</sup> Frontotemporal dementia associated disorders affect about 60,000 Americans, primarily men between 50 and 60 years of age, and comprise an average of 15 percent of all dementia cases.<sup>4,5</sup> Both disorders, ALS and FTD, may be inherited together.<sup>6</sup>

Neither ALS nor FTD have cures, and treatment options are limited. Current treatment options focus on slowing disease progression and improving the patient's quality of life, rather than curing the disease. Recent research has revealed that familial ALS, which accounts for roughly 10 percent of all ALS cases,<sup>3</sup> and familial FTD have genetic mutations on the same chromosome. These findings suggest that antisense oligonucleotide (ASO) therapy may be a realistic treatment option by targeting these genetic markers. Still, further research in neurodegenerative disorders is necessary in order to find a cure for these devastating diseases.

## Disease Background

### Amyotrophic Lateral Sclerosis (ALS)

Neither ALS nor FTD have defined diagnostic tests and the clinical presentation may be similar between the two. Amyotrophic lateral sclerosis symptoms usually do not show until later stages in life and may include muscle weakness in the arms and legs, twitching, slurred speech and difficulty chewing, swallowing or breathing.<sup>1,3</sup> Amyotrophic lateral sclerosis is a diagnosis of exclusion, but may be supported by abnormal electromyography and nerve conduction study results. Sensory nerve conduction is still intact in ALS patients, so nerve conduction studies will yield normal results. However, electromyography of muscles associated with the cervical, thoracic and lumbar nerve regions will be abnormal because of chronic denervation from ALS. These results will show



repeating, multispiked electrographs common to all muscular atrophy diseases.<sup>7</sup> Magnetic resonance imaging (MRI) is not very helpful in these patients because results are often normal, however MRI can aid in the exclusion of other cerebral diseases.<sup>1</sup>

The only FDA approved drug for treating ALS is riluzole (Rilutek®) dosed 50 mg twice daily. Riluzole inhibits the release of glutamate and inactivates voltage gated sodium channels.<sup>8</sup> In a double-blind, placebo-controlled trial of riluzole, ALS patients receiving riluzole had better survival and safety outcomes with decreased muscle deterioration compared to placebo. Of 155 patients (77 treated with riluzole and 78 treated with placebo), 74 percent of riluzole patients were still living at 12 months compared to only 58 percent of placebo patients. Muscle deterioration, measured by muscle strength tests, was also statistically significantly lower in riluzole patients with a 33.4 percent decline in muscle deterioration rate versus a 22.9 percent decline with placebo. The most common side effects reported with riluzole were asthenia, spasticity, nausea and mild alanine transaminase (ALT) increase, but these effects are common to the

ALS patient population in general.<sup>9</sup> Riluzole is the only medication that slows ALS progression. Other medications prescribed only ease symptoms and do not stop or slow the disease progression. Nonpharmacologic treatment options include physical, occupational and speech therapy for motor skill rehabilitation and nutritional support for hypoproteinemia. Mechanical ventilation can also be used for patients with decreased respiratory function due to weakened respiratory muscles and has been shown to improve patients' quality of life and prolong survival.<sup>1,10</sup>

### Frontotemporal dementia (FTD)

Frontotemporal dementia is divided into three major classes with further subclasses based on clinical presentation, as shown in Table 1.<sup>5,11</sup> Like ALS, FTD has no definitive diagnostic test and is also a diagnosis of exclusion. Frontotemporal dementia often is confused with Alzheimer's disease because of similar symptoms and brain region effects. Testing is done to distinguish between the two disease states. An MRI may reveal frontal and temporal lobe atrophy in late stage FTD while positron emission tomography and single photon emission computed tomography scans can measure decreased

**Table 1. Frontotemporal Dementia Subclasses.**<sup>5,11</sup>

Class	Major Effect	Symptoms
<b>Behavioral Variant FTD (bvFTD)</b>	Demeanor	<ul style="list-style-type: none"> <li>• Lack of empathy</li> <li>• Inability to emotionally adapt to social cues</li> <li>• Abrupt mood changes</li> <li>• Hyperactivity and impulsive behavior</li> </ul>
<b>Primary Progressive Aphasia (PPA)</b>	Speech and language	<i>See subclass</i>
<i>Nonfluent Variant</i>	Speech	<ul style="list-style-type: none"> <li>• Hesitant speech</li> <li>• Difficulty speaking</li> <li>• Progressive reading and writing decline</li> <li>• Difficulty swallowing and late stage muteness</li> </ul>
<i>Semantic Variant</i>	Recognition and understanding	<ul style="list-style-type: none"> <li>• Difficulty recalling familiar words</li> <li>• Inability to understand familiar words</li> <li>• Difficulty recognizing objects and people</li> </ul>
<i>Logopenic Variant</i>	Recall	<ul style="list-style-type: none"> <li>• Slow recall of words</li> <li>• Short term memory loss</li> <li>• Inability to understand long phrases</li> <li>• Progressive reading and writing decline</li> <li>• Difficulty swallowing and late stage muteness</li> </ul>
<b>FTD Movement Disorder</b>	Movement and cognition	<i>See subclass</i>
<i>Corticobasal Degeneration (CBD)</i>	Movement with some cognition	<ul style="list-style-type: none"> <li>• Bradykinesia, rigidity and tremor</li> <li>• Limb dystonia</li> <li>• Visual-space impairment</li> <li>• Inability to control hand or arm movement</li> </ul>
<i>Progressive Supranuclear Palsy (PSP)</i>	Movement	<ul style="list-style-type: none"> <li>• Gait problem and loss of balance</li> <li>• Facial and upper body muscle stiffness</li> <li>• Shifting eye movements</li> <li>• Prolonged laughter or crying</li> </ul>

brain activity. Unlike Alzheimer's, FTD does not cause significant memory decline but is associated with significant motor dysfunction. A neurological exam can confirm symptoms of FTD and categorize the specific subtype.<sup>2</sup> Unlike ALS, there are no FDA approved medications to treat any form of FTD, but symptomatic management is similar.<sup>5</sup>

### Pathophysiology

Despite the rise in awareness of ALS due to the social media "ice bucket challenge," there is still much to learn about ALS and FTD. We do know that ALS is a neurodegenerative disease that has both genetic and environmental factors that influence diagnosis and prognosis of the disease.<sup>12</sup> The area of ALS that is most well-studied is genetically-oriented ALS. The most prevalent genes implicated in the diagnosis of ALS include: Cu/Zn superoxide dismutase-1 (SOD1), transactive response DNA-binding protein of 43kD (TARDBP), fused in sarcoma (FUS), c9ORF72 genes and (vesicle-associated membrane protein)-associated type B (VAPB). The c9ORF72 gene has been identified as the most common genetic cause of ALS. There are other genes that may implicate ALS but have not been proven. The genes that have implications in both ALS and FTD are c9ORF72 and TARDBP. It should also be noted that one or many of these gene-mutations can cause ALS. Regardless of the mutations similar pathophysiologic effects are observed. Each mutation leads to motor neuron death; however they do so via different mechanisms.

Superoxide dismutase-1, located on chromosome 21, was the first gene identified with mutations. Superoxide dismutase-1 functions as an enzyme commonly found in the body that breaks down toxins and free radicals.<sup>12</sup> These toxins and free radicals can damage neurons that play a role in muscle movement. Inappropriate regulation of glutamate can exacerbate neuronal damage caused by SOD1 mutations. These defects can cause a breakdown of lower motor neurons at a young age. Due to the prevalence of the SOD1 mutation, it is a target of interest in ASO treatment in clinical trials.

Another gene of interest is c9ORF72 which codes for a protein localized in the brain.<sup>12</sup> Its exact mechanism is unknown, but a mutation in the gene causes interruption of RNA machinery. This gene mutation can contribute to the classic ALS pathology of muscle wasting but can also lead to degeneration in the brain leading to changes in mental status. Amyotrophic lateral sclerosis and FTD are commonly diagnosed together in patients due to the dual pathology of this mutation.

Regardless of which gene mutations are present in ALS patients, the symptomatology always presents similarly. Mutations lead to motor neuronal death whether it be through oxidative stress, misfolded protein accumulation, mitochondrial abnormalities or neuronal excitotoxicity.<sup>18</sup> The excess of glutamic acid produced and released in ALS patients leads to excitotoxicity, causing neuronal death. Riluzole (Rilutek®)

**Table 2. Genes Involved in the Development of Amyotrophic Lateral Sclerosis and Frontotemporal Dementia.<sup>13-17</sup>**

Gene	Mechanism of Action	Pathophysiologic Effect of Mutation	Disease Implications
Cu/Zn superoxide dismutase (SOD1)	Binding of toxins and free radicals to prevent harm to nerve cells	Oxidative stress leading to motor neuron death	ALS
Transactive response DNA-binding protein of 43kD (TARDBP)	Binds to RNA	Interruption of RNA machinery leading to motor neuron death	ALS and FTD
Fused in sarcoma (FUS)	Unknown	Interruption of RNA machinery leading to motor neuron death	ALS and FTD
c9ORF72	Unknown	Interruption of RNA machinery leading to motor neuron death	ALS and FTD
VAMP-associated type B (VAPB)	Recognizes and regulates unfolded protein buildup in the endoplasmic reticulum	Affects endosomal vesicle trafficking leading to motor neuron death	ALS



is proposed to inhibit glutamate and, therefore, to exert a beneficial effect in ALS patients. Antisense oligonucleotide therapy is targeted at preventing the protein translation of specific mRNA strands by binding to them, which is another target in ALS therapy.

### Treatment/Trials/Research

Oligonucleotides are relatively short unmodified or chemically modified single-stranded DNA thought to hybridize into unique sequences that are each targets in cells.<sup>19</sup> Various types of oligonucleotides have been classified based on their chemistry (e.g., methylphosphonates, phosphorothioates). Theoretically, oligonucleotides were designed to specifically modulate the transfer of genetic information to proteins. The mechanism by which they produce their effect is subtle and complex. Some mechanisms have been defined, but there is still insufficient proof for other mechanisms known to exist. Despite limited knowledge on the mechanism of oligonucleotides, two classes of ASOs have been determined and include RNase H (an enzyme that hydrolyzes the RNA strands of RNA and DNA hybrid helices) dependent oligonucleotides, which induce degradation of messenger RNA, and steric-blocker oligonucleotides, which inhibit the progression of RNA splicing or translation. Antisense oligonucleotides must penetrate targeted cells in order to downregulate gene expression. Uptake by cells is believed to occur by adsorptive endocytosis and fluid phase pinocytosis. The relatively low cost, possibility of sound design and simple concept of oligonucleotides, along with developments in human genome sequencing, have led to the use of oligonucleotides as therapeutic tools and as subjects of various clinical trials and therapeutic studies.

Studies using ASOs as treatments for ALS have been conducted to target various mutations that may contribute to ALS. One study found potentially dangerous upregulations of GluR3, an  $\alpha$ -amino-3-hydroxy-5-methyl-4-isoxazole propionic acid (AMPA) receptor subunit in SOD1G93A (a SOD1 subtype gene) transgenic mouse model of familial ALS.<sup>20</sup> An antisense peptide nucleic acid against GluR3 was created and injected into SOD1 G93A mice, producing significant delay in onset of locomotor impairment.

Another study focused on the use of antisense short single-stranded oligonucleotides that were designed to selectively reduce the accumulation of specific portions of the c9ORF72 gene, the most common genetic cause of ALS.<sup>21</sup> The accumulation of c9ORF72 in peripheral, neuronal and glial cells contributes to the development of ALS. In this study, ASOs were demonstrated to be an effective and tolerable therapy by selectively reducing the accumulation of expanded c9ORF72 RNA foci without affecting the overall amount of c9ORF72 encoding mRNAs. Both of these studies have contributed to the continuously increasing number of in vitro ASO experiments that allow for characterization of new targets and potential therapeutic agents, such as ISIS 333611.<sup>19</sup>

ISIS 333611 is an ASO designed in the first-in-human study on the use of antisense oligonucleotides as an ALS therapy.<sup>22</sup> The objective of the study conducted by Miller and colleagues was to assess the safety, tolerability and pharmacoki-

netics of ISIS 333611. ISIS 333611 was designed to inhibit SOD1 expression through intrathecal administration in patients with familial ALS related to human SOD1. In this randomized, placebo controlled phase 1 trial, 21 patients were administered ISIS 333611 over 11.5 hours. Four cohorts, each with eight SOD1 positive ALS subjects, were given increasing doses of ISIS 333611 (0.15mg, 0.5 mg, 1.5 mg or 3 mg). Subjects within each cohort were randomized (six drug and two placebo). Additionally, participants were allowed to re-enroll in subsequent cohorts; therefore, seven patients enrolled two times and two patients enrolled three times. All dosed participants completed the study and had a variety of SOD1 mutations. Patients varied in age, disease onset and time since diagnosis. Safety was assessed by adverse event collections, physical and neurological examinations, vital signs, clinical laboratory tests, electrocardiograms, ALS functional rating scale-revised assessments, forced vital capacity and recording of use of accompanying medications.

When SOD1 protein concentrations were measured in the cervical and lumbar spinal cord of trial subjects and nontrial subjects, there were no significant differences between the two groups.<sup>22</sup> No significant changes in cerebral spinal fluid (CSF) SOD1 concentrations were found in re-enrolled participants dosed in more than one cohort. As predicted by Miller and colleagues, the single doses given in the study did not provide drug levels that would be high enough to reduce CSF SOD1 concentration; however, because CSF SOD1 levels were found in all participants and those who re-enrolled, they concluded that CSF SOD1 protein concentration could be a pharmacodynamic biomarker for ISIS 333611 for future studies.

Of the participants, 84 percent reported adverse events; however, the most commonly reported adverse events, post lumbar puncture syndrome and back pain, were considered to be associated with the intrathecal infusion procedure and not the drug.<sup>22</sup> There was no difference in frequency between drug and placebo treated groups, and the number of adverse events did not increase as the dose of ISIS 333611 increased. There were two severe side effects (lacunar infarction and pneumonia) that were reported and required hospitalization; however, these were seen in the same placebo treated patient. Re-enrollment did not increase the type and frequency of reported adverse events. Adverse events were found to decrease with re-enrollment. No dose limiting toxicities were identified at doses up to 3.0 mg. Dose-dependent CSF and plasma concentrations were observed when ISIS 333611 levels were measured in the plasma at 13 time points from preinfusion to 12 hours postinfusion and in CSF preinfusion and right after postinfusion.

This trial demonstrates that ASOs may be promising agents for ALS.<sup>22</sup> Although ASOs directed against the SOD1 mutation may be successful, human studies on other ASO targets, such as specific portions of c9ORF72 RNA, may also show the same promising results for potential ALS treatments.<sup>20-22</sup> Also, safety and tolerability assessments for any ASO would need to be tested in future studies to make sure treatments do not produce significant neurological and behavioral deficits in humans. In addition to safety, succeeding phase trials

**Table 3. ALS Sequelae Management.<sup>12</sup>**

Medication	Role in Management
Riluzole	ALS
Amitriptyline, Selective serotonin reuptake inhibitors (SSRIs), mirtazapine, buspirone, diazepam, lorazepam	Anxiety
Diazepam, phenytoin, vitamin E	Cramps
Mirtazapine, SSRIs, tricyclic antidepressants (TCAs), venlafaxine	Depression
Amantadine, bupropion SR, fluoxetine, pyridostigmine, venlafaxine	Fatigue
Amitriptyline, atropine, diphenhydramine, hyoscyamine, scopolamine	Sialorrhea
Baclofen, benzodiazepines, dantrolene, tizanidine	Spasticity
Dextromethorphan/quinidine	Pseudobulbar affect
Amitriptyline, oxybutynin, tolterodine	Urinary urgency

Adapted from: Gordon PH. Amyotrophic Lateral Sclerosis: An Update for 2013 Clinical Features, Pathophysiology, Management and Therapeutic Goals. *Aging and Disease*. 2013 Nov; 4(5): 295-310. Available from: [www.ncbi.nlm.nih.gov/pmc/articles/PMC3794725/pdf/ad-04-05-295.pdf](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3794725/pdf/ad-04-05-295.pdf)

on ASOs directed against SOD1 would need to focus on the efficacy of ISIS 333611, perhaps by using the biomarker SOD1 protein concentration as concluded by Miller et al.<sup>22</sup>

### Role of a Pharmacist

With ALS and FTD currently lacking a cure, the management of these diseases is largely palliative. The only FDA approved medication is riluzole (Rilutek®) which has been shown to slow disease progression in ALS patients.<sup>8</sup> Pharmacists must collaborate in the management and coordination of these patients' medications. With many of these patients experiencing sequelae such as anxiety, cramps, depression, fatigue, sialorrhea, spasticity and urinary urgency, pharmacists are essential to manage the pharmacologic therapy associated with each sequela. Another role that the pharmacist may play is in managing the adverse effects from riluzole and the effects of the disease, which in certain instances can be additive. For example, both riluzole and benzodiazepines used for anxiety can cause respiratory depression, and ALS patients can suffer from respiratory failure due to disease progression.

Since ALS patients may also have altered pharmacokinetics, dosing must be managed very closely. Medication adherence is important for ALS patients because symptom management greatly influences quality of life in these patients. With many ALS multidisciplinary teams lacking pharmacists, it is vital that pharmacists engage in the management of these patients whose well-being depends greatly on pharmacologic management of sequelae. Eventually, if ASOs are found to be successful agents for ALS, it may become the responsibility of the pharmacist to be able to identify which mutations patients have and which treatments would be best for them.

### Conclusion

Amyotrophic lateral sclerosis and FTD are diseases that are becoming more prevalent, and there is an increasing awareness of these devastating diseases within the United States due to efforts such as social media's "ice bucket challenge." These diseases are debilitating and lead to a drastically decreased quality of life and a much shorter life expectancy. Currently, there are various theories as to what causes the diseases, but there is still not enough evidence to find a cure. With the only FDA approved medication being riluzole (Rilutek®), palliative care and sequelae management by health care providers are central to the care of a patient with a neurodegenerative disease. As depicted in Table 3, pharmacists have a variety of roles in the management of patients with these diseases, with the most important being proper and safe management of the sequelae associated with the pathology of ALS and FTD. Titrating doses, properly treating sequelae and managing drug interactions can not only help increase the patients' quality of life but also lengthen their lifespan. Although there are many unknowns in these diseases, research and drug trials are leading us closer to better managing the diseases and also closer to a cure.

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## Assessment Questions

1. Which of the following is not a symptom of ALS?
  - A. Muscle weakness in the arms and legs
  - B. Slurred speech
  - C. Severe headache
  - D. Difficulty breathing
2. True or False: FTD has no significant motor dysfunction, but does present with significant memory decline.
  - A. True
  - B. False
3. While in a medication therapy management (MTM) session with your patient, you note that she has difficulty recalling simple words when speaking. When you ask her about her daily diet, she cannot even remember what she had for breakfast and it is only 10:00 a.m. Her chart notes that the patient has been diagnosed with FTD recently. What specific class of FTD does your patient most likely have?
  - A. Primary progressive aphasia: Logopenic variant
  - B. Behavioral variant
  - C. Primary progressive aphasia: Nonfluent variant
  - D. Movement disorder: Corticobasal degeneration
4. Which class of FTD presents with a lack of empathy and an inability to emotionally adapt to social cues?
  - A. Behavioral Variant FTD (bvFTD)
  - B. Corticobasal Degeneration (CBD)
  - C. Semantic Variant
  - D. Primary Progressive Aphasia (PPA)
5. Which gene mutation is the most common genetic cause of ALS?
  - A. FUS
  - B. c9ORF72
  - C. TARDBP
  - D. SOD1
6. Which of the following genes is not implicated in both ALS and FTD?
  - A. FUS
  - B. C9ORF72
  - C. VAPB
  - D. TARDBP
7. Which gene's mutations does the agent ISIS 333611 primarily target?
  - A. SOD1
  - B. VAPB
  - C. FUS
  - D. TARDBP
8. Which of the following side effects of ISIS 333611 were most commonly reported, but considered to be administration-related in the human phase 1 trial?
  - A. Lacunar infarction and pneumonia
  - B. Neurological deficits and cognitive decline
  - C. Post lumbar puncture syndrome and back pain
  - D. Xerostomia and angioedema
9. Which of the following is/are a function(s) of a pharmacist in the management of ALS and FTD?
  - A. Management of sequelae
  - B. Patient and family education on the disease
  - C. Dosing adjustments based on altered pharmacokinetics
  - D. All of the above
10. Which of the following ALS pharmacologic therapies can lead to respiratory depression?
  - A. Riluzole
  - B. Benzodiazepines
  - C. Venlafaxine
  - D. Two of the above



Ohio Northern University is accredited by the Accreditation Council for Pharmacy Education as a provider of continuing pharmacy education. This program is eligible for credit until 5/7/2018.

To receive continuing education credit for this program, you must answer the above questions and fill out the evaluation form. Please visit [www.raabecollegeofpharmacy.org/PAW](http://www.raabecollegeofpharmacy.org/PAW) to enter the required information. Please allow two to three weeks for electronic distribution of your continuing education certificate, which will be sent to your valid email address in PDF format.



To receive continuing education credit for this program, visit [www.raabecollegeofpharmacy.org/PAW](http://www.raabecollegeofpharmacy.org/PAW) OR fill out the form below including your indicated answers to the assessment questions and return to:

Office of Continuing Education at The Raabe College of Pharmacy  
Ohio Northern University  
525 South Main Street  
Ada, Ohio 45810

### Continuing Education Registration & Evaluation Form

Program Title: **Current Trials and Therapies for the Treatment of Amyotrophic Lateral Sclerosis and Frontotemporal Dementia**

UAN: 0048-0000-15-207-H01-P CEUs: 0.1

*All information must be printed CLEARLY to ensure accurate record keeping for attendance and the awarding of continuing education credit. You MUST provide your CPE Monitor# and Month and Day of birth to receive credit.*

Name: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

State: \_\_\_\_\_

Zip: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

Check one: Pharmacist ☐

Technician ☐

License #: \_\_\_\_\_

State: \_\_\_\_\_

CPE Monitor #: \_\_\_\_\_

Birthday (MM/DD): \_\_\_\_\_

Program Content:	Strongly Disagree			Strongly Agree		
The program objectives were clear.	1	2	3	4	5	
The program met the stated goals and objectives:						
1. Identify the symptoms of ALS and FTD.	1	2	3	4	5	
2. Classify FTD subtypes based on patient presentation.	1	2	3	4	5	
3. Recognize the most prominent gene mutations in ALS and FTD.	1	2	3	4	5	
4. Describe various targets of ASO therapy.	1	2	3	4	5	
5. List common and serious adverse effects of ISIS 333611.	1	2	3	4	5	
6. Define the role of the pharmacist in the management of ALS and FTD.	1	2	3	4	5	
The program met your educational needs.	1	2	3	4	5	
Content of the program was interesting.	1	2	3	4	5	
Material presented was relevant to my practice.	1	2	3	4	5	
Audio/visual and/or printed materials aided the learning process.	1	2	3	4	5	
The program used effective teaching/learning methods.	1	2	3	4	5	
The learning assessment activities were appropriate.	1	2	3	4	5	
The program showed good objectivity and no commercial bias.	1	2	3	4	5	
Would you recommend this program to a colleague?	1	2	3	4	5	
What was the most valuable part of this program?	_____					

Based on what you have learned what one change do you plan to make in your practice? \_\_\_\_\_

Speaker Content:	Strongly Disagree			Strongly Agree		
The speaker was well prepared and knowledgeable about the topic.	1	2	3	4	5	
The quality of the speaker was excellent.	1	2	3	4	5	
The speaker provided adequate time for questions.	1	2	3	4	5	
Comments: _____						

Suggestion for future programs you would like to see: \_\_\_\_\_

### Answers to Assessment Questions—Please Circle Your Answer

1. A B C D

3. A B C D

5. A B C D

7. A B C D

9. A B C D

2. A B

4. A B C D

6. A B C D

8. A B C D

10. A B C D

Any questions/comments regarding this continuing education program can be directed to Lauren Hamman, Advanced Administrative Assistant for the Office of Continuing Education (email: [l-hamman@onu.edu](mailto:l-hamman@onu.edu), phone 419-772-2280).



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