

IMPLEMENTATION OF INTERPROFESSIONAL EDUCATION: RESPIRATORY
MANAGEMENT IN AMYOTROPHIC LATERAL SCLEROSIS

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RESPIRATORY MANAGEMENT IN AMYOTROPHIC LATERAL
SCLEROSIS

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ABSTRACT

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease that affects nerve cells, leading to muscle weakness, including weakness of respiratory muscles. Respiratory issues significantly contribute to the morbidity and mortality of persons with ALS. Therefore, respiratory management is a critical aspect of care. There is a concerning lack of awareness and knowledge among rural and urban healthcare professionals regarding the respiratory management of persons with ALS. Healthcare professionals need to understand the differences between oxygenation and ventilation and the importance of following evidence-based guidelines. Nurse practitioners play a crucial role in the care of a person with ALS, overseeing and coordinating interprofessional care. Regular care in multidisciplinary ALS clinics is beneficial, but due to the complexity of the disease, persons with ALS often require care from various healthcare professionals in a variety of settings. An interprofessional healthcare approach is favorable for providing the highest quality of care for ALS patients.

This project aimed to address the knowledge gap by designing, implementing, and evaluating an educational session focusing on interprofessional collaboration. This project targeted students pursuing healthcare degrees in various disciplines aiming to better equip healthcare students with knowledge before they enter practice. Participants completed pre- and post-surveys to determine if knowledge increased and to elicit attitudes and beliefs about interprofessional education. Quantitative and qualitative methods were utilized. Findings suggest that integrating educational sessions for healthcare students effectively enhances knowledge and positively benefits interprofessional interactions, which can lead to better health outcomes.

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DEDICATION

To the patients who have trusted me to be a part of their journey and have fueled my passion for improving healthcare. To my colleagues who have shared their knowledge and skills with me while teaching me the importance of interprofessional collaboration. You each played a role in providing the inspiration it took to create this project, with the hope that it may contribute to the betterment of patient care.

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LIST OF ABBREVIATIONS

ALS	Amyotrophic Lateral Sclerosis.
ED	Emergency Department.
IPE	Interprofessional Education.
NP	Nurse Practitioner.
PALS	Persons with Amyotrophic Lateral Sclerosis.
PCP	Primary Care Provider.
SPHD	Students Pursuing a Healthcare Degree.

CHAPTER 1: INTRODUCTION

Background and Significance

Amyotrophic lateral sclerosis (ALS) is a devastating neurodegenerative disease that damages motor neurons, leading to muscle weakness, disability, paralysis, and death ("Understanding ALS", n.d.; Verma, 2021). The progression of ALS includes weakness of respiratory muscles. Respiratory muscle weakness disrupts the intricate coordination of multiple muscle groups that work together to provide crucial respiratory functions. Deterioration of respiratory muscle strength and function can cause respiratory insufficiency, hypoventilation, hypercapnic respiratory failure, compromised cough function, increased risk of aspiration, respiratory infections, and respiratory emergencies (Racca et al., 2020). Since there is no cure for ALS, medical management aims to slow disease progression, manage symptoms, and improve quality of life.

Respiratory issues significantly contribute to the morbidity and mortality associated with ALS. Mehta et al. (2023) reported an estimated prevalence of 31,842 cases of ALS within the United States, or 9.9 per 100,000 people. Mehta et al. (2022) reported an average estimated incidence rate of 1.5 to 1.7 per 100,000 people in the United States. However, the midwestern United States has a higher incidence rate, between 2.5 to 2.9 per 100,000. Due to the rapid disease progression and respiratory involvement, persons with ALS die between two and five years following diagnosis or disease onset (Foster & Salajegheh, 2019; Mehta, Kaye, Raymond, Wu, et al., 2018; Raymond et al., 2019). The nature of the disease requires management by multiple disciplines to provide the highest quality of care for the patient. The nurse practitioner or healthcare provider oversees and coordinates the interprofessional approach to care.

Problem Statement

Despite the devastating impact of respiratory complications in ALS, there is a concerning lack of awareness and knowledge among healthcare professionals discussed amongst the healthcare team, even in critical care settings. However, research on this topic is deficient. Failure to follow current ALS care guidelines can have detrimental effects. Understanding the differences between oxygenation and ventilation is critical, as ALS causes an issue with ventilation, not oxygenation. One common respiratory management mistake that healthcare professionals make is providing supplemental oxygen to a patient with ALS without the concurrent use of noninvasive ventilation. Using supplemental oxygen alone can quickly create issues due to the high risk of hypercapnia with neuromuscular weakness (Chiou et al., 2016; Gay & Edmonds, 1995; Racca et al., 2020). Given the impact of respiratory dysfunction in patients with ALS, appropriate and timely management of respiratory symptoms is crucial for enhancing quality of life and prolonging life (Burkhardt et al., 2017).

Nurse practitioners (NPs) play multiple roles in the care of a person with ALS. Important roles include assessment, symptom management, health maintenance, education, emotional support, and care coordination (Davis & Lou, 2011; Houde & Mangolds, 1999). Regular care in a multidisciplinary ALS clinic is highly beneficial for persons with ALS (PALS), but due to the complexity of the disease, PALS often require care in various healthcare settings. Regardless of the setting, an interprofessional healthcare approach to care is favorable. Therefore, this practice improvement project has an interprofessional focus. This project will aim to provide education to students pursuing an undergraduate or graduate healthcare degree in nursing, pharmacy, allied health sciences, public health, nutrition sciences, and counseling. By focusing on students, the

co-investigator can implement education that impacts a variety of future healthcare workers while their knowledge is still developing, preparing them for their future roles.

Purpose

This project aims to provide education on respiratory care for persons with ALS with a focus on interprofessional collaboration to better equip students with knowledge prior to their transition into practice. Potential impacts could improve future collaboration and care outcomes for persons with ALS. This improvement may occur once the healthcare students graduate and enter into practice, having been exposed to the information and emphasis on collaborative practice.

Objectives

1. Implement an educational session for students pursuing a healthcare degree focused on enhancing ALS respiratory management.
2. 100% of students pursuing a healthcare degree will indicate increased knowledge of respiratory management for patients (with ALS) after completion of the educational session.
3. Assess attitudes and beliefs about interprofessional interactions among students pursuing a healthcare degree.

CHAPTER 2: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Amyotrophic Lateral Sclerosis (ALS) is characterized by the degeneration of both upper and lower motor neurons ("Understanding ALS", n.d.). The degeneration causes communication breakdown between the brain, spinal cord, and peripheral muscles. The clinical manifestations of ALS are diverse and include dysfunction of many critical functions such as mobility, speech, swallowing, and breathing. Due to the disease's complexity, an interprofessional treatment approach is beneficial for a person with ALS (Berg et al., 2005; Davis & Lou, 2011; Houde & Mangolds, 1999). This review aims to describe current ALS management guidelines and investigate challenges associated with respiratory management in ALS, highlighting the need for education for the NP and the entire healthcare team. The Theory of Adult Learning will be discussed as the theoretical framework for this project.

List of Definitions

Atrophy. Waste away ("Understanding ALS", n.d.).

Dysarthria. Motor speech disorder which can be classified according to the underlying neuropathology and is associated with disturbances of respiration, laryngeal function, airflow direction, and articulation resulting in difficulties of speech quality and intelligibility (Enderby, 2013).

Hypercapnia. Presence of excessive amounts of carbon dioxide in the blood (Merriam-Webster, n.d.-a)

Hypoventilation. Deficient ventilation of the lungs that results in reduction in the oxygen content or increase in the carbon dioxide content of the blood or both (Merriam-Webster, n.d.-c)

Non-REM sleep. Stage of sleep when eyes don't move, brain waves are much slower, and muscle tone is maintained (Summer & Singh, 2023)

Paralysis. Loss of the ability to move (Merriam-Webster, n.d.-b)

Pseudobulbar affect. Involuntary, sudden, and frequent episodes of laughing and/or crying far in excess of situation which may have provoked it (Kasarskis, n.d.)

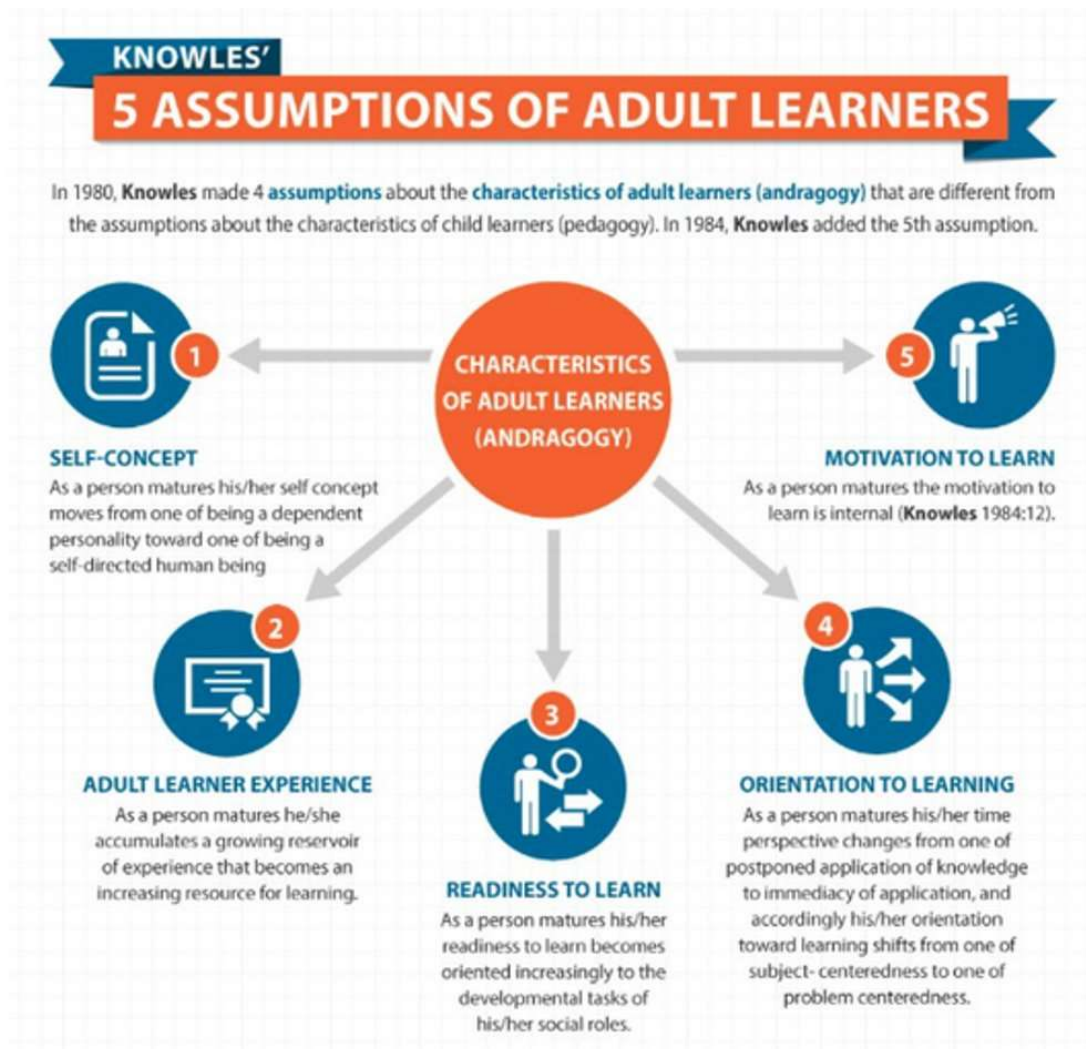
REM sleep. Stage of sleep characterized by rapid eye movements, complete loss of muscle tone, irregular breathing, elevated heart rate, and increased brain activity (Summer & Singh, 2023).

Theoretical Framework

The project's theoretical framework is based on Malcolm Knowles' theory of adult learning, also known as andragogy. The adult learning theory suggests that adults have unique characteristics and learning needs that should be considered when designing effective learning experiences (Knowles, 1973). As seen in Figure 1, Malcolm Knowles acknowledged five assumptions about adult learners: self-concept, the adult learning experience, readiness to learn, orientation to learning, and motivation to learn. The five assumptions guide the design and delivery of educational programs for adult learners. The following describes the five assumptions related to this practice improvement project.

Figure 1

Knowles' Five Assumptions



Note. The figure is open for public access. (Appendix A). ("The Adult", 2014).

Assumption One: Self-Concept

Knowles' first assumption is that as a learner grows older into adulthood, their self-concept transforms from dependent to independent (Knowles, 1973). Adult learners prefer to take control of learning opportunities. Knowles observed that when a student is pursuing professional schooling or work, the student actively shows self-direction or moves toward independence. This practice improvement project (PIP) is aimed at students pursuing healthcare

degrees (SPHD). Following Knowles' assumption, the students have taken a step toward professional schooling, becoming more independent as adult learners.

The adult learning theory is at the base of many healthcare professional educational programs (Mukhalalati & Taylor, 2019). The theory has also been used to provide self-directed continuing education courses to nurses and providers, including training in a distance-accessible or virtual form (Smith et al., 2021). This PIP will allow the learner to be involved in person or virtually. The virtual option makes the educational session accessible to more SPHDs, including students in rural locations. Students, from a variety of healthcare backgrounds, will be able to attend the interprofessional education session voluntarily, as there are three offerings for educational sessions each semester.

Assumption Two: Adult Learning Experience

The assumption is that as an individual ages and matures, a wealth of experience is accumulated and can be used as an excellent resource for future learning opportunities (Knowles, 1973). Past experiences provide a foundation for the individual to connect with new knowledge. Knowles identified that adult learners prefer discussion for learning. This PIP includes an interactive activity to allow participants to discuss a real-world case study. Participants will be placed in groups with other adult learners to build off each other's past experiences and practice critical thinking. Some may have already entered clinical experiences at the time of the education, while others may not have yet, so all participants will have had the opportunity to learn from one another.

Assumption Three: Readiness to Learn

According to Knowles' third assumption, adults tend to develop a readiness or "need" to learn information that will impact areas where they feel personal and professional accountability

(Knowles, 1973). Many healthcare professionals within the target population for the project will encounter persons with ALS. The educational session provides examples that directly relate to the healthcare setting. The likelihood of retaining information increases when learning is related to professional practice. The educational session will allow the learners to develop personal and professional advancement. The discussions surrounding collaboration will also impact participants by learning to be cognizant of a team approach and roles of other healthcare professionals.

Assumption Four: Orientation to Learning

The fourth assumption is that orientation to learning changes as we age, from subject-based learning in childhood to problem-based learning in adulthood (Knowles, 1973). Problem-based learning applies a topic to a life event or problem, allowing for immediate and realistic application. The educational session is centered around a current problem frequently seen throughout healthcare settings. Some learners are currently completing clinical hours and can immediately apply the knowledge and resources gained during the session to patient care.

Assumption Five: Motivation to Learn

Motivation to learn was an assumption that was added in 1984. As we get older, our motivation to learn moves from an external factor to an internal factor (Merriam & Caffarella, 1999). The internal drive is what supports the continued desire to seek learning opportunities. Motivation is obtained when information is relevant and applicable to the learner's role and environment. The learner's self-motivation is emphasized with the PIP as the learner shows self-motivation to learn by attending and participating in the optional educational session and surveys.

Conclusion

Knowles' Adult Learning Theory explains how adult learners prefer to take control of their learning opportunities. Knowles' five assumptions include self-concept, adult learning experience, readiness to learn, orientation to learning, and motivation to learn. By applying the assumptions of the adult learning theory to providing education to healthcare professionals, the education provided can create a more engaging and practical learning experience that may result in improved patient care and outcomes.

Literature Review

Introduction

Breathing is a vital part of daily life. The process of breathing in (inspiration) and breathing out (expiration) is an involuntary function. Inspiration and expiration require the work of multiple muscle groups working together. Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disease that affects nerve cells, leading to muscle weakness, including weakness of respiratory muscles (Verma, 2021). There is currently no cure for ALS, and the progression of the disease ultimately leads to paralysis and death. Other terms commonly used for amyotrophic lateral sclerosis include motor neuron disease, Charcot's disease, and Lou Gehrig's disease ("Understanding ALS", n.d.; Verma, 2021). Although some subtypes of ALS present differently, the literature review will focus on the classic form of ALS, as described by the earlier definition.

Amyotrophic Lateral Sclerosis

Amyotrophic lateral sclerosis (ALS) is an incurable, progressive neuromuscular disease first detected by Jean-Martin Charcot in 1869 ("Understanding ALS", n.d.). ALS causes progressive deterioration of both upper and lower motor neurons. Motor neurons are nerve cells

located within the nervous system. Upper motor neurons run from the brain to the spinal cord, whereas lower motor neurons run from the anterior horn of the spinal cord to the peripheral muscle groups. Therefore, the deterioration of the motor neurons disrupts the pathway from the brain to the muscles, ultimately affecting the body's ability to perform and coordinate voluntary muscle movements. Voluntary muscle movements are vital in everyday functions, such as talking, swallowing, moving, and breathing. With ALS, muscles become weak and atrophy, progressing to paralysis. The most common clinical manifestations of classic ALS represent a decline in motor function (Verma, 2021).

The Greek meaning of Amyotrophic Lateral Sclerosis summarizes the disease process ("Understanding ALS", n.d.). "Amyotrophic" translates to "no muscle nourishment". "Lateral" refers to the side of the body, which signifies the location of stimulation from motor neurons leading to the muscles. "Sclerosis" means hardening, which occurs following progressive degeneration. ALS is a fatal disease affecting people worldwide.

Clinical Manifestations

The clinical onset, pattern of progression, and patient prognosis look different for each patient with ALS. Due to the wide range of clinical manifestations at onset and through progression, ALS can be difficult to diagnose. There is not an ALS-specific diagnostic marker, so an ALS diagnosis is made by patient-reported history, the clinical presentation of upper motor neuron and lower motor neuron involvement that is progressing, EMG evidence, and ruling out other disease processes that can mimic the manifestations of ALS (Quinn & Elman, 2020). Upper motor neuron signs on the exam are noted with spasticity, hyperreflexia, pathologic reflexes, and pseudobulbar affect (Zayia & Tadi, 2022). Lower motor neuron signs include muscle weakness, fasciculations, atrophy, flaccidity, and hyporeflexia. Providers often detect

signs when the patient presents to the clinic with a concern. A neurologist commonly completes the full ALS work-up and diagnosis.

Clinical manifestations noted at the onset of the disease are grouped into categories according to the initial presenting features (Quinn & Elman, 2020; Verma, 2021). The two most common forms are limb-onset and bulbar-onset. Limb-onset ALS is a term that is used when the presenting muscle symptoms are noted within a patient's limb. Limb-onset ALS accounts for around 70% of presenting patients. Limb-onset ALS often originates in the distal portion of the extremity, such as the hand or foot, with an asymmetric presentation. In contrast, approximately 20-25% of patients present with bulbar-onset (Foster & Salajegheh, 2019; Quinn & Elman, 2020). Bulbar-onset is a category encompassing the involvement of the bulbar muscles, which are located within the head and neck. Based on the location, manifestations such as facial weakness, dysarthria, or dysphasia are noted (Quinn & Elman, 2020). Bulbar-onset ALS tends to progress quicker to respiratory issues due to the location of muscle weakness.

Regardless of the onset location, the progressive nature of ALS causes signs and symptoms to eventually involve multiple body areas, including the bulbar, cervical, thoracic, and lumbosacral regions (Verma, 2021). The neurodegeneration progression can rapidly cause disability and death. Most persons with ALS (PALS) die from a respiratory issue from progression to respiratory muscles (Foster & Salajegheh, 2019). Research varies in the typical timeline of survival for a patient with ALS. Some researchers state that the survival rate for a majority of patients with ALS is between two to five years from diagnosis (Mehta, Kaye, Raymond, Wu, et al., 2018), whereas other researchers state two to five years from disease onset (Foster & Salajegheh, 2019; Raymond et al., 2019). The differentiation is substantial according

to Danielle Richards et al.'s (2021) research, as the length of time between onset and diagnosis can be delayed by nine months to two and a half years.

Epidemiology

In 2008, the ALS Registry Act was passed in the United States. The ALS Registry Act authorized the Secretary of Health and Human Services and the Director of the Centers for Disease Control and Prevention (CDC) to create a National ALS Registry. Currently, the National ALS Registry numbers are collected through self-enrollment, the Centers for Medicare & Medicaid Services (CMS), the Veterans Health Administration (VHA), and the Veterans Benefits Administration (VBA) (Mehta, Kaye, Raymond, Punjani, et al., 2018). A diagnosis of ALS can occur before age 18, but it is rare. The National ALS Registry statistics exclude persons younger than 18. One goal of the National ALS Registry is to obtain information about the epidemiology of amyotrophic lateral sclerosis, including prevalence and incidence (Congressional Research Service, 2008; Mehta et al., 2014).

National Prevalence

Mehta et al. (2014) first used data from the National ALS Registry to determine the estimated prevalence of ALS on a national level. The National ALS Registry data alone from October 10, 2010 to December 31, 2011, totaled 12,187 PALS equaling a prevalence rate of 3.9 per 100,000 (Mehta et al., 2014). The most recent prevalence data from the National ALS Registry is from 2017 and shows the number of ALS cases to be 17,800, which is 5.5 per 100,000 people (Mehta et al., 2023). However, all states do not require reporting to the National ALS Registry, and some PALS have private insurance plans or Medicaid. Therefore, to estimate the additional number of cases that were not accounted for through the National ALS Registry,

Mehta et al. (2023) used capture-recapture methodology and concluded an estimated prevalence of 31,843 total cases, or 9.9 per 100,000 people. According to Mehta et al. (2023), “While 2017 demonstrated a higher mean prevalence rate, this was due to better case-ascertainment by the National ALS Registry and not necessarily an upward trend in national prevalence” (p. 114).

National Incidence

The first national incidence data was collected from the National ALS Registry from 2014 to 2016 in the United States. The most up-to-date incidence rates from the National ALS Registry are from 2016. The estimated number of new cases of ALS was 5,695 persons in 2014, 6,045 in 2015, and 4,861 in 2016, which allowed for incidence rates ranging between 1.5-1.7 per 100,000 people (Mehta et al., 2022). Mehta et al. (2022) sectioned the United States into four demographic regions for a further breakdown of incidence rates. They determined that incidence rates ranged from 0.9-1.0 per 100,000 in the South to 2.5-2.9 per 100,000 in the Midwest. The Midwest included the states of Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

Midwestern United States

Although the ALS Association (ALSA) recognizes 20 ALS clinics in Minnesota, North Dakota, South Dakota, Iowa, and Wisconsin. There are seven clinics in Minnesota, five in Wisconsin, four in Iowa, three in South Dakota, and only one in North Dakota. Throughout the five states, the ALSA serves 1,045 persons living with ALS (ALS Association, personal communication, 2023). From January 2023 to October 2023, there were 187 newly registered persons living with ALS.

Respiratory Issues with ALS

Important muscle groups supporting the respiratory system include the bulbar, intercostal, diaphragm, and abdominal muscles (Guion & Paladenech, 2017). Bulbar muscles in the head and neck control functions such as swallowing, speaking, and managing the airway. Intercostal muscles engage to help with both inspiration and expiration. The diaphragm is the primary muscle in breathing. The diaphragm is found in the lower section of the chest and contracts or moves down during inspiration to allow the lungs to expand and fill with air. Abdominal muscles work as expiratory muscles as their contraction on expiration assists with moving the diaphragm back up to its position within the thorax. The abdominal muscles also assist with coughing, which can clear mucus from the lungs and throat. The muscles work together in normal breathing as a pump.

As discussed above, the process of normal muscle function is disrupted with the onset of muscle weakness from ALS. The decline in respiratory muscles, especially the diaphragm, intercostal muscles, and abdominal muscles, leads to pump failure, also known as hypercapnic respiratory failure (Racca et al., 2020). Common symptoms of respiratory muscle weakness include excessive daytime sleepiness, morning headaches, vivid dreams, nighttime arousals, shortness of breath with everyday activities, or difficulty breathing while lying flat (Guion & Paladenech, 2017; Miller et al., 2009a).

The same muscles are needed to produce an adequate cough to clear secretions (Racca et al., 2020). Also, weakness of the bulbar muscles places PALS at an increased risk for aspiration due to difficulty managing secretions. The aspiration risk and ineffective coughing increase the risk of respiratory infections (such as a viral cold or bacterial pneumonia), acute or chronic respiratory failure, or other respiratory emergencies.

Hypoventilation for PALS is often first revealed during sleep (Racca et al., 2020). Not all muscles function during sleep as during the day with complete neurological control. Although the diaphragm is one muscle that continues to function throughout sleep cycles, accessory respiratory muscles do not. For example, upper airway muscle involvement is decreased in non-REM stages of sleep and paralyzed in REM sleep. Therefore, a patient with diaphragm weakness is at an increased risk for sleep-related hypoventilation. Hypoventilation affects oxygenation and sleep quality, which if left untreated, can affect cognition, memory, energy, cardiac function, muscle function, and quality of life. With ALS, sleep-related hypoventilation will progress to daytime hypoventilation as the respiratory muscles weaken (D’Cruz et al., 2018; McCool & Tzelepis, 2012; Summer & Singh, 2023).

Monitoring Respiratory Function

Since ventilation is often first affected at night while the person is in a supine position, respiratory muscle weakness can go unnoticed during the day. Therefore, consistent monitoring of respiratory function and symptoms is crucial. American Academy of Neurology guidelines for the care and management of a patient with ALS recommend pulmonary function tests, nocturnal oximetry, and sniff nasal pressure as optimal pulmonary tests for detecting respiratory insufficiency (Miller et al., 2009a). However, there is weak evidence. Pulmonary testing is often ordered at least every six months (Khan et al., 2023) or as needed if respiratory changes occur. The pulmonary testing is often completed in coordination with neurology, sleep medicine, pulmonary, or ALS multidisciplinary visits. However, primary care providers and other healthcare professionals may also order testing. The type of pulmonary testing may differ for each person depending on their status, abilities, and use of respiratory equipment.

Pulmonary function tests (PFTs) should be performed in both an erect and supine position every time the PFT site has the accommodations. PFTs measure the strength of the diaphragm, intercostals, and abdomen and how they function together (Guion & Paladenech, 2017). Nocturnal oximetry is a study that is completed within the patient's home. A device with a pulse oximeter that measures oxygen levels while the patient is asleep is sent home. The device is returned to the facility so the team can interpret the results. Sniff nasal inspiratory pressure also measures the strength of the diaphragm, but the probe is inserted into the nostril, which can be especially beneficial if there is bulbar weakness. Monitoring for progression, a subjective and objective assessment by the nurse practitioner or medical provider at each healthcare visit is vital, looking for respiratory function, aspiration, or respiratory infection (Houde & Mangolds, 1999).

Recommendations, in some situations, to get a more in-depth assessment through polysomnography (sleep study) are necessary (Bach & Pham, 2022). Ensuring the facility completing the sleep study can monitor carbon dioxide throughout the study is vital for a patient with neuromuscular weakness. Carbon dioxide monitoring helps to rule out central apnea or obstructive apnea issues from respiratory muscle weakness issues thereby determining the correct respiratory treatment for each specific patient that targets the underlying pathophysiology. Measurement of peak cough expiratory flow rate can also be helpful when wanting to determine the strength of a patient's cough and ability to clear secretions from the lungs (Racca et al., 2020).

Amyotrophic Lateral Sclerosis (ALS) is a fatal disease, and respiratory complications commonly cause death for many PALS (Foster & Salajegheh, 2019). Hence, the importance of identifying respiratory conditions in patients with ALS so the appropriate respiratory

management options can be offered to treat symptoms, prevent respiratory infections, and increase quality of life. Every healthcare professional can play a role in respiratory management for PALS.

Respiratory Management and Medical Response

Amyotrophic lateral sclerosis is progressive and does not have a cure. Therefore, treatment objectives are to slow the disease process, improve symptoms, maintain mobility, and improve quality and length of life. Burkhardt et al. (2017) noted that guideline-recommended respiratory treatments have been shown to prolong life for patients with ALS. Two commonly used guidelines for ALS respiratory management are CHEST guidelines and American Academy of Neurology guidelines. Figure 2 is an algorithm researched and created by Khan et al. (2023) for the American College of Chest Physicians guidelines (CHEST guidelines) showing the recommendation for noninvasive ventilation initiation for PALS experiencing respiratory failure symptoms. CHEST guidelines refer to recommendations for neuromuscular disorders in general, which includes ALS. Figure 3 shows a respiratory management algorithm as recommended by the American Academy of Neurology (Miller et al., 2009a).

Guideline articles emphasize the importance of weighing the treatment options with the patient's wishes and goals of care to ensure shared determination of the respiratory treatment recommendation (Khan et al., 2023; Miller et al., 2009b). Throughout the guidelines, there is no recommendation to use oxygen for management of respiratory issues from ALS, yet the local ALS clinic often finds that many providers continue to order oxygen as first line treatment. Oxygen use with neuromuscular weakness has been linked to hypercapnia for many years, although oxygen alone continues to be mistakenly administered by healthcare professionals (Chiou et al., 2016; Gay & Edmonds, 1995; Racca et al., 2020). These guideline algorithms

should be used instead to decrease the risk of hypercapnia. Whether the healthcare provider is ordering the oxygen, applying the oxygen, or just visiting with the patient, all healthcare professionals can catch this issue. Therefore, providing education about current evidence-based guidelines to all types of healthcare professionals is important.

Figure 2

CHEST Guidelines

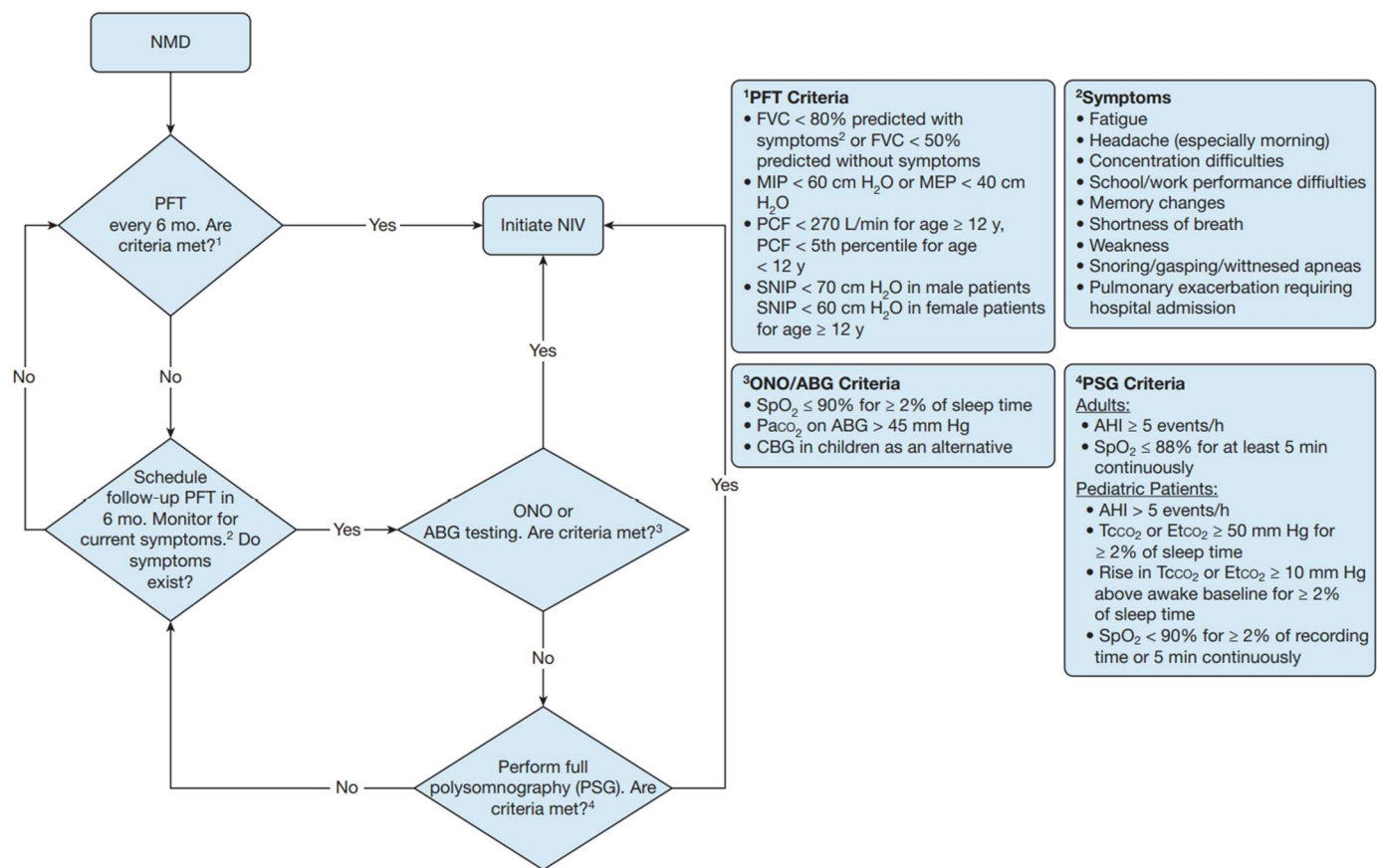
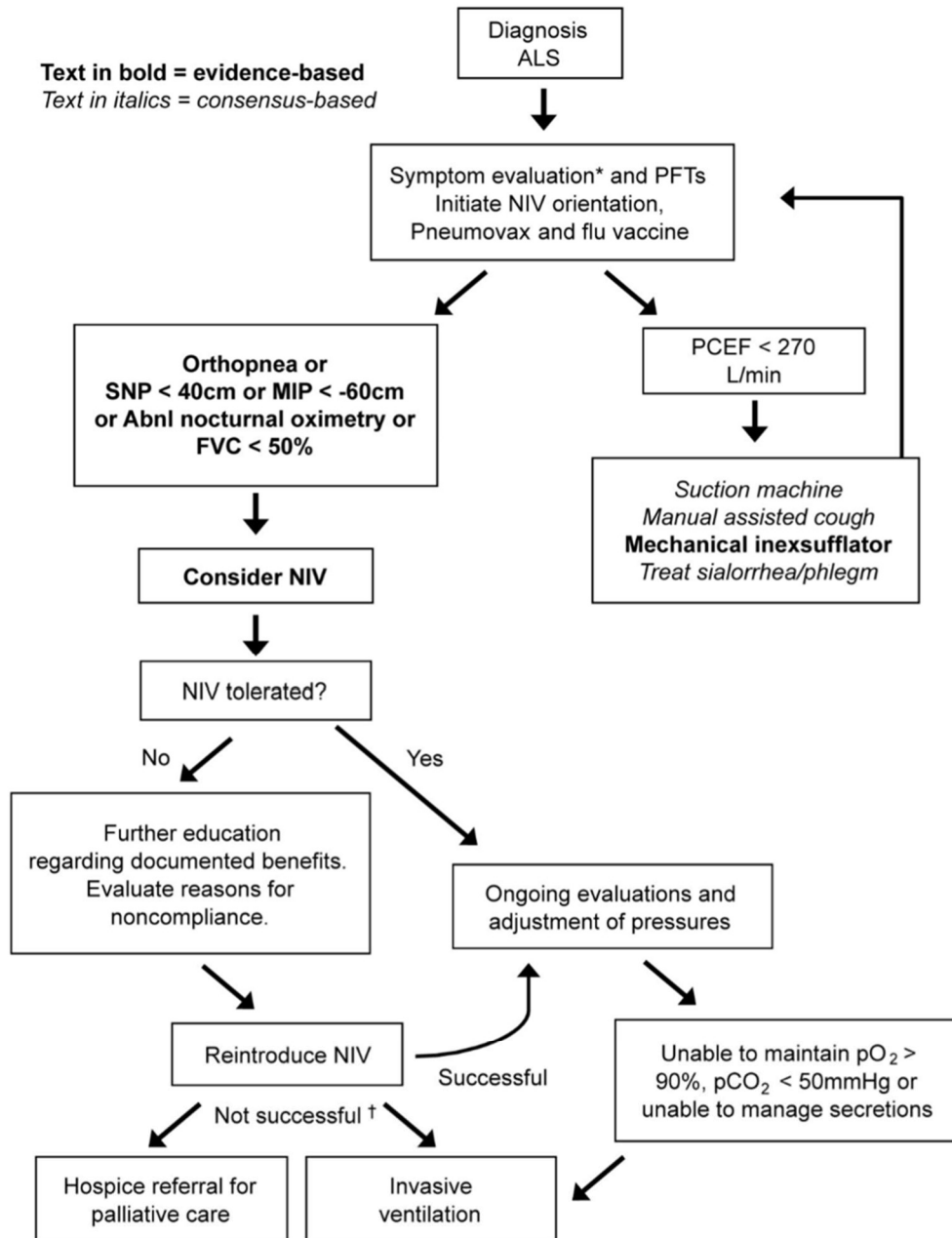


Figure 1 - Flowchart for NIV initiation for patients with NMD showing respiratory failure symptoms. ABG = arterial blood gas; CBG = capillary blood gas analysis; ETco₂ = end-tidal CO₂; MEP = maximum expiratory pressure; MIP = maximum inspiratory pressure; NIV = noninvasive ventilation; NMD = neuromuscular disease; ONO = overnight oximetry; PCF = peak cough flow; PFT = pulmonary function testing; SNIP = sniff nasal inspiratory pressure; SpO₂ = arterial oxygen saturation; tcPCO₂ = transcutaneous PCO₂.

Note. The figure was produced by Khan et al. in 2023. Permission for use of the material was obtained from Elsevier (Appendix B)

Figure 3

AAN Guidelines



PFT = pulmonary function tests; PCEF = peak cough expiratory flow; NIV = noninvasive ventilation; SNP = sniff nasal pressure; MIP = maximal inspiratory pressure; FVC = forced vital capacity (supine or erect); Abnl.nocturnal oximetry = $pO_2 < 4\%$ from baseline. *Symptoms suggestive of nocturnal hypoventilation: frequent arousals, morning headaches, excessive daytime sleepiness, vivid dreams. †If NIV is not tolerated or accepted in the setting of advancing respiratory compromise, consider invasive ventilation or referral to hospice.

Note. The figure was produced by Miller et al. in 2009 and labeled “Figure 2—Respiratory management algorithm”. Permission for use of the material was requested from the American Academy of Neurology (Appendix C).

ALS Clinic

An ALS Clinic offers a multidisciplinary care approach to persons with amyotrophic lateral sclerosis ("ALS Certified Centers & Clinics", n.d.). The multidisciplinary team members have experience working specifically with the ALS population. Each ALS Clinic team includes different healthcare professionals, including nursing, physical therapy, occupational therapy, speech and language pathology, dietician services, social work, respiratory therapy, sleep medicine, neurology, psychology, and/or palliative care. Furthermore, many ALS Clinic team members work closely with their local ALS Association chapter.

Over the years, research has shown the benefit of multidisciplinary ALS care for PALS (Berg et al., 2005; Davis & Lou, 2011; Houde & Mangolds, 1999). A systematic review and meta-analysis was completed by de Almeida et al. (2021) to examine further the effects on survival and quality of life between PALS receiving care from a multidisciplinary clinic (MDC) versus PALS solely attending a neurology clinic. Although the perceived health-related quality of life for patients in either setting did not differ, longer survival and better mental health quality of life were reported by the patients following with an MDC. Guidelines from the American Academy of Neurology recommend the consideration of a referral to an MDC for PALS to “optimize health care delivery”, “prolong survival”, and “to enhance quality of life” (Miller et al., 2009b, p. 1229).

Nurse Practitioner Role

North Dakota and the surrounding states are full practice authority states for nurse practitioners (NPs). Full practice states allow NPs “to evaluate patients; diagnose, order and interpret diagnostic tests; and initiate and manage treatments, including prescribing medications and controlled substances, under the exclusive licensure authority of the state board of nursing”

(American Association of Nurse Practitioners, 2022c). Approximately 70% of NPs throughout the United States are primary care providers (American Association of Nurse Practitioners [AANP], 2022a).

With the vast number of rural areas throughout North Dakota, primary care NPs play an even more prominent role in providing care to patients with chronic conditions such as ALS. There is one affiliated ALS Clinic in North Dakota, which requires patients to travel up to 6 hours to get to an ALS multidisciplinary clinic. To bridge the time between visits to the ALS Clinic, the local primary care provider often has eyes and ears on the patient more frequently than the ALS multidisciplinary team. Therefore, the primary care NP role is integral to the recommended team approach to caring for an ALS patient. An NP's essential roles in caring for a patient with ALS include assessment, symptom management, health maintenance, education, emotional support, and care coordination (Davis & Lou, 2011; Houde & Mangolds, 1999).

Many PALS present to primary care providers for regular check-ups and episodic appointments. Assessment is utilized to determine if there has been disease progression. The physical examination should include neurological, musculoskeletal, and pulmonary assessments (Houde & Mangolds, 1999). Assessment and a thorough history can draw attention to signs and symptoms of concern. PALS can experience various symptoms due to progressive weakness, which is discussed in more detail in the Clinical Manifestations section above. Respiratory concerns are common and can range from subtle to severe. Early recognition of respiratory changes is crucial so the PCP can ensure proper follow-up and interventions (Davis & Lou, 2011).

Respiratory symptom management by the PCP may include education, medication prescriptions, equipment, lab monitoring, imaging, further testing, or referrals. The PCP is also

able to monitor health maintenance recommendations, such as ensuring the patient is up-to-date on vaccinations and smoking cessation, which decrease the risk for respiratory infections and further lung damage (Houde & Mangolds, 1999; National Center for Immunization and Respiratory Diseases, 2022; U.S. Department of Health & Human Services, 2022). PALS also present to the PCP's office for a follow-up from an emergency department (ED) visit or hospitalization. The local ALS clinic has noted that the ED, hospital, and primary care offices are areas where oxygen frequently continues to be prescribed. The follow-up appointment with the PCP is a prime time to catch the problem and turn to evidence-based guideline recommendations for respiratory management for PALS.

Providing education to patients, families, and caregivers is critical in every stage of the disease. Patient education is the foundation for patients to make informed decisions about their goals of care, treatment decisions, and end-of-life wishes (Houde & Mangolds, 1999). NPs, as the PCP, are also equipped to provide emotional support for the patient and the caregivers with empathy and compassion, which is at the heart of nursing. The American Association of Nurse Practitioners (2022b) highlights the NPs' emphasis on health education and counseling. Emotional support can include offering counseling in person in the clinic as well as offering resources such as support groups, spiritual care, and referrals to mental health professionals. As the disease progresses, travel can become difficult for patients and families. Patients rely heavily on primary care providers to be the care coordinator for services within the local community and continue to coordinate and communicate with the ALS clinic team of specialists (Davis & Lou, 2011).

Outside primary care, NPs and many other healthcare professionals provide medical care to PALS in various healthcare settings. Settings may include a clinic, ambulance service,

emergency room, or hospital. As a result, this education is applicable within the NP field and many other healthcare professional fields.

Interprofessional Care

As discussed in the “ALS Clinic” section, regular care in a multidisciplinary ALS clinic greatly benefits the patient as the team is all located in one location to see PALS. Due to the complexity of the disease, PALS often require care outside of the multidisciplinary ALS Clinic. Whether the setting is home care, primary care, outpatient clinic, walk-in clinic, emergency department, inpatient, or any other healthcare-related setting, an interprofessional or collaborative approach to care is preferred. According to the World Health Organization (2010), “Collaborative practice happens when multiple health workers from different professional backgrounds work together with patients, families, carers, and communities to deliver the highest quality of care. It allows health workers to engage any individual whose skills can help achieve local health goals” (p. 7).

Barriers

The ALS Association (ALSA) website has resources available for PALS to present to healthcare providers regarding general information about providing care to a patient with ALS (“Preparing for a Medical Emergency While Living with ALS”, 2021). In a midwestern ALS clinic, PALS are provided with a binder that includes a printed copy directly from the ALSA website. The ALS clinic team educates the patient and family about the contents and the importance of providing the information to healthcare professionals in settings outside of our multidisciplinary clinic, such as primary care, emergency room, hospital, or surgery. The information provided also highlights respiratory considerations specifically for PALS. For example, one section reads, “ALS patients have restrictive respiratory compromise, and the use

of O₂ is not normally needed unless the patient is in the end stages of ALS or has another pulmonary diagnosis. Oxygen alone may raise carbon dioxide levels and cause toxicity. A noninvasive ventilatory device (e.g., BPAP, noninvasive mechanical ventilation) is usually needed instead. Ventilation is critical” (“Medical Information Packet”, n.d., p. 15).

Although the ALS team provides education specific to respiratory changes, respiratory treatment options, and dangers of oxygen therapy alone, the local ALS clinic staff continues to stumble upon patients being prescribed supplemental oxygen as monotherapy for respiratory issues, even when it is not appropriate. The local ALS clinic team has seen multiple barriers for patients to get respiratory information to the provider in an emergency. Common barriers include communication, comfort level, and lack of knowledge.

The ability to communicate verbally can be affected by ALS. As discussed previously, dysarthria occurs with bulbar muscle weakness. Progressive dysarthria makes communicating difficult for PALS, especially in a fast-paced emergency room or healthcare environment. Also, in a high-stress moment, the patient or family member may have difficulty remembering to grab the patient’s binder, including the ALS information for the emergency room and hospital staff. Patients and family members may feel uncomfortable discussing treatments or providing information to a healthcare professional. The local ALS clinic has had many family members of PALS call from the hospital to request that the local ALS clinic staff contact the healthcare team within the hospital to explain why the patient should be changed from oxygen to noninvasive ventilation. Although healthcare professionals are attempting to treat the symptom, many are not adequately treating the cause of the respiratory issue due to the lack of knowledge about neuromuscular conditions.

Lack of Knowledge & How Training Will Resolve

There are a variety of treatments available that can help manage some of the respiratory symptoms that occur in PALS. Providers are often unaware of the guidelines or respiratory recommendations for patients with neuromuscular weakness. Therefore, incorrect treatments may be provided. Most commonly, staff from the local ALS clinic consistently see healthcare professionals provide oxygen to patients with neuromuscular disease without noninvasive ventilation. Often, the patient's own device is even available within the room but sits unused. Lack of knowledge of adequate respiratory management for PALS is a longstanding issue (Chiou et al., 2016; Racca et al., 2020). While looking at provider awareness of carbon dioxide levels prior to oxygen supplementation and intubation, Chiou et al. (2016) concluded that the carbon dioxide level was only known for 2 of 316 patients. Racca et al. (2020) supported that "emergency room (ER) physicians and consultant neurologists must be aware of the respiratory risks of such patients, be able to recognize early signs, and take action to treat respiratory failure adequately" (p. 498).

Offering educational training that targets students pursuing a healthcare degree (SPHD) will be a benefit as the students will soon enter the workforce in many different healthcare settings. Guidelines are helpful for healthcare professionals to understand and offer knowledge of respiratory management options to patients. Many healthcare institutions allow access to current guidelines for ALS patients through evidence-based clinical decision support resources; however, many healthcare professionals are unaware of these resources. The educational session will also be an opportunity to provide SPHD with the resources of trusted websites to keep up to date on current guidelines and recommendations, as research is constantly changing. In addition

to providing resources and education to bridge the knowledge gap, exposure to interprofessional collaboration can impact future practice.

Interprofessional Education (IPE)

Within the Framework for Action on Interprofessional Education and Collaborative Practice, the World Health Organization (2010) states, "Interprofessional education occurs when students from two or more professions learn about, from and with each other to enable effective collaboration and improve health outcomes" (p. 10). Research has shown many benefits of incorporating interprofessional learning opportunities into the education of SPHD (Dyess et al., 2019; Miyata et al., 2022; World Health Organization, 2010). Interprofessional education (IPE) and activities allow the practice of using interprofessional teamwork and communication to work on shared problem-solving while building knowledge and skill sets to prepare for collaborative care. Interprofessional Education Collaborative (2023) affirms the importance of IPE by stating, "Interprofessional collaborative practice is key to safe, high-quality, accessible, equitable, person/client-centered care and enhanced population health outcomes desired by all" (p. 15).

Summary

Due to the disruption of the respiratory system, many patients with neuromuscular disease will require assistance with maintaining sufficient oxygen and carbon dioxide levels. Thus, patients often seek medical care due to experiencing respiratory distress and other respiratory emergencies. When caring for patients with a neuromuscular disease, special considerations must be addressed, especially regarding respiratory management. Healthcare professionals practicing in areas such as primary care, urgent care, emergency rooms, and hospitals must care for patients with neuromuscular disease without previous experience or

specialized education. Lack of knowledge can be addressed by implementing educational training with an interprofessional approach.

CHAPTER 3: METHODS

Overall Project Design

The proposed plan is a practice improvement project (PIP). An invitation to participate in the PIP was disseminated electronically by listserv to undergraduate and graduate level students pursuing a healthcare degree (SPHD) through North Dakota State University, with student sites in Fargo, ND and Bismarck, ND. IRB approval was obtained through the NDSU Institutional Review Board (Appendix D) and was exempt from the criteria with usual survey methods.

Implementation Plan

Evidence-based Practice Model

The Iowa Model was utilized as the evidence-based practice (EBP) framework for this practice improvement project. The Iowa model is a well-established EBP model used for implementation projects within many healthcare settings (Collaborative et al., 2017; Speroni et al., 2020). The step-by-step Iowa Model process used for this practice improvement project will be detailed in the following sections. Permission to use the Iowa Model was obtained before implementing this practice improvement project (Appendix E).

Selecting a Topic

The local ALS Clinic team has identified the lack of respiratory management education as a barrier for healthcare professionals to provide appropriate care for patients with ALS and other neuromuscular diseases. The co-investigator is a part of the local ALS Clinic team and has a professional connection to the need for this project through many healthcare situations that have occurred with patients who have ALS and other neuromuscular diseases. The need for this practice improvement project was further recognized through the literature review and conversation with the ALS Association team members. The co-investigator is passionate about

providing evidence-based education to students pursuing healthcare degrees (SPHD) through the development of this project.

State the Question or Purpose

After selecting a topic and determining the question and purpose of the project, the Iowa model provides a critical decision point for determining if the topic is a priority (Collaborative et al., 2017). A literature review and discussions with members of a midwestern ALS Clinic team identified a disconnect between recommended practice guidelines of respiratory management for patients with ALS and current practices. The difference shows a gap in knowledge, which can lead to detrimental effects on the patient (Chiou et al., 2016; Gay & Edmonds, 1995; Racca et al., 2020). Therefore, the topic was identified as a priority, and the project moved on to the next step within the Iowa model: forming a team.

Form a Team

Forming a team with interprofessional team members was critical for this project. Working together to collaborate with key team members offered a greater depth of knowledge, skills, and resources to develop and implement this practice improvement project. Experience, background, and interest guided the selection of individuals as team members for this project. The team was comprised of the co-investigator and a four-person supervisory committee, including the faculty chair, two additional School of Nursing faculty members, and a graduate appointee. The faculty chair is an Assistant Professor of Practice within the Doctor of Nursing Practice (DNP) program at North Dakota State University (NDSU) with 13 years of experience as an NP practicing within family medicine, pediatrics, and sleep medicine fields. The second committee member is an Assistant Professor of Practice at NDSU School of Nursing and provides chronic disease management in a rural North Dakota setting as an NP in rural family

medicine. The third committee member works in academia at NDSU as an Assistant Professor of Practice in the School of Nursing with a research interest for interprofessional collaboration. The graduate appointee is from the Health Nutrition and Exercise Science background, working with an emphasis on interprofessional education.

While forming a team, the co-investigator contacted the ALS Association (ALSA) and met on multiple occasions with the ALSA Manager of Education and Competencies. During the first meeting, the co-investigator learned that the ALSA education team also identified the need for education on the respiratory management of ALS. The ALSA was developing a module focusing on educating allied healthcare professionals on the respiratory management of a patient with ALS. The co-investigator partnered with the ALS Association (ALSA) by providing feedback and recommendations to the ALSA education team during the module creation process. Permission to utilize parts of the Respiratory Strategies for Improved Quality of Life for ALS Patients module was obtained prior to implementation (Appendix F).

Assemble, Appraise, and Synthesize

The NDSU library was used to complete an extensive literature review. A search was conducted in PubMed, CINAHL, and Cochrane. Further literature was obtained through the NDSU interlibrary loan and gray literature. Preference was given to articles published within the last five years to ensure the use of the most current research. Some articles over five years old were used when no updated research was available, when relevant to the project, and to show historical evidence.

Assembling, appraising, and synthesizing literature led the co-investigator to think about the second decision point in the Iowa model, which is determining if there is sufficient evidence (Collaborative et al., 2017). Although the co-investigator has been unable to find specific

research on the implementation of ALS respiratory education that is specific to interdisciplinary healthcare professionals or SPHD, research on evidence-based guidelines and research supporting the use of a multidisciplinary team approach to treating PALS, strengthened the level of evidence for the need for this practice improvement project.

Design & Pilot the Change

While designing and piloting the change, the co-investigator considered decision-point three of the Iowa model, which is deciding if the change is appropriate for adoption into practice (Collaborative et al., 2017). This practice improvement project looked for a change in knowledge in appropriately providing respiratory care to patients with ALS following the educational session. This practice improvement project targeted SPHD in a midwestern urban setting and their thoughts on working as a team with students from other healthcare disciplines. The results of the PIP determined the change was appropriate, providing a reason for the co-investigator to move on to integration and sustainability.

Integrate & Sustain the Change

The ALSA is a national nonprofit organization that is a vital partner with many ALS clinics throughout the United States. The ALSA website has a specific section for healthcare professionals that offers many resources and educational opportunities. The co-investigator provided links within the educational session to lead SPHD to evidence-based sites, such as the ALSA healthcare professionals' website where the SPHD have access to view other available resources which may further benefit the student's future practice. The educational session was recorded and posted to the NDSU College of Health and Human Sciences webpage for Interprofessional Grand Rounds (<https://www.ndsu.edu/healthprofessions/ipe/>). At this project's end, the co-investigator plans to discuss the opportunity to provide a link to this educational

session and/or other resources within patient electronic medical records at a midwestern ALS Clinic. The link would allow healthcare professionals who are caring for PALS to be notified of a respiratory-learning experience and current ALS management guidelines.

Disseminate the Results

The final step of the Iowa Model is the dissemination of results. The results of the PIP will be disseminated through a final defense at North Dakota State University (NDSU) with key stakeholders. The PIP will be published to ProQuest through NDSU. The co-investigators will also consider publication in NP education journals focusing on IPE.

Setting/Sample/Recruitment

To offer the opportunity to more individuals, the educational session was available in person and online. The education session included a presentation and an interactive activity. The co-investigator presented the educational session at NDSU College of Health and Human Sciences Interprofessional Grand Rounds on November 3, 2023, from 12:00 – 12:50 p.m. in the NDSU Memorial Union Oceti Sakowin Ballroom.

The practice improvement project included a convenience sample of SPHD in an undergraduate or graduate program within the North Dakota State University College of Health and Human Sciences who are interested in the content subject or are required for a course to attend the Grand Rounds session. Recruitment for the practice improvement project was completed through email. Emails were sent through the NDSU listserv. The educational session was offered to:

- Undergraduate nursing students (potential participant pool of 589 students)
- Graduate nurse practitioner students (potential participant pool of 56 students)
- Graduate pharmacy students (potential participant pool of 216 students)

- Undergraduate allied health science students (potential participant pool of 363 students)
- Undergraduate and graduate public health students (potential participant pool of 98 students)
- Undergraduate and graduate nutrition students (potential participant pool of 26 students)
- Graduate counselor education students (potential participant pool of 66 students)

The Health and Human Science College of NDSU recently combined all the above departments. There were a total of 1,414 students within the included departments at the time of implementation. Students have undergraduate and/or graduate backgrounds, so a variety of experiences, ranging from no patient care to completion of clinical rotations, were anticipated.

NDSU School of Nursing is accredited by the Commission of Collegiate Nursing Education and is approved by the North Dakota Board of Nursing. NDSU offers 4 nursing program options with an end goal of obtaining a Bachelor of Science in Nursing (BSN) degree including ("School of Nursing", 2023):

- Pre-licensure BSN program – A four-year program that incorporates the pre-professional program prior to the professional program and is available in both Fargo and Bismarck locations. Clinical opportunities occur throughout various healthcare settings as the student progresses through the program.
- Accelerated (Post-baccalaureate) BSN program – A blended in-person and online program aimed for students who have completed a bachelor's degree or graduate degree in a non-nursing program. The program is accelerated so the student is able to obtain the BSN degree in a little over one year.

- Licensed Practical Nurse to BSN blended online program – A blended in-person and online program aimed for students who are already certified Licensed Practical Nurses (LPNs). The LPN must pass 4 advanced placement (validation) exams prior to admission into the program. The program consists of 6 semesters.
- Registered Nurse to BSN program – A program that is online for students who are Registered Nurses (RNs) from an accredited nursing program. The program has 5 semesters of classes.

The Doctor of Nursing Practice (DNP) program is a 3-year program that prepares nurses with a BSN degree to become family nurse practitioners. Throughout the program, the DNP student completes more than 1,020 hours of clinical practice providing face-to-face care for patients.

NDSU School of Pharmacy is a professional Doctor of Pharmacy (PharmD) program, along with an option to receive the addition of a master's or PhD degree. The PharmD also has an opportunity for PharmD student to receive a dual-degree with an addition of a Master of Business, Master of Public Health, or PhD ("School of Pharmacy", 2023). Allied Sciences at NDSU include Bachelor of Science degrees in medical laboratory science, radiologic sciences (radiography, echocardiography, diagnostic medical sonography), and respiratory care ("Allied Sciences", 2023). Certificate, accelerated, undergraduate, graduate, and dual degree options are available within NDSU's Department of Public Health ("Public Health", 2023). NDSU offers two undergraduate dietetic tracks. A master's degree will be required for new dietitians starting in 2024. NDSU also offers an accelerated Bachelor of Science/Master of Science 5-year program that requires 1,000 hours of clinical ("Nutrition Science", n.d.). Counselor education students at NDSU are master's or doctorate prepared on a school counseling, clinical mental health counseling, or counselor education and supervision track ("Counselor Education", 2023).

At the NDSU College of Health and Human Sciences Interprofessional Grand Rounds, a QR code was provided on the opening presentation screen which was viewable to participants both in person and online. In person participants also had the QR code available on a pamphlet on the table. The QR code brought the participant to a name survey that requested first name, last name, and email address. Upon completion of the name survey, a link to the pre-survey was emailed to the participants. The co-investigator verbally requested for willing participants to complete the name survey and pre-survey prior to the educational session. During the educational session, the students had an opportunity to work as an interprofessional team while engaging in an interactive activity. At 12:40 pm, a link to the post-survey was emailed to the participants that had provided their email address in the name survey. The coinvestigator has access to the names and email addresses of participants that completed the name survey. The names and email addresses are not linked to the participant's pre-survey or post-survey responses, keeping the survey results anonymous.

Candy was provided to in-person participants for enhanced participation and interaction during the event. Students participating online did not have access to candy or alternative. Participants that completed the surveys had an opportunity to provide name and email to be entered into a drawing for a chance to win 1 out of 4 \$10 Caribou gift cards. To choose the winners, participant names and emails were exported to a numbered Excel spreadsheet. The winners of the gift cards were chosen randomly by use of the Google number generator. The co-investigator used Qualtrics to elicit and analyze data. A statistician assisted with inferential statistics. A pre-survey and post-survey consisting of multiple choice, Likert scale, 11-point rating scale, and open-ended questions was utilized to elicit demographics, educational information, clinical experience, prior experience with caring for a patient with ALS or another

neuromuscular disease, the effectiveness of the education, knowledge and confidence levels, and perspective of an interprofessional learning experience. The responses to the questions provided feedback to identify common themes and significance to SPHD. Additionally, the responses offered valuable insights for recommendations for future interprofessional project training implementations.

Evaluation

The project objectives were evaluated with a descriptive statistical design. Objective one of this practice improvement project was to implement an educational session focused on enhancing respiratory management for patients with ALS. Objective one was evaluated by completion of the PowerPoint for the presentation, creation of the interactive activity, and completion of the IPE Grand Rounds educational session.

Objective two was to increase SPHD knowledge of respiratory management for patients with ALS after completion of the educational session. The knowledge gained from the educational session was evaluated using multiple-choice, 11-point rating scale, and open-ended questions in a pre- and post-survey format on knowledge questions about the content presented. The pre-survey was provided at the beginning of the educational session, prior to discussion, and the post-survey was provided immediately following the educational session. The co-investigator developed the survey questions with committee feedback. Data was collected using Qualtrics through NDSU, a secure electronic software. Knowledge was measured by finding the difference between pre-survey and post-survey scores of the participating SPHD. If the educational session increased the knowledge of the participants, the score on the post-survey knowledge questions would be higher than the pre-survey knowledge. An outline of the pre-survey questions is in Appendix G and post-survey questions in Appendix H.

Objective three of this practice improvement project was to assess attitudes and beliefs about interprofessional interactions among SPHD. The co-investigator and Chair developed Likert scale post-survey questions based on questions from the Readiness for Interprofessional Learning Scale (RIPLS) questionnaire. The RIPLS questionnaire is a validated interprofessional survey tool. RIPLS was used to evaluate the student attitudes and beliefs following the interactive interprofessional activity.

Conclusion

In conclusion, this practice improvement project required the incorporation of the Adult Learning Theory and the IOWA model to guide the preparation and implementation of the educational session. Data collection and analysis provided results to determine the project objectives' success and an opportunity to give recommendations for further studies. Table 1 demonstrates the relationship between the objectives, activities, and evaluation for this PIP.

Table 1*Objective – Activities – Evaluation Table*

Objectives	Activities	Evaluation
Develop and implement an educational session focused on enhancing respiratory management for patients with ALS.	-Study current literature -Work closely with team members who organize the Interprofessional Grand Rounds at NDSU -Create PowerPoint presentation -Send invitation to students within the NDSU College of Health Professions to attend the educational session	-PowerPoint completed -Interactive activity constructed -IPE Grand Rounds presentation and interactive activity completed
100% of students pursuing a healthcare degree will indicate increased knowledge of respiratory management for patients (with ALS) after completion of the educational session.	-Provide in-person and online educational session	-Pre-surveys questions 2, 3, 4, 5, 6 -Post-survey questions 1, 2, 3, 4, 5, 8
Assess attitudes and beliefs about interprofessional interactions among students pursuing a healthcare degree.	-Provide interactive activity to be completed within groups of interprofessional students	-Pre-survey questions 7, 13 -Post-survey questions 6, 7, 8

CHAPTER 4: RESULTS

This chapter presents the results of the project. The project results relied mostly on descriptive analysis; however, inferential analysis is included in areas to help support the descriptive data. Due to an issue with Qualtrics that was out of the co-investigator's control and design, individual responses from pre-survey to post-survey were unable to be matched. The co-investigator acknowledges that the assumption of independent observations for inferential tests was unable to be met. The inferential results are included, despite the tests being robust to fully support the descriptive results and graphics used for this project. Due to the limitation above, the results are in aggregate form. The alpha level chosen for inferential tests was 0.05.

Quantitative results from the pre- and post-survey and qualitative results from the post-survey questions will be discussed. A response was not required for survey questions, therefore not all questions received an answer from every participant. The percentages within the tables and charts reflect the percentages of the participants that answered the specified question. This chapter will start with demographics results, then the remaining pre- and post-survey results will be organized by objective.

Demographics

Attendance for the educational session was determined to be 113 healthcare professional students, with 67 students from the School of Nursing and 46 students from the School of Pharmacy. The surveys were optional for the students in attendance. Following the consent, the pre-survey received 106 total responses and the post-survey received 92 responses.

Demographics were obtained from pre-survey questions. There were between 99 and 102 participants that completed the demographics questions with 83 identifying biological sex as

female, 16 as male, and three participants with a preference not to identify. Further responses to the demographic questions were as follows.

Figure 4

Participant Program

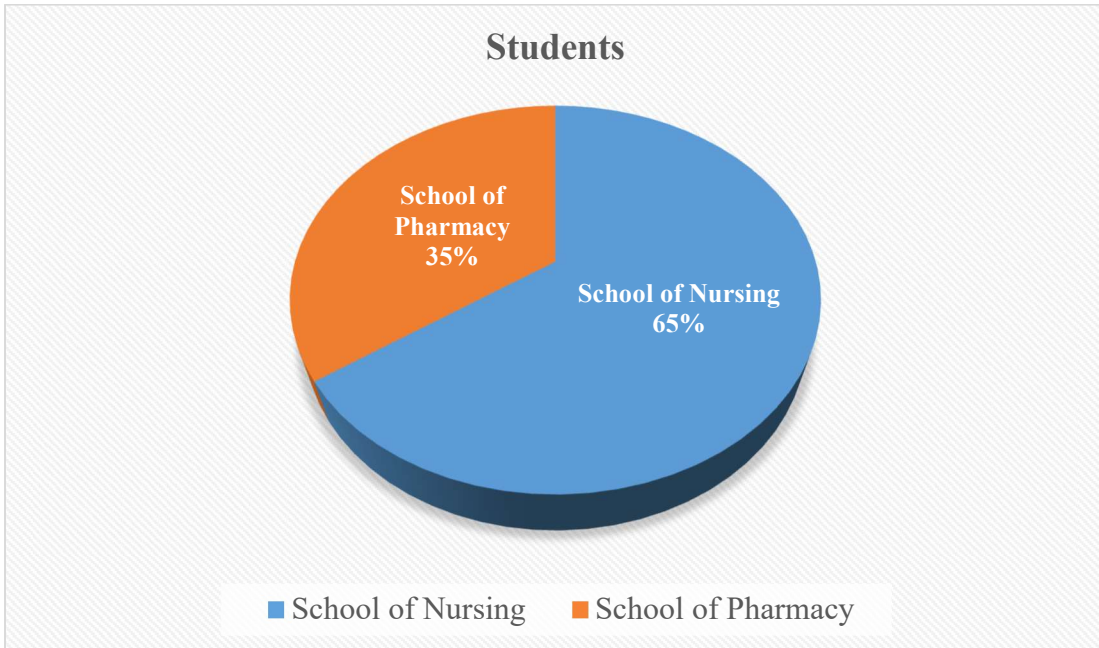
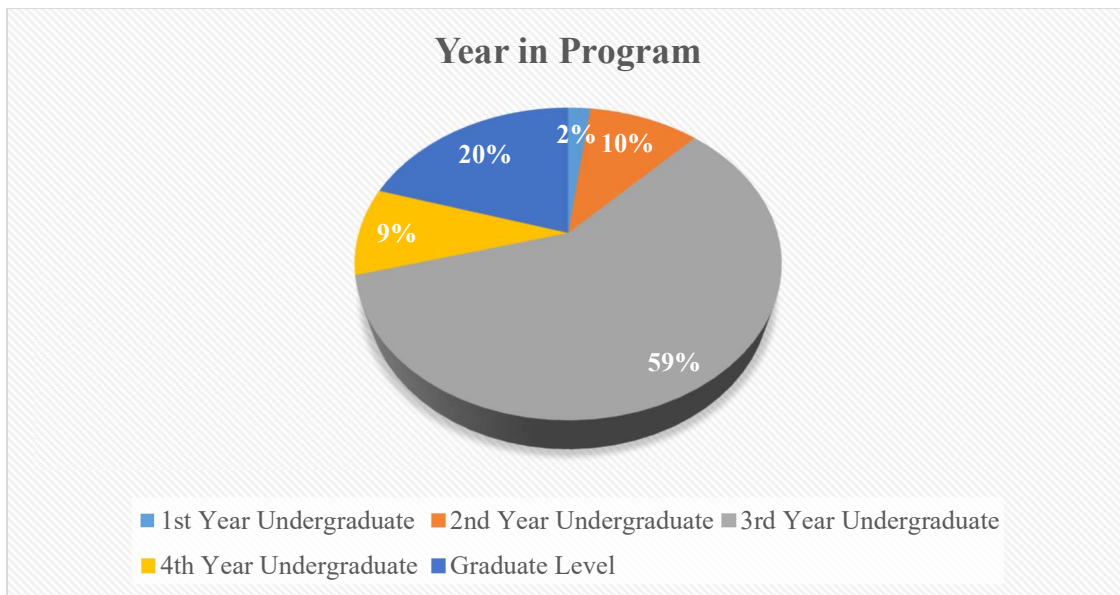


Figure 5

Participant Program Year



Out of 102 participants, 101 had previous clinical experience which may include various encounters such as clinical rotations or employment in a healthcare setting. Whereas one participant had no prior clinical experience. Eighty-five percent of participants had never received prior training and had not had experience caring for a patient with ALS or another neuromuscular disease.

Objectives

Objective One

Develop and implement an educational session focused on enhancing respiratory management for patients with ALS was met by completion of the PIP educational session, which included a presentation and interactive activity. The presentation was created by the co-investigator using Microsoft PowerPoint and was presented in-person and by Zoom on November 3, 2023. The interprofessional interactive activity included a case study, which was designed by the co-investigator and integrated into the presentation. The presentation and case study were completed within a 50-minute time-frame. Following the session, the Grand Rounds coordinators asked students to evaluate the session and student feedback was overwhelmingly positive for learning and the experience.

Objective Two

One hundred percent of students pursuing a healthcare degree will indicate increased knowledge of respiratory management for patients (with ALS) after completion of the educational session was considered partially met. This objective was evaluated using quantitative data from five questions that were identical from pre- to post-survey. Qualitative data was also used through one open-ended question on the post-survey.

For the first knowledge-related question, participants were asked to rate their knowledge on a 0-10 scale by answering the question, ‘How do you rate your knowledge of respiratory management for a patient with ALS?’ As seen in Table 2, the mean rating of pre-survey participants was 3.2063, which increased to 6.1975 on post-survey response. A two-sample t-test was used with recognition that the observations are not independent across the two groups represented in the pre-survey and post-survey, as the participant identification was unavailable to the co-investigator. The first point in time, Time 1, represents the time the individuals took the pre-survey. The second point in time, Time 2, represents the time of the post-survey. The t-test suggests there was enough statistical evidence (p-value <0.0001) to reject the null hypothesis, suggesting a statistically significant difference between the means from pre-survey to post-survey. Figure 6 shows a shift to the right indicating an increase in knowledge ratings from Time 1 to Time 2.

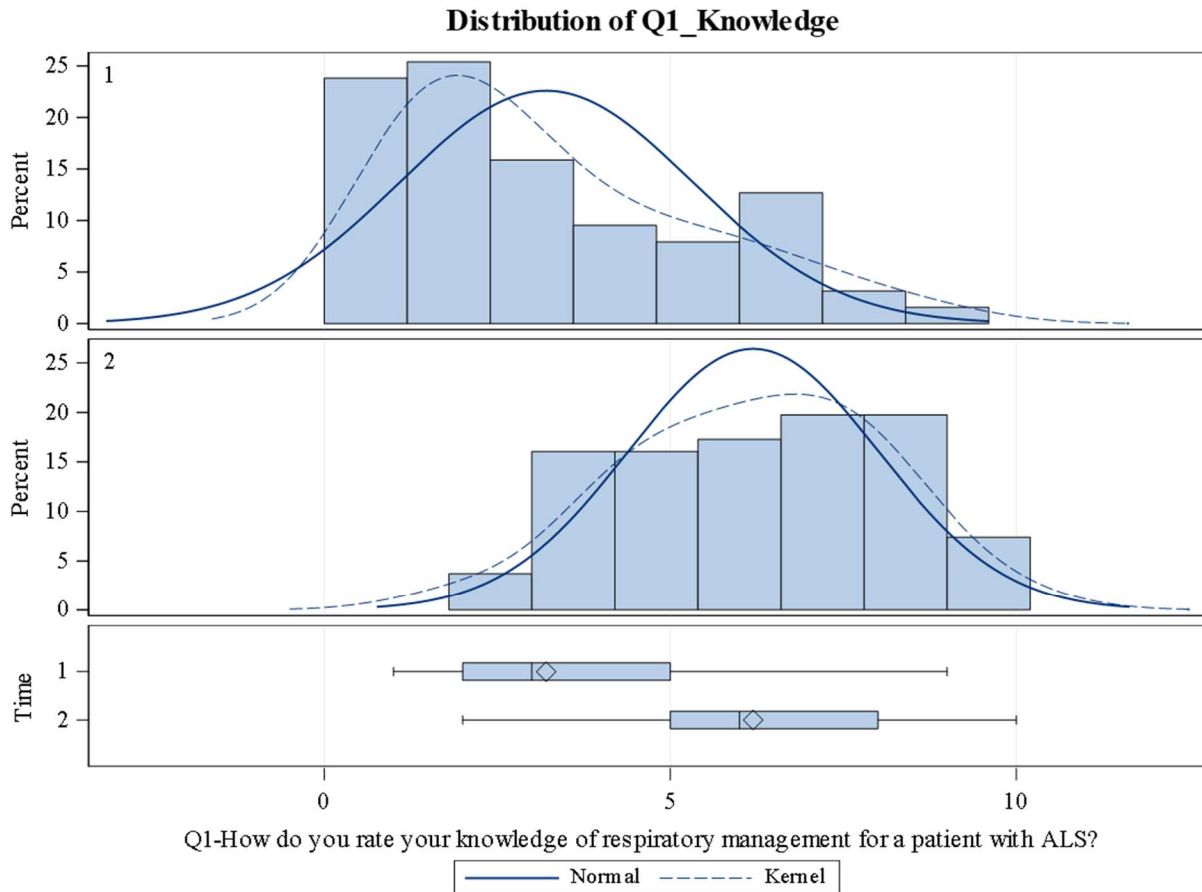
Table 2

Rating of Knowledge of Respiratory Management in ALS

Time	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
Pre-survey (1)		3.2063	2.6728	3.7399	2.1187	1.8026	2.5704
Post-survey (2)		6.1975	5.7967	6.5983	1.8126	1.5700	2.1445
Diff (1-2)	Pooled	-2.9912	-3.6394	-2.3429	1.9522	1.7491	2.2090
Diff (1-2)	Satterthwaite	-2.9912	-3.6531	-2.3292			
	Method	Variances	DF	t Value	Pr > t		
	Pooled	Equal	142	-9.12	<.0001		
	Satterthwaite	Unequal	122.03	-8.95	<.0001		

Figure 6

Knowledge Rating



Note: Time 1 indicates pre-survey response and Time 2 indicates post-survey response.

The second knowledge-related question posed was ‘*Which of the following healthcare professionals would be helpful in providing care to a patient with ALS?*’ The participants were given an opportunity to select neurology, nursing, pharmacy, respiratory therapy, counseling, nutrition, exercise science, public health, radiologic science, and laboratory science. This question was included to look further at the need for multiple team members so there was not one particular answer. The results were as follows in Table 3.

Table 3*Helpful Healthcare Professionals Caring for a Patient with ALS*

Table of Choice by Time			
Choice	Time		
	Pre-survey (1)	Post-survey (2)	Total
Neurology	<i>n</i> = 82 53.95%	<i>n</i> = 70 46.05%	152
Laboratory Science	<i>n</i> = 68 44.16%	<i>n</i> = 86 55.84%	154
Nursing	<i>n</i> = 97 51.87%	<i>n</i> = 90 48.13%	187
Pharmacy	<i>n</i> = 95 51.35%	<i>n</i> = 90 48.65%	185
Respiratory Therapy	<i>n</i> = 94 51.65%	<i>n</i> = 88 48.35%	182
Counselor	<i>n</i> = 75 47.47%	<i>n</i> = 83 52.53%	158
Nutrition	<i>n</i> = 78 48.45%	<i>n</i> = 83 51.55%	161
Exercise Science	<i>n</i> = 74 53.62%	<i>n</i> = 64 46.38%	138
Public Health	<i>n</i> = 49 38.28%	<i>n</i> = 79 61.72%	128
Radiologic Science	<i>n</i> = 64 43.24%	<i>n</i> = 84 56.76%	148
Total	776	817	1593

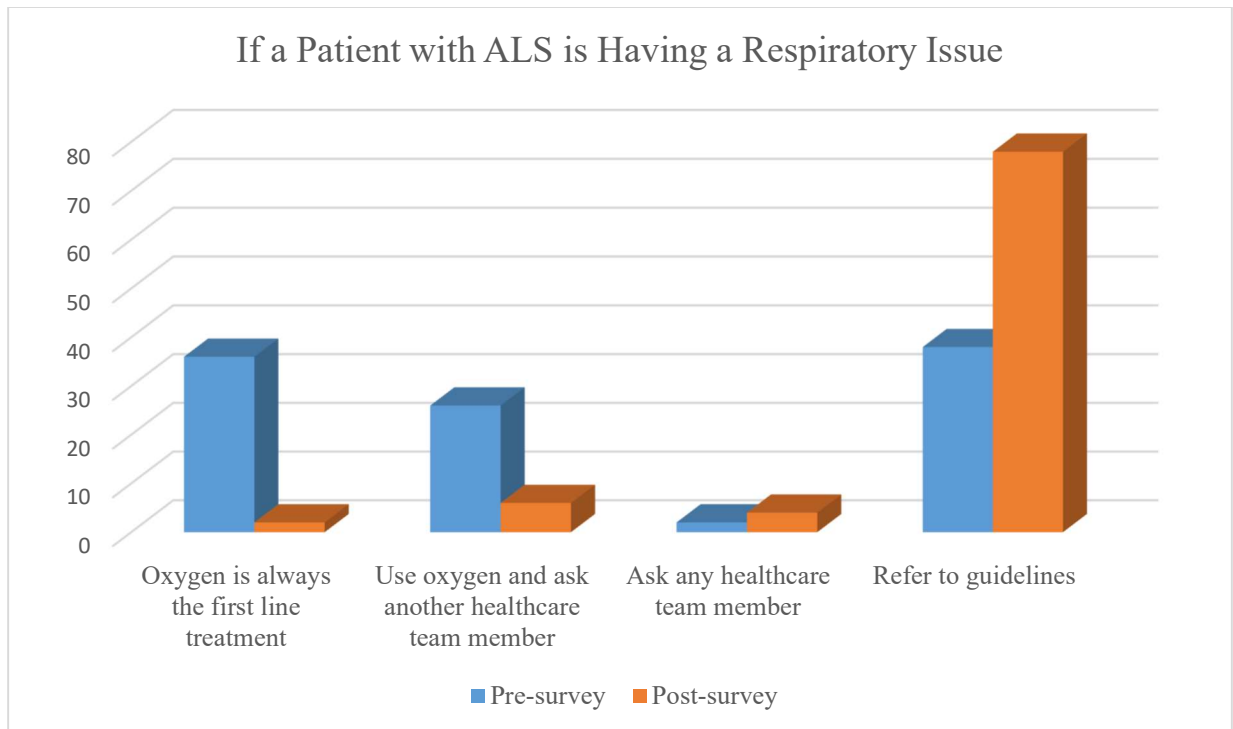
‘If a patient with ALS is having a respiratory issue’ was the third question assessing knowledge and provided a choice of four options for the initial step to respiratory management. There were 102 individuals that responded to this question on the pre-survey and 90 individuals that responded on the post-survey. As seen in Figure 7, when comparing percentages from pre- to post-survey response, the *‘oxygen is always the first line treatment’* response decreased from 35.29% to 2.22% and *‘use oxygen and ask another healthcare team member’* response decreased

from 25.49% to 6.67%. While ‘ask any healthcare team member’ increased from 1.96% to 4.44% and ‘refer to guidelines’ increased from 37.25% to 86.67%.

The null hypothesis in the analysis is that the proportions from the pre-survey and post-survey are equivalent to each other. A chi-square test was performed to evaluate the difference between the pre-survey and post-survey responses. The chi-square analysis yielded a statistically significant difference in the mean test scores between the pre-survey and post-survey. Although not all underlying assumptions of chi-square testing are fully met as previously explained, based on the obtained p-value of <0.0001 , the null hypothesis can be rejected suggesting strong evidence to indicate significant differences from pre-survey to post-survey. The chi-square test results support the observed changes and offer an intuitive understanding of the shift in response profiles from pre- to post-survey.

Figure 7

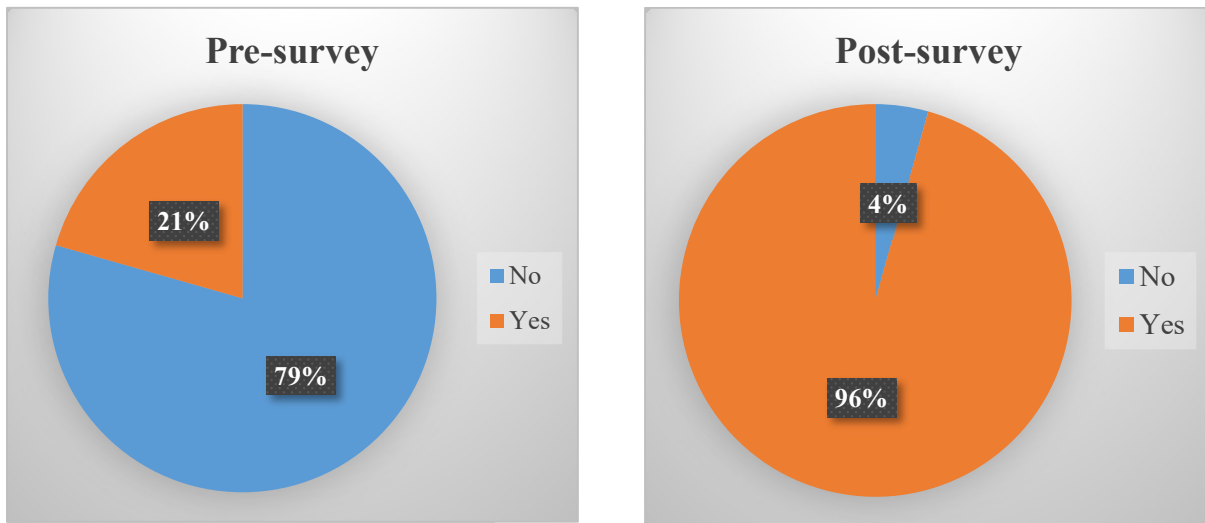
Response to ALS Respiratory Issue



The fourth survey question assessing knowledge was a ‘yes’ or ‘no’ question that stated, ‘I know where to find guidelines and resources to care for a patient with ALS.’ As seen in Figure 8 below, more individuals responded ‘no’ in the pre-survey. However, the post-survey response shifted to a majority responding ‘yes’.

Figure 8

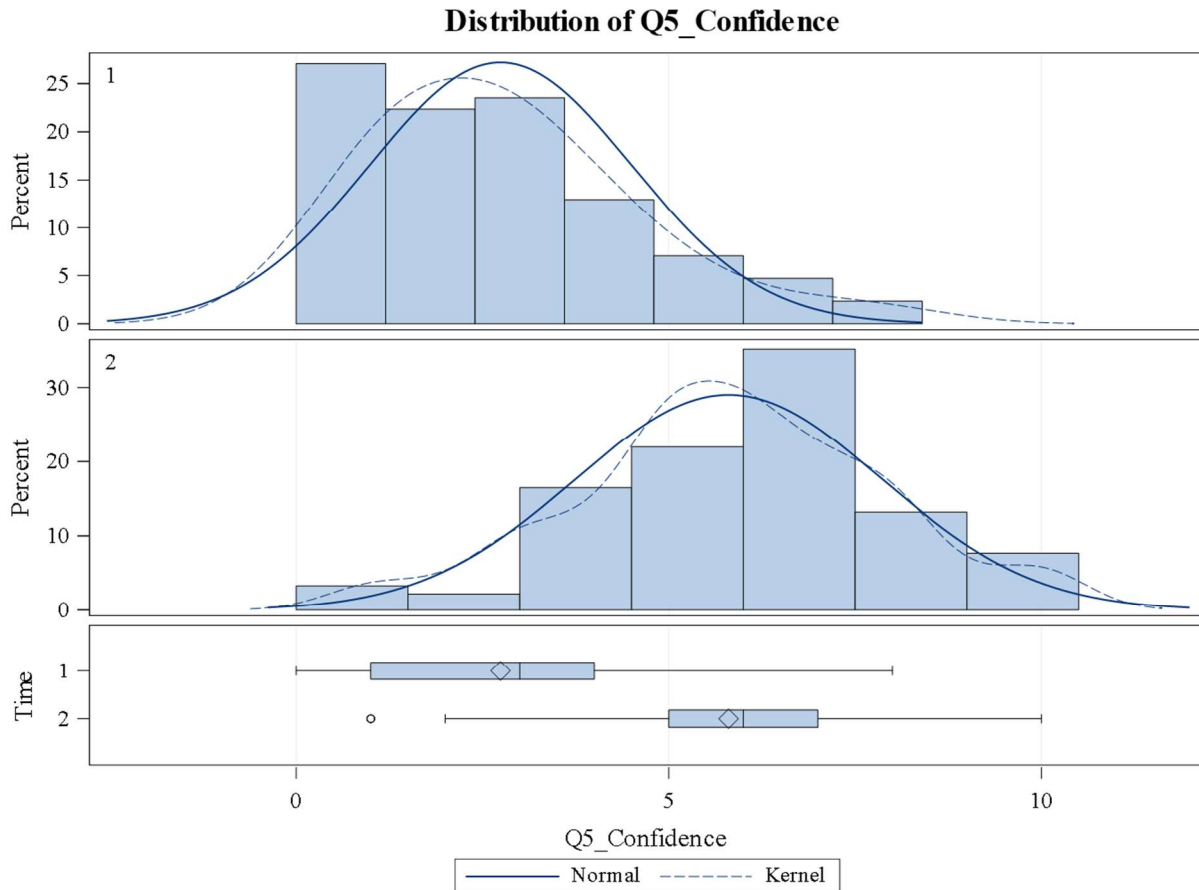
Awareness of ALS Guidelines and Resources



‘How do you rate your confidence in your ability to provide evidence-based care to a patient with ALS?’ was the fifth knowledge-based question asked to participants on the pre- and post-surveys. The participants were prompted to answer this question using a 0-10 scale. The average confidence rating among participants in the pre-survey was 2.7412, which notably increased to 5.8022 in the post-survey. A two-sample t-test was run with acknowledgement of not all assumptions being met as previously stated. The results of the t-test presented statistical evidence (p-value <0.0001) to reject the null hypothesis, indicating a statistically significant difference between means observed from the pre-survey to the post-survey. Figure 9 shows a visual representation of the rightward shift in confidence ratings from pre-survey (Time 1) to post-survey (Time 2).

Figure 9

Confidence Rating



Note: Time 1 indicates pre-survey response and Time 2 indicates post-survey response.

The post-survey included one open-ended question. ‘*What was your main takeaway from your interprofessional learning experience?*’ aimed to encourage participants to share additional details about knowledge gained throughout the interprofessional learning experience. Overall, students indicated benefit from the education. Table 4 highlights a variety of participant responses.

Table 4

Takeaways from IPE Experience: Knowledge

Post-survey Question	Participant Responses
What was your main takeaway from your interprofessional learning experience?	<ul style="list-style-type: none">• “We should refer to guidelines for als”• “Supplemental oxygen is not the first line of treatment for an ALS patient (can be applied to other neuromuscular conditions as well) in respiratory distress and there are guidelines for treatment focused on ventilation.”• “Oxygen is not always the number one treatment option”• “Also that oxygen is usually not the best treatment for ALS.”• “The biggest thing I took away from this interprofessional learning experience was the fact that patients with ALS may not benefit from supplemental oxygen like some healthcare professionals may assume.”• “NO OXYGENATION unless indicated for ALS”• “O2 is not very helpful, I learned about ventilation devices and cough assist devices”• “Oxygen should not be the first treatment option for ALS patient”• “I learned how treat patient with ALS has resp problem.”• “I had thought oxygenation was the way to go without considering the physical act of ventilation”• “Learning that ventilation is most important”• “ALS needs ventilation not just oxygen”• “Oxygen is not the first thing you should do!”• “Treatment doesn’t always include oxygen. Look to guidelines for best treatment of ALS”

Objective Three

Assess attitudes and beliefs about interprofessional interactions among students pursuing a healthcare degree was met. Objective three was evaluated through a combination of quantitative and qualitative data. Quantitative data was received from one question exclusive to the pre-survey, one asked identically on the pre-survey and post-survey, and one that included a set of 19 Likert-style questions. Qualitative data was also included from one open-ended question on the post-survey.

When asked about previous involvement in an interprofessional education (IPE) activity on the pre-survey, 30% ($N = 102$, $n = 31$) of participants had experience, while 70% ($n = 71$) of participants had no prior IPE activity involvement. The question ‘*I intend to use what I have gained today in my future practice*’ was asked on the pre- and post-survey, with results visible in Table 5. No participants chose the options ‘*strongly disagree*’ or ‘*disagree*’. A chi-square test was conducted to examine the association between the pre- and post-survey responses. The null hypothesis is that the pre-survey percentages and the post-survey percentages are similar. Based on the results of a p-value of 0.1629, the null hypothesis cannot be rejected, indicating there was no statistically significant change in aggregate answers from the pre-survey to the post-survey.

Table 5

Intention for Future Practice

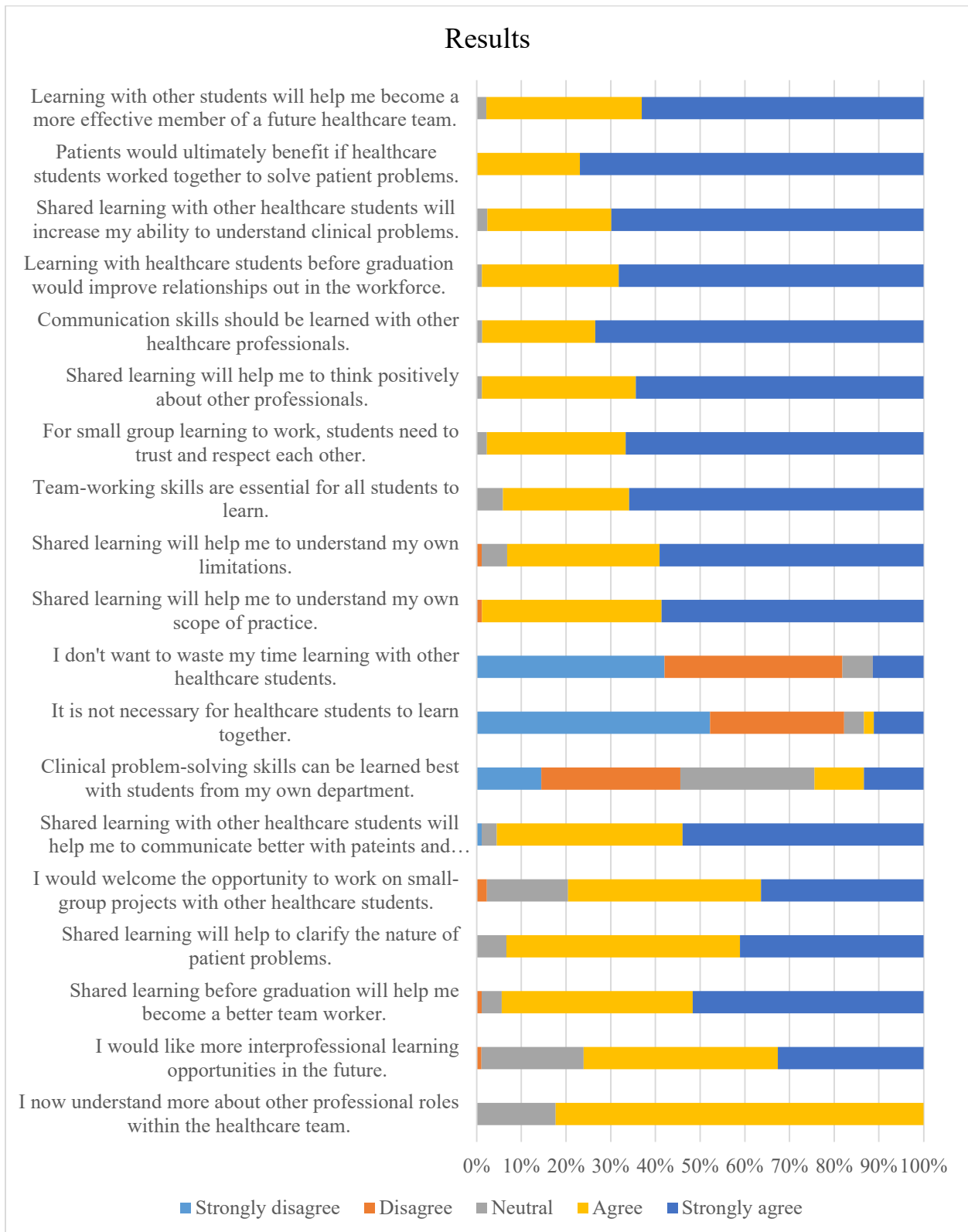
of Time				
Time	I intend to use what I have gained today in my future practice.			
	Neutral	Agree	Strongly agree	Total
Pre-survey (1)	$n = 7$ 6.93%	$n = 42$ 41.58%	$n = 52$ 51.49%	$N = 101$
Post-survey (2)	$n = 3$ 3.26%	$n = 30$ 32.61%	$n = 59$ 64.13%	$N = 92$
Frequency Missing = 1				

Statistic	DF	Value	Prob
Chi-Square	2	3.6296	0.1629

Attitudes and beliefs were also measured with 19 five-point Likert scale questions provided on the post-survey. The Likert scale options included strongly disagree, disagree, neutral, agree, and strongly agree. Results can be viewed in Figure 10.

Figure 10

Questions Derived from RIPLS Questionnaire



‘What was your main takeaway from your interprofessional learning experience?’ was an open-ended question on the post-survey to prompt further information from participants regarding attitudes and beliefs about interprofessional interactions. This question yielded 70 responses. Two major themes regarding interprofessional care were identified while analyzing the qualitative data. A summary of responses for theme one, *collaboration*, is in Table 6 and for theme two, *communication*, is in Table 7.

Table 6

Takeaways from IPE Experience: Collaboration

Post-survey Question	Participant Responses
What was your main takeaway from your interprofessional learning experience?	<ul style="list-style-type: none">● “To collaborate with different specialties to provide excellent care to ALS patients.”● “It’s important to work with many other professions when taking care of patients.”● “Nursing and pharmacy professions (and others) can benefit from each other's experience to help care for a patient.”● “Each role has their own responsibilities but they work closely together to ensure the best possible care for patients.”● “Working together as a healthcare professional team will greatly improve patient outcomes.”● “Collaboration is key!”● “Working together can help bring together different viewpoints that ultimately lead to the best outcomes.”● “The main takeaway from this interprofessional learning experience is that collaboration with other healthcare roles is essential and will provide better patient care.”● “Being alone is not the best choice. Using your peers and multiple opinions will be the best option for the best outcome to your patients.”● “My main takeaway was that it is very important for all health care professionals to work together to provide the best care possible for patients. All about teamwork.”● “It is important to collaborate with other healthcare professionals for complex diseases (like ALS) in order to provide the best patient care.”● “It is incredibly important to be able to work with a multidisciplinary team, as this is often what is required for disease treatment.”● “Working together can give different perspectives of how we can best care for patients.”● “It is important for everyone to contribute from each profession to come to the best possible conclusion and treatment for the patient.”● “All of the experts in each specialty of health profession field can collaborate and combine their ideas to provide the best and most safe care for the patient.”

Table 7

Takeaways from IPE Experience: Communication

Post-survey Question	Participant Responses
What was your main takeaway from your interprofessional learning experience?	<ul style="list-style-type: none">• “It is important for interprofessional communication in order to have the safest possible care for the patient.”• “Other units and teams looks at things so differently and effective communication is incredibly important in order to get the best care for the patient.”• “All roles are interconnected and should communicate consistently to specialize care for each individual patient.”• “There are many different departments of people who help take care of a patient so communication is very needed.”• “Communication is KEY”• “Especially in complex cases, talking with the entire interprofessional team is extremely important and steps can be missed if members are not included.”• “Being able to effectively and respectfully communicate with other healthcare professionals will improve my experience as well as the level of patient care.”• “My main takeaway was how in depth the communication between healthcare team members is to provide well rounded care.”

CHAPTER 5: DISCUSSION AND RECOMMENDATIONS

Summary

This study used quantitative and qualitative methods to create an interprofessional environment, aiming to understand knowledge, attitudes, and beliefs of college students pursuing a professional healthcare degree. The outcomes of this project indicate that implementing an educational session is an effective approach to increasing knowledge. Additionally, the feedback from the healthcare students further emphasized the positive results of the interprofessional interactions that occurred during the educational session. The results will be discussed by each of the three objectives in the section below.

Discussion

Objective One

Develop and implement an educational session focused on enhancing respiratory management for patients with ALS. Objective one was met on November 3, 2023, at the conclusion of the educational session implementation. The educational session included a PowerPoint presentation titled “Candy & A Case Study – IPE Team Approach to an ALS Case” that was created by the co-investigator. The PowerPoint content on slides 1-13 included an explanation of the disease process of ALS, the basics of respiration (ventilation vs. oxygenation), the function of respiratory muscles, symptoms of hypoventilation, two respiratory guideline algorithms, and examples of respiratory equipment. Slides 14-16 content included a case study and introduction of a new Collaboration Model created by the primary investigator and co-investigator, which uses the acronym CARE. CARE stands for Communicate, Advocate, Reflect, and Evaluate and was implemented to help the students work through the interactive case study using interprofessional collaboration with healthcare students of another healthcare program.

The PowerPoint slides 18-23 completed the presentation with resources for healthcare professionals, examples of other neuromuscular disorders, further discussion on use of oxygen, an opportunity for student questions, and a list of references. Student feedback, which was requested by the Grand Rounds coordinators, was overwhelmingly positive. Therefore, further supporting this type of education for health professionals prior to entering practice for preparation and possible enhanced patient outcomes.

Objective Two

One hundred percent of students pursuing a healthcare degree will indicate increased knowledge of respiratory management for patients (with ALS) after completion of the educational session. The second objective was partially met. Although knowledge increased as evidenced by changes from five pre-survey answers to post-survey answers, as well as responses from an open-ended question eliciting the participant's main takeaway from the experience, the co-investigator was unable to determine if knowledge increased for 100% of the students due to an error in Qualtrics. When asked, '*How do you rate your knowledge of respiratory management for a patient with ALS?*', the mean rating increased from pre-survey to post-survey response, moving from 3.2063 to 6.1975. In similar comparison, the other question asking participants to rate on a 0-10 scale was, '*How do you rate your confidence in your ability to provide evidence-based care to a patient with ALS?*'. Mean confidence ratings more than doubled from pre-survey to post-survey from 2.7412 to 5.8022. In addition, audience engagement during the interactive activity hugely impacted the success of this project.

Ackrivo (2023) looked at the progress and gaps of pulmonary care for patients with ALS. Two of the gaps discussed by Ackrivo (2023), including limited training of chronic respiratory failure and limited access to neuromuscular respiratory specialists, further support the

importance of this PIP. Training becomes even more important for healthcare professionals that practice in rural areas, such as the Midwest, where the access to specialists is even more sparse. . Along with providing training, another potential solution for lack of formal education on ALS respiratory care is online education resources (Ackrivo, 2023). As discussed throughout this PIP, one of the biggest respiratory mistakes for a patient with ALS is the inappropriate use of oxygen, which was highlighted throughout the presentation with education on the differences between oxygenation and ventilation, the issues seen in practice, and resources for students and healthcare providers to aid in treatment decision making, such as respiratory guidelines. This PIP was successful in highlighting resources, including guideline algorithms. Prior to the session, a large majority, specifically 79% of participants, did not know where to find guidelines and resources to care for a patient with ALS. However, the session had a clear impact on participant awareness as 96% of participants showed confidence in the ability to access guidelines and resources following implementation of the educational session.

Results from the multiple-choice survey question, *‘If a patient with ALS is having a respiratory issue’*, also showed knowledge benefit post-educational session. The survey question highlighted knowledge concepts of the importance of guidelines, as well as the differences between oxygenation and ventilation. Responses showed a meaningful decrease in the belief that oxygen should be a part of the first-line treatment and a significant shift toward ‘refer to guidelines’ as the preferred recommendation, showing a positive change in knowledge.

Participants comments such as “Supplemental oxygen is not the first line of treatment for an ALS patient (can be applied to other neuromuscular conditions as well) in respiratory distress and there are guidelines for treatment focused on ventilation” and “Treatment doesn’t always include oxygen. Look to guidelines for best treatment of ALS” further emphasizes the change in

participant knowledge following the educational session. The co-investigator concluded that although this project may not impact all healthcare professionals, continued emphasis on interprofessional education can potentially help decrease the gap.

‘Which of the following healthcare professionals would be helpful in providing care to a patient with ALS?’ was asked on the pre-survey and post-survey. The educational session was meant to increase the knowledge and awareness of the importance of every healthcare team member in caring for a patient with ALS. Therefore, the co-investigator projected that response rates for every discipline would increase on the post-survey. Although percentages from pre- to post-survey increased for some disciplines, such as laboratory sciences, counselor, nutrition, public health, and radiologic science, others decreased, which included neurology, nursing, pharmacy, respiratory therapy, and exercise science. Reflecting on the educational session, the co-investigator did not include all disciplines that were options of this multiple-choice question in the discussion, excluding neurology and exercise science. The exclusion of neurology and exercise science did not specifically align with the results, but the way the information was provided could have had some influence on the varied responses. During the case study interactive activity, the students had an opportunity to raise their hand and discuss their thoughts about their role, roles of other healthcare professionals, need for collaboration, and actions to be taken within their scope. The discussion predominantly focused on pharmacy and nursing as those were the students in attendance. Interestingly, the percentage of students that chose *‘nursing’* decreased from 51.87% on pre-survey to 48.13% on post-survey. The percentage of students that chose *‘pharmacy’* also decreased from 51.35% on pre-survey and 48.35% on post-survey. Another contributing factor could be the reduction of the number of participants from

pre- to post-survey. Due to the limitation with a post-survey issue, the co-investigator was unable to look for trends between demographics and the response to this question.

Ishikawa et al. (2021) studied a different ALS topic than this PIP, however, the targeted sample was similar, aimed toward college students pursuing a degree in a variety of healthcare degrees. The study included two half-day educational sessions six months apart, with results showing knowledge maintained from the first session to the second. Ishikawa et al. (2021) also found that the students' knowledge increased with an educational session that provided an interactive activity, suggesting that the inclusion of an interactive activity may affect the overall learning experience and retainment of knowledge. Ishikawa et al. (2021) concluded that even a short training session can have a lasting impact not only on the student's knowledge but also may have an impact on other healthcare workers and the ALS patients they serve.

In summary, significant changes from pre-survey to post-survey responses were observed in four out of five descriptive knowledge questions. Maddock et al. (2023) discuss the importance of inclusion of interdependence and embodiment in interprofessional learning experiences to improve knowledge and skills. Embodiment allows students an opportunity to be engaged in a real-life scenario, while interdependence encompasses the need for different professionals to be involved in the project to provide their unique set of skills. Both interdependence and embodiment were incorporated into this project and the results of the Maddock et al. (2023) study further support the findings of this project. Overall, the changes noted from the pre- to post-survey response in this project indicate the educational session likely influenced the increase of participant knowledge. Participant open-ended responses were positive and further illuminated the benefits of the educational session.

Objective Three

Demographic information was collected from 102 participants. Results showed many participants were inexperienced in IPE activities, with 70% having no previous IPE exposure. Objective three, *assess attitudes and beliefs about interprofessional interactions among students pursuing a healthcare degree* was met as evidenced by results from 19 five-point Likert scale questions and one open-ended question.

Comparison of pre-survey and post-survey response to the question *'I intend to use what I have gained today in my future practice'* did not show a statistically significant change. Interestingly, no participants chose *'strongly disagree'* or *'disagree'* on either survey, showing a large majority of participants had intentions to use the information that was delivered and the IPE experience that was provided both before and after the educational session. To further investigate attitudes and beliefs of interprofessional interactions, 19 five-point Likert scale questions, derived from the RIPLS questionnaire, were included in the post-survey. RIPLS data from this PIP was similar to the results of Atwa et al. (2023). Apart from four questions, mean rankings for all other questions were higher for this PIP. Three of the four exceptions included, *'I don't want to waste my time learning with other healthcare students'*, *'it is not necessary for healthcare students to learn together'*, and *'clinical problem-solving skills can be learned best with students from my own department'*. Lower means for these three questions show a more positive attitude or belief in teamwork and collaboration with other healthcare students. The fourth question, *'I would welcome the opportunity to work on small-group projects with other healthcare students'* had a slightly lower but similar mean score of 4.14 for this PIP, compared to 4.23 in the study by Atwa et al. (2023). For this PIP, all participants *'agreed'* or *'strongly agreed'* that *'patients would ultimately benefit if healthcare students worked together to solve*

patient problems.' Participants were aware of the importance of working together. Inclusion of IPE at NDSU may contribute to the less robust difference in pre- to post-survey response to this question.

Further illumination of the attitudes and beliefs of participants was noted through an open-ended opportunity at the end of the post-survey. Many responses to the open-ended question also highlighted the benefits of interprofessional education, specifically identifying communication and collaboration as key concepts. One participant answered, "Being able to effectively and respectfully communicate with other healthcare professionals will improve my experience as well as the level of patient care." Another participant stated, "The main takeaway from this interprofessional learning experience is that collaboration with other healthcare roles is essential and will provide better patient care." Student feedback in the David et al. (2024) study revealed themes consistent with this project, concluding that providing interactive IPE work within education can prepare students for future practice in the healthcare setting.

Project Framework

Malcolm Knowles' adult learning theory was used as the framework for creating this project. Reflection of the five assumptions of adult learners, which include self-concept, adult learning experience, readiness to learn, orientation to learning, and motivation to learn, was beneficial throughout the process of designing, implementing, and evaluating this PIP for SPHD. With application of these assumptions, the PIP provided an engaging and effective educational experience for SPHD.

Dissemination

Dissemination of results is a key step of a practice improvement project. The purpose, problem, objectives, and methodology for the PIP were displayed through a poster presentation

at the North Dakota Nurse Practitioner Association Pharmacology Conference in Bismarck, North Dakota in the fall of 2023. As this was prior to the implementation of the project, the results were not available at the time of the poster presentation. A recording of the educational session will be available to the public on the NDSU College of Health and Human Sciences Interprofessional Grand Rounds page at <https://www.ndsu.edu/healthprofessions/ipe/>. The findings from this PIP will be shared with the dissertation committee through the co-investigator's final defense in spring of 2024. There is potential for further dissemination of the results through academic journal publication, with the goal of reaching a broader healthcare community.

Strengths and Limitations

Strengths

Many strengths were identified throughout the steps of this PIP. The implementation setting provided a great opportunity for reaching healthcare students. In addition, good survey response numbers helped to get an accurate picture of the knowledge, attitudes, and beliefs of a majority of the students in attendance at the educational session. Incorporating a case study as an interactive activity was a benefit to the overall effect of this PIP as it yielded great student participation through the opportunity of discussion and teamwork.

Although ALS is a small subset of patients, the education was presented in a way to expose students to important lessons that can be used in practice, regardless of the patient's diagnosis. First, many disease processes rely on the understanding of the differences between oxygenation and ventilation. Key concepts of both were discussed in the educational session. Also, the importance of looking to evidence-based guidelines for treatments, regardless of the

health condition, was emphasized. Exposure to interprofessional interactions is beneficial as interprofessional teamwork is required throughout healthcare settings and situations.

Limitations

There were many strengths to this PIP, but there were also limitations that were identified. Inadvertently, per Qualtrics misalignment, the post-survey results did not contain a matching identification to the pre-survey results. Consequently, the survey results were unable to be individually matched from pre- to post-survey. Since demographic data was on the pre-survey but not on the post-survey, no conclusions were able to be drawn regarding the influence of demographic data on knowledge or attitudes and beliefs of interprofessional education.

Although the descriptive statistics were evident, this limitation did cause assumptions to not be fully met for the inferential testing that was used. The surveys were also not set up to require participants to answer every question, which could help maintain consistency throughout each question. Although the participation was good, the survey process required multiple steps and could have deterred some students from participating or stopping mid-survey. Survey responses only included nursing and pharmacy students. Therefore, the study did not provide representation of students in the fields of allied health sciences, public health, nutrition sciences, or counseling.

Recommendations

Strengths and limitations were reviewed to create recommendations for future projects. As previously discussed, a response to every question on the surveys was not required in this PIP. Future PIPs should require a response to every pre-survey and post-survey question by every participant to streamline data collection and interpretation. If applicable, an incentive could be tied to the requirement of completion of every question on the pre-survey and post-survey.

Although the theory and model used to frame this project were valuable, IPE models could be considered to guide future projects. Also, further evaluation of the amount and type of prior exposure to IPE of students in their respective programs could be considered. As mentioned by David et al. (2024), many barriers are presented in the implementation of IPE into collegiate curricula, including students not perceiving a benefit, unequal number of students throughout programs, financial costs, and differing course meeting times. Further investigation of the students' attitudes and prior exposures could be beneficial in continuing to develop IPE curriculum that minimizes barriers.

While the invitation for this educational session was sent to all students in the NDSU College of Health and Human Services, only students from the School of Nursing and the School of Pharmacy were in attendance. The co-investigator would recommend further recruiting efforts to other programs within the College of Health and Human Services. Incorporating other programs would provide the opportunity for education to be presented to a wider audience of healthcare students, increasing the pool of future healthcare professionals that have been exposed to the information provided in the educational session. During the interactive activity, input from students of more varied programs would give students more perspectives to consider and take into their future practice.

As the lack of education and awareness has already been identified in the current workforce, the co-investigator recommends distribution of education to healthcare professionals that are providing care to patients with ALS and other neuromuscular diseases. The information from the presentation could be designed to go deeper as appropriate, depending on the audience. The education would be suitable in multiple healthcare settings, with a recommendation to start in more acute care settings, such as emergency departments and hospitals. Providing continuing

medical education (CME) credits would be one possible recommendation to influence overall participation from practicing healthcare professionals.

Conclusion

The purpose of this PIP was to provide education on the respiratory care of ALS patients with a focus on interprofessional collaboration to better equip students prior to their transition into practice. With 70% of nurse practitioners functioning as primary care providers within the United States (American Association of Nurse Practitioners [AANP], 2022a) and the vast amount of rural areas in the Midwest, there is a significant need for education. Keen skills in assessment, symptom management, health maintenance, education, emotional support, and care coordination are important for patient care, especially with a patient with a complex disorder, such as ALS (Davis & Lou, 2011; Houde & Mangolds, 1999). Nurse practitioners are integral to patient care and play a huge role in communicating and working with interdisciplinary healthcare team members. Learning the appropriate skills to work as an interprofessional team is applicable across diverse healthcare experiences and healthcare professions.

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APPENDIX A: INFOGRAPHIC OPEN ACCESS

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APPENDIX B: CHEST GUIDELINES PERMISSION

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APPENDIX D: IRB APPROVAL



10/10/2023

Dr. Heidi Lynn Saarinen
Nursing

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #IRB0004934, "Implementation of Interprofessional Education: Respiratory Management in Amyotrophic Lateral Sclerosis"

NDSU Co-investigator(s) and research team:

- Heidi Lynn Saarinen
- Brooke Danielle Marquardt

Approval Date: 10/10/2023

Expiration Date: 10/09/2024

Study site(s): The educational session will take place at the NDSU Memorial Union Oceti Sakowin Ballroom as a part of the NDSU College of Health and Human Sciences Interprofessional Grand Rounds. The co-investigator will present in person. Grand Rounds already has a person appointed to manage zoom break out rooms for potential participants to participate online throughout the presentation on behalf of the co-investigator. All Grand Rounds presentations are recorded but only the speaker is video recorded and potential participants will not be able to be identified through the video recording.

Funding Source:

The above referenced human subjects research project has been determined exempt (category 2,3) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, *Protection of Human Subjects*).

Please also note the following:

- The study must be conducted as described in the approved protocol.
- Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
- Promptly report adverse events, unanticipated problems involving risks to subjects or others, or protocol deviations related to this project.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.

NDSU has an approved FederalWide Assurance with the Department of Health and Human Services: FWA00002439.


RESEARCH INTEGRITY AND COMPLIANCE




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Shipping Address: Research 1, 1735 NDSU Research Park Drive, Fargo ND 58102

NDSU is an EQ/AA university.

APPENDIX E: IOWA MODEL PERMISSION

Permission to Use The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care 

 Kimberly Jordan - University of Iowa Hospitals and Clinics <survey-bounce@survey.uiowa.edu>  

To: Campbell, Brooke Sun 6/11/2023 3:24 PM

You have permission, as requested today, to review and/or reproduce *The Iowa Model Revised: Evidence-Based Practice to Promote Excellence in Health Care*. Click the link below to open.

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APPENDIX F: ALS ASSOCIATION PERMISSION

Hello Laurie,

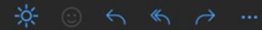
I hope you have been doing well. I will be doing a presentation on ALS respiratory management to students pursuing a healthcare degree at North Dakota State University. I am emailing to request permission to utilize parts of the Respiratory Strategies for Improved Quality of Life for ALS Patients module along with other pictures and resources from the ALSA website within my presentation. As an example, my presentation will be given with an interprofessional approach so I think it would be beneficial to show the example of the "Patient Interview-Exploring Respiratory Involvement" questions that were presented within the module. Do you know who I could contact within the ALSA to obtain permission?

Thank you for your time,

Brooke Campbell RN, BSN
Doctor of Nursing Practice Student
North Dakota State University

Laurie McFarren <laurie.mcfarren@als.org>

To: Campbell, Brooke



Thu 9/7/2023 10:54 AM

Hi Brooke!

I hope things are going well for you! We'd love for you to use our resources. I double checked with Leslie, and as long as you cite the website and/or the respiratory course feel free to use anything you find helpful!

Sincerely,

Laurie McFarren | Manager, Education & Competencies

The ALS Association | 1300 Wilson Blvd., Suite 600 | Arlington, VA 22209 | [als.org](https://www.als.org)

APPENDIX G: PRE-SURVEY QUESTIONS

1. How do you rate your knowledge of respiratory management for a patient with ALS?
0-10 scale

2. Which of the following healthcare professionals would be helpful in providing care to a patient with ALS? (select all that apply)
 - Neurology
 - Nursing
 - Pharmacy
 - Respiratory therapy
 - Counselor
 - Nutrition
 - Exercise Science
 - Public Health
 - Radiologic sciences
 - Laboratory science

3. If a patient with ALS is having a respiratory issue:
 - Oxygen is always the first line treatment
 - Use oxygen and ask another healthcare team member
 - Ask any healthcare team member
 - Refer to guidelines

4. I know where to find guidelines and resources to care for a patient with ALS.
 - Yes
 - No

5. How do you rate your confidence in your ability to provide evidence-based care to a patient with ALS?
0-10 scale

6. I intend to use what I have gained today in my future practice.
 - Strongly Agree
 - Agree
 - Neutral
 - Disagree
 - Strongly Disagree

7. What is your role at NDSU?

- Faculty – Specify Department (Write-in)
- School of Nursing student
- School of Pharmacy student
- Department of Allied Sciences student
- Counselor Education student
- Nutrition Program student
- Exercise Sciences Program student
- Department of Public Health student
- Student pursuing a degree not listed above – Specify Department (Write-in)

8. What year in your program are you?

- 1st year undergraduate
- 2nd year undergraduate
- 3rd year undergraduate
- 4th year undergraduate
- Graduate student
- Faculty (not applicable)

9. What is your biological sex?

- Female
- Male
- Prefer not to identify

10. Do you have any clinical experience (clinical rotations, job title working in a healthcare setting, etc.)?

- Yes
- No

11. Have you ever had training or cared for a patient with Amyotrophic Lateral Sclerosis (ALS) or another form of neuromuscular disease?

- Yes
- No

12. Have you been involved in an interprofessional education (IPE) activity in the past?

- Yes
- No

APPENDIX H: POST-SURVEY QUESTIONS

1. How do you rate your knowledge of respiratory management for a patient with ALS?
0-10 scale

2. Which of the following healthcare professionals would be helpful in providing care to a patient with ALS? (select all that apply)
 - Neurology
 - Nursing
 - Pharmacy
 - Respiratory therapy
 - Counselor
 - Nutrition
 - Exercise Science
 - Public Health
 - Radiologic sciences
 - Laboratory science

3. If a patient with ALS is having a respiratory issue:
 - Oxygen is always the first line treatment
 - Use oxygen and ask another healthcare team member
 - Ask any healthcare team member
 - Refer to guidelines

4. I know where to find guidelines and resources to care for a patient with ALS.
 - Yes
 - No

5. How do you rate your confidence in your ability to provide evidence-based care to a patient with ALS?
0-10 scale

6. I intend to use what I have gained today in my future practice.
 - Strongly Agree
 - Agree
 - Neutral
 - Disagree
 - Strongly Disagree

“The following questions are reflective of your time learning with other disciplines from this activity. Please choose the response that you feel best reflects your experience from this activity.”

7. Learning with other students will help me become a more effective member of a future healthcare team.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

8. Patients would ultimately benefit if healthcare students worked together to solve patient problems.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

9. Shared learning with other healthcare students will increase my ability to understand clinical problems.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

10. Learning with healthcare students before graduation would improve relationships out in the workforce.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

11. Communication skills should be learned with other healthcare professionals.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

12. Shared learning will help me to think positively about other professionals.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

13. For small group learning to work, students need to trust and respect each other.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

14. Team-working skills are essential for all students to learn.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

15. Shared learning will help me to understand my own limitations.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16. Shared learning will help me to understand my own scope of practice.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

17. I don't want to waste my time learning with other healthcare students.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

18. It is not necessary for healthcare students to learn together.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

19. Clinical problem-solving skills can be learned best with students from my own department.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

20. Shared learning with other healthcare students will help me to communicate better with patients and other professionals.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

21. I would welcome the opportunity to work on small-group projects with other healthcare students.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

22. Shared learning will help to clarify the nature of patient problems.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

23. Shared learning before graduation will help me become a better team worker.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

24. I would like more interprofessional learning opportunities in the future.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

25. I now understand more about other professional roles within the healthcare team.

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

26. What was your main takeaway from your interprofessional learning experience?

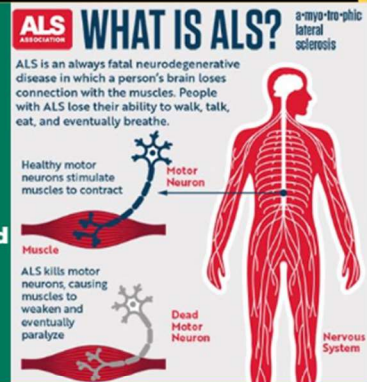
(Write-in)

APPENDIX I: EXECUTIVE SUMMARY

NDSU | NURSING

Interprofessional Education: ALS Respiratory Management

Amyotrophic lateral sclerosis (ALS) leads to weakness of the respiratory muscles. Respiratory issues significantly contribute to the morbidity and mortality of persons with ALS. Therefore, respiratory management is a critical aspect of care. There is a concerning lack of awareness and knowledge among rural and urban healthcare professionals regarding the respiratory management of persons with ALS. Healthcare professionals need to understand the differences between oxygenation and ventilation and the importance of following evidence-based guidelines.



This project aimed to address the knowledge gap by designing, implementing, and evaluating an educational session including a PowerPoint and interactive case study focusing on interprofessional collaboration. This project targets students pursuing healthcare degrees in various disciplines aiming to better equip healthcare students with knowledge before they enter practice.

- **Effectively enhanced knowledge and confidence of healthcare students**
- **Positively benefited interprofessional interactions**
- **Students identified communication and collaboration as key takeaways from the interprofessional learning activity**
- **Guided students to evidence-based guidelines and resources for future practice**

