AN EDUCATION INTERVENTION PROJECT IN COMMUNITY CLINICS TO IMPROVE THE IDENTIFICATION OF PATIENTS WITH PULMONARY ALVEOLAR PROTEINOSIS AND TO CORRECTLY IDENTIFY THE TYPE UTILIZING THE DIFFERENTIAL DIAGNOSTIC ALGORITHM

A Scholarly Project

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

Of Doctor of Nursing Practice

By

Catherine Poisson

Liberty University

Lynchburg, VA

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Scholarly Project Chair Approval:

Debra Maddox DNP, CNS-C, FNP-C Date:

ABSTRACT

With over 7000 types, rare diseases affect 25-30 million Americans and contribute to over one trillion dollars in healthcare-related costs. Prescribers lack the knowledge to improve awareness, identification, and treatment of rare diseases. Pulmonary alveolar proteinosis is a rare disease in which patients present with symptoms such as dyspnea, fatigue, and respiratory infections. Diagnosis can take four to 92 months. A differential diagnostic algorithm published in the literature can guide clinicians in identifying the type of pulmonary alveolar proteinosis the patient has. In addition, if the clinicians perform a laboratory test called the granulocyte-macrophage autoantibody test, this test provides 100% sensitivity and specificity, leading to a diagnosis of autoimmune pulmonary alveolar proteinosis that accounts for 90% of cases. This project aimed to implement an educational intervention for providers at pulmonary and primary care outpatient community clinics to increase confidence levels in identifying patients with pulmonary alveolar proteinosis, utilizing the differential diagnostic algorithm, and identifying the type following a case study. Using a pretest and posttest, the Wilcoxon signed-rank analysis showed statistical significance in all five outcomes that education improves the confidence of prescribers to identify and utilize the differential diagnostic algorithm, workup with lab tests and treatments, and provide resources for patients. In addition, 100% of prescribers used the differential diagnostic algorithm to correctly identify the type of pulmonary alveolar proteinosis following a case study. Limitations of this study included sample size and increased provider demand, which limited their time and availability.

Keywords: pulmonary alveolar proteinosis, granulocyte-macrophage autoantibody test, education

Acknowledgments

I want to thank multiple people who saw me through the completion of my evidence-based practice project. First, my Doctor of Nursing Practice Scholarly Chair, Dr. Maddox, DNP, CNS-C, FNP-C. Her ever-positive attitude, encouragement, and prayers were always uplifting during every phase of my project. Second, my family supported me through all my long days away from them to see this through to completion. I'm so thankful for all the laughs together. Third, my mom and dad were instrumental in uplifting my spirits and directing my thoughts to the end goal. Finally, I am thankful for all the gifted professors I have encountered at Liberty University. I am so grateful that I chose Liberty University for my Doctor of Nursing Practice degree.

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List of Abbreviations

aPAP: Autoimmune Pulmonary Alveolar Proteinosis

BAL: Bronchiolar Lavage

DBSC: Dried Blood Spot Card

GMAB: Granulocyte Macrophage Antibody

GM-CSF: Granulocyte Macrophage Colony Stimulating Factor

NORD: National Organization of Rare Disease

OLB: Open Lung Biopsy

PAP: Pulmonary Alveolar Proteinosis

TBLB: Transbronchial Lung Biopsy

WLL: Whole Lung Lavage

SECTION ONE: INTRODUCTION

The United States Department of Health and Human Services (2022) reports that the United States (US) defines a rare disease as "a condition that affects fewer than 200,000 people" (p. 1). In addition, it is reported that there are as many as 7,000 rare diseases and around 25-30 million Americans living with them (Tisdale et al., 2021). Rare disease contributes to healthcare costs three to five times more than non-rare disease, and direct and indirect medical cost burdens to patients and healthcare systems were estimated to be one trillion dollars in 2019 (Tisdale et al., 2021).

A survey by Definitive Health (2021) reported that the lack of rare disease education for physicians and the lack of awareness of symptoms related to the rare disease are some of the most significant hurdles and obstacles those in the medical profession face. The survey reported that less than one-third of the respondents evaluated their organization as having the proficiency and capability to diagnose rare diseases (Rare Disease, 2021). Moreover, a quarter of the respondents rate their organizations as dedicated and proficient in treating rare conditions (Rare Disease, 2021). Key takeaways of this survey include: The most impactful requirement for addressing rare diseases is the necessity for more education; improved coordination between health systems and organizations; and finally, increased cross-collaboration with other providers to bridge the gap of diagnosis and treatment (Rare Disease, 2021). Another study by Vandeborne et al. (2019) showed that rare disease knowledge and awareness were highest among general practitioners and that academic and continuous medical education should concentrate on increasing rare disease identification and responsiveness.

Background

Pulmonary alveolar proteinosis (PAP) is a rare disease with various symptoms, such as dyspnea, fatigue, persistent cough, sputum expectoration, chest tightness, and chest pain (Carey et al., 2019). PAP is divided into three groups: congenital, secondary, and autoimmune (aPAP) (Bai et al., 2022). Since about 90% of cases are autoimmune, focusing on aPAP identification is vital (McCarthy et al., 2022). According to Iftikar (2021), aPAP patients develop autoantibodies against granulocyte-macrophage colony stimulating factor (GM-CSF) signaling, which causes dysfunction of the alveolar macrophage. The inability to degrade surfactant can lead to surfactant accumulation, respiratory infections, and the potential for respiratory failure (Iftikar et al., 2021). Not only is GM-CSF critical for alveolar macrophage function, but it is also critical for systemic immune-mediated functions (Ataya et al., 2021). As a result, aPAP patients are at a higher risk for secondary and systemic infections (Iftikar et al., 2021).

The overall prevalence of PAP has been measured to be at least seven cases per million individuals in the general population (McCarthy et al., 2018; Trapnell et al., 2019). Pulmonary Alveolar Proteinosis occurs more often in men than in women, and exposures like dust and smoking increase the risk of PAP (Cleveland Clinic, 2018). Since PAP often goes undiagnosed or misdiagnosed, the true prevalence of PAP could be higher (McCarthy et al., 2018; Trapnell et al., 2019). The most prevalent type, aPAP, commonly presents in adults ages 30 to 40 but can occur in children as young as age three. According to Jouneau et al. (2020), all types of PAP actuarial survival at five years was 88 ± four percent, with most deaths (72%) linked to a progression to chronic respiratory failure. The survival at five years is currently around 95% (Jouneau et al., 2020). Autoimmune PAP may be suspected based on the history and physical performed, which can include the following: breathlessness of prolonged onset; crackles in the

lungs with auscultation; routine blood tests are usually regular; and a high-resolution computerized tomography (CT) scan, which typically reveals extensive white patches within the lungs called ‘crazy paving’ (NORD, 2019).

The total cost of caring for these patients is difficult to ascertain due to the delay in the diagnosis. However, an extensive health insurance claims database for 15 million patients was investigated over a span of 15 years. Their results showed that PAP patients had significantly more comorbidities, healthcare utilization, and associated medical costs than control patients, matched for age and gender (McCarthy et al., 2018).

In conjunction with PAP disease awareness and screening, there is high diagnostic accuracy with a serum GMAb test to identify the autoimmune type of PAP. This blood test can determine aPAP and reduce unnecessary invasive lung biopsies. The GMAb test for aPAP and tests utilized for the other types of PAP are performed at minimal sites in the United States. The GMAb test may be performed at no cost to patients if they are enrolled in clinical research. If patients are not enrolled in clinical research, the cost of the test depends on their specific insurance plan. Recently, Carey et al. (2022) compared a dried blood spot card (DBSC) for GMAb collection to serum testing, and results showed that the DBSC was also able to diagnose aPAP with 100% sensitivity. The DBSC is performed through a National Institutes of Health grant, conveniently performed at home by the patient. Lastly, the PAP Foundation is currently setting up patient assistance programs to assist with associated costs to patients.

There are currently no standard treatment guidelines besides whole lung lavage (WLL) for patients. Moreover, only a few identified centers around the United States routinely perform WLL s for PAP patients (PAP Foundation, 2022). WLL is associated with many adverse effects, including infections, fever, pneumothorax, pleural effusion, and hypoxemia (Awab et al., 2017).

With no current approved treatments by the Food and Drug Administration (FDA), clinical trials and patient registries are ongoing to optimistically add to the body of evidence for treating aPAP (Clinicaltrials.gov, 2022). Multiple case studies and a prospective study of inhaled GM-CSF showed improvements in gas exchange and functional health status (Sheng et al., 2018; Tazawa et al., 2019; Trapnell et al., 2020). A study in PAP with oral statins was associated with improvements in dyspnea, radiographic abnormalities, and pulmonary function (McCarthy et al., 2018). Additional therapies, such as plasmapheresis, have been proposed as alternatives for PAP (Garber et al., 2015). Resources for patients include the PAP Foundation and the National Organization of Rare Diseases (NORD). In conclusion, it is evident in the literature that early identification, diagnosis, and treatment options improve patient outcomes, minimize morbidity, and lower healthcare-related costs (McCarthy et al., 2018).

Problem Statement

Faviez et al. (2020) describe that 24% of specialist doctors do not have the time to devote to rare disease diagnoses and have limited knowledge of diagnosing patients. Misdiagnosis, underdiagnosis, and delayed diagnosis of rare diseases are common (Faviez et al., 2020). Rare diseases can overwhelmingly impact patients and families since they are often challenging to identify (Sobrido et al., 2019). Sobrido et al. (2019) recommend screening protocols for rare diseases, whether clinical, biomarker, genetic diagnostic, or a combination of these methods.

Delays in PAP diagnoses and subsequent treatment can result in reduced pulmonary homeostasis, increasing opportunistic infections (Ataya et al., 2021). A PAP differential diagnostic algorithm is currently available and in the literature. This algorithm outlines all types of PAP and which testing should be performed to establish a PAP diagnosis (Trapnell et al., 2019; Ataya et al., 2021; Trapnell et al., 2020). The diagnosis of aPAP requires a serum

granulocyte-macrophage autoantibody (GMAb) test that providers can order that can provide 100% sensitivity and specificity, leading to a diagnosis of aPAP (Ataya et al., 2021; Trapnell et al., 2020). With improved time to diagnosis, additional advantages for patients are enrollment into the PAP patient registry, monitoring of symptoms, treatment, and participation in a clinical trial.

Purpose of the Project

Awareness of rare diseases is low, and education interventions are paramount to identify and treat the condition quickly and to improve patient outcomes while decreasing the economic burden. PAP is a rare disease, and a differential diagnostic algorithm can differentiate types of PAP and corresponding diagnostic tools to order. Educating providers on this rare disease and delivering information regarding the current availability of a differential diagnostic algorithm is essential to recognizing, diagnosing, and treating PAP. In the most prevalent type, aPAP, delays in diagnosis can cause a buildup of surfactant in the lungs, which cannot be cleared, leading to chronic respiratory failure (NORD, 2017). With improved time to diagnosis and treatment, patient outcomes such as reduction of dyspnea, fatigue, respiratory infections, and chronic respiratory failure can be improved (NORD, 2017).

Therefore, the purpose of this project was to implement an educational intervention for providers at pulmonary and primary care outpatient community clinics to increase the confidence levels in the following: identification of presenting signs and symptoms of PAP; the utilization of the differential diagnostic algorithm; ordering the test(s) needed to determine the correct type of PAP; the prescribing treatment, referral, or clinical trials; and the available resources and information. Finally, the prescribers would accurately identify the correct type of PAP after review of a case study. As such, this project had three aims. The first aim was to increase

provider knowledge of PAP presenting signs and symptoms, tests, treatment, and patient resources by conducting a brief intervention utilizing a PowerPoint presentation. The second aim was to increase provider knowledge of a differential diagnostic algorithm through a handout. The third aim was to present a case study to test whether clinicians could correctly identify the type of PAP utilizing the differential diagnostic algorithm.

Clinical Question

The education intervention project addressed the clinical question: Among pulmonary and primary care providers in outpatient community clinics, will education on PAP improve confidence and utilization of the differential diagnostic algorithm following a case study? The project's clinical question elements included confidence in the presenting signs and symptoms of PAP, the availability of the differential diagnostic algorithm for PAP, the test(s) to determine the correct type of PAP, treatment, referral, and clinical trial information, and available patient resources. In addition, after reading the case study, the primary care and pulmonary care providers would correctly identify the type of PAP. The differences in test scores will demonstrate provider confidence before and after the education intervention by utilizing a pre-intervention and post-intervention test. Participation in this project was completely voluntary. A specialized framework called PICO is utilized when implementing an EBP project to formulate the question and to facilitate the literature search. Below is the PICO outline. PICO stands for population, intervention, comparison, and outcome.

P: The pulmonary and primary care providers at outpatient community-based clinics were the population studied.

I: The intervention was to implement a PowerPoint education module to educate and increase staff confidence in the rare disease PAP, including presenting symptoms and

findings, treatment, and patient resources. Providers were educated on the availability of the differential diagnostic algorithm for PAP. The providers reviewed a case study and the differential diagnostic algorithm to identify the type of PAP.

C: A pretest and posttest were used to measure the prescribers' confidence and ability to identify a patient presenting with PAP symptoms utilizing the differential diagnostic algorithm.

O: Prescribers will have increased confidence levels in identifying patients presenting signs and symptoms of PAP, utilizing the PAP differential diagnostic algorithm to determine the type of PAP, ordering the test(s) needed to diagnose patients with PAP, prescribing treatment, referrals, or clinical trials for patients diagnosed with PAP, providing PAP patients with resources and information on their disease, and applying the differential diagnostic algorithm to correctly identify the type of PAP after reading a case study.

PICO Question: Does an educational intervention for providers at pulmonary and primary care outpatient community clinics increase confidence in the following: the identification of presenting signs and symptoms of PAP; the utilization of the differential diagnostic algorithm; the prescribing treatment, referral, or clinical trials; the available resources and information; and by accurately identifying the correct type of PAP after review of a case study?

SECTION TWO: LITERATURE REVIEW

Pulmonary alveolar proteinosis is a rare disease that historically provides few randomized controlled trials (RCTs). Improving the prevention, diagnosis, and treatment of rare and

neglected diseases is a priority for the Food and Drug Administration (FDA, 2019). Currently, there is no standard of care for patients that present with symptoms seen in this rare disease.

Within the literature review, multiple case reports shed light on how complex the diagnosis of PAP is due to the wide variety of presenting symptoms between adolescents and adults (Ariel et al., 2019; Hawkins et al., 2021; Huaringa & Francis, 2016; Feld et al., 2021). Delays in diagnosis have been reported by Ariel et al. (2019) to take four to 92 months. The standard workup for the presenting symptoms of PAP includes laboratory tests which may show elevated white blood cells or be inconclusive; a chest x-ray which may show bilateral alveolar infiltrates; a high-resolution computerized tomography (CT) scan, which will show crazy-paving in a geographic distribution otherwise known as ground-glass opacities; and pulmonary function tests, which can be normal or show diminished diffusing capacity (Carey et al., 2019). Once these test results are completed, a PAP diagnosis will be suspected but cannot be conclusive.

In a study with 85 PAP patients, presenting symptoms included the following: 59% had dyspnea; 54% had a cough; 18% had fatigue; 10% had a low-grade fever; 10% had weight loss; two percent had hemoptysis; and 21% were asymptomatic (Ariel et al., 2019). A case study by Huaringa and Francis (2016) showed presenting symptoms of a long-standing, productive cough but denied fever, chills, weight loss, and night sweats. Alisari et al. (2021) reported a case of a 15-year-old that presented with a history of shortness of breath and low oxygen saturation. A case study by Huaringa and Francis (2016) reported that a 52-year-old presented with a prolonged standing cough and sputum production.

The first step to the best clinical outcomes is an accurate diagnosis (Rare Diseases, 2020). Patients and their caregivers can suffer mentally and emotionally while devoting resources via time and energy on their journey to a diagnosis (Rare Diseases, 2020). Among 84 registrants

who completed the National Registry Questionnaire, delayed diagnosis of PAP was as much as one year and one month after the onset of symptoms. In addition, although lung biopsies fail to identify any PAP-causing disease, a medical record review of 68 participants indicates that 51 (75%) of patients underwent lung biopsy (surgical: 47%, transbronchial: 43%, or both: 10%) as part of their initial evaluation; 13% of biopsies failed to identify PAP (Carey et al., 2019).

With the ongoing uncertainty of a confirmed diagnosis, additional invasive procedures are ordered and performed. The three standard procedures utilized are a bronchoscopy with bronchoalveolar lavage (BAL), a transbronchial lung biopsy (TBLB), or an open lung biopsy (OLB). The BAL will have Schiff (PAS)-positivity in the lung fluid (Hauringa & Francis, 2016). The lung biopsies will not be conclusive and cannot diagnose PAP (Carey et al., 2019).

The most prevalent type of PAP is autoimmune PAP (aPAP). These patients are unique because they have developed antibodies against GM-CSF. There is one laboratory test that is currently available, named GMAb. This test can provide a confirmatory diagnosis of aPAP. This laboratory test has 100% sensitivity and specificity in diagnosing aPAP 100% of the time (Ataya et al., 2021; Carey et al., 2019; Hawkins et al., 2021; Uchida et al., 2014).

McCarthy et al. (2018) reported that serum GM-CSF autoantibody testing is confirmatory for diagnosing aPAP. Furthermore, a serum blood test replaces invasive lung biopsies, resulting in an earlier diagnosis, reduced morbidity, and decreased healthcare costs.

Search Strategy

A systematic review and literature search were performed utilizing the Jerry Falwell Library at Liberty University. The following keywords were searched: pulmonary alveolar proteinosis, autoimmune pulmonary alveolar proteinosis; serum GM-CSF; GMAb testing; aPAP delay in diagnosis; aPAP time to diagnosis; and diagnosing pulmonary alveolar proteinosis. The search included articles published in the English language. Because aPAP is a rare disease, the

literature search was performed in the last seven years. In the initial literature review, there were 1,482 articles available.

Critical Appraisal

Appraisal of evidence for this proposed project is displayed in a matrix in Appendix A utilizing Melnyk's Level of Evidence hierarchy (U of M, 2019). There were 18 articles reviewed using Melnyk's framework. The initial literature review includes the following: one meta-analysis, two double-blind placebo-controlled trials; one claims database interrogation; four case reports; one national registry questionnaire; one review of descriptive studies; four qualitative case studies; two case-controlled studies; one retrospective study; and one expert opinion. This search resulted in the following levels of evidence: one level one, two level twos; one level three; three level fours; five level fives; five level sixes, and one level seven.

Synthesis

The literature review and the critical appraisal of the evidence generated key essential topics contributing to the proposed education intervention. These topics include: autoimmune PAP, PAP, rare disease, and the differential diagnostic algorithm. Prescribers lack confidence in identifying and treating rare disease. Clinicians may not be aware of the differential diagnostic algorithm, delays in a PAP diagnosis can contribute to poor patient health outcomes. If the PAP is the autoimmune type, there is a serum GMAb test that has 100% sensitivity and specificity, leading to positive confirmation and diagnosis of the most prevalent type. Through disease awareness and utilization of the differential diagnostic algorithm, clinicians can determine if patients should receive further testing, such as a serum GMAb.

Conceptual Framework/Model

The Iowa Model served as the conceptual framework and model for the scholarly project. The Iowa Model was developed in the early 1990s and has been widely utilized in numerous academic and healthcare organizations to guide the implementation of evidence for facilitating change (Steelman, 2015). The Iowa Model is instrumental in evaluating and infusing research findings into patient care while promoting quality care (Buckwalter et al., 2017). The Iowa Model focuses on practice change by incorporating concepts that include the following: identifying triggering issues and opportunities; assembling, appraising, and synthesizing the body of evidence; designing and piloting the practice change; and identifying and sustaining the practice change (Melnyk & Fineout-Overholt, 2019). Approval to use the Iowa Model is in Appendix C.

Summary

The literature review persuasively delivered evidence of the challenges in diagnosing this rare disease, PAP. It is difficult to establish a systematic approach to diagnosis due to the rarity and sporadic presentation of PAP patients in the pulmonary and primary care community clinic setting. Delays in diagnosis are accompanied by invasive, unnecessary, and diagnostic procedures such as OLB. Ataya et al. (2021) confirm that GMAb testing is recommended to enhance the simple and noninvasive detection and diagnosis of aPAP. In addition, screening for PAP is essential since up to one-third of patients with aPAP may be asymptomatic at diagnosis (Ataya et al., 2021).

Therefore, the purpose of this project was to implement an educational intervention for providers at pulmonary and primary care outpatient community clinics to increase the confidence levels in the following: identification of presenting signs and symptoms of PAP; the utilization of

the differential diagnostic algorithm; ordering the test(s) needed to determine the correct type of PAP; the prescribing treatment, referral, or clinical trials; and finally, the available resources and information that the prescribers would use to accurately identify the correct type of PAP after review of a case study utilizing the differential diagnostic algorithm. As such, this project had three aims. The first aim was to increase provider knowledge of PAP presenting signs and symptoms, tests, treatment, and patient resources by conducting a brief intervention utilizing a PowerPoint presentation. The second aim was to increase provider knowledge of a differential diagnostic algorithm through a handout. The third aim was to present a case study to test whether clinicians could correctly identify the type of PAP utilizing the differential diagnostic algorithm.

SECTION THREE: METHODOLOGY

Design

The education intervention was guided by utilizing the Iowa Model for Evidence-Based Practice. The Iowa Model guided the pilot study and was a quasi-experimental designed practice improvement study (Mateo & Foreman, 2014). The project utilized a pretest questionnaire to assess current knowledge of PAP. Next, an education module using a PowerPoint presentation was delivered that provided education surrounding the identification of patients presenting signs and symptoms of PAP, the availability of the PAP differential diagnostic algorithm to determine the type of PAP, the test(s) needed to diagnose patients with PAP, the treatment, referrals, or clinical trials for patients diagnosed with PAP, and finally, patient resources and information.

After the education intervention, a posttest questionnaire measured staff knowledge. The same five questions were asked in the posttest. In addition, the providers were given a case study to read and review. Following the case study, the providers were asked to identify the type of PAP that the patient in the case study had. Providers were instructed to utilize the differential

diagnostic algorithm for reference. Post-education follow-up questions were performed eight weeks following the initial education and analyzed for long-term impact and knowledge retention of PAP education. Lastly, the providers were asked if they had identified a PAP patient or utilized the differential diagnostic algorithm since the education intervention had been delivered.

Measurable Outcomes

The education intervention evaluated and assessed five outcomes for this project which included:

1) Providers will have increased confidence in identifying patients with signs and symptoms associated with PAP.
2) Providers will have increased confidence utilizing the differential diagnostic algorithm tool.
3) Providers will have increased confidence in ordering the test(s) needed to determine the correct type of PAP.
4) Providers will have increased confidence in treatment, referral, and clinical trials.
5) Providers will have increased confidence in providing PAP patients with patient resources and information on their disease.

Setting

The setting for this education intervention was delivered to outpatient primary care and pulmonary clinics in a local rural-based hospital. The mission of the facility is to “improve and preserve the health and well-being of those we serve”, and their vision is to “redefine the healthcare experience, becoming the best place to work, practice medicine, and receive care” (RH, 2022). The clinics are based in Hamilton County. Hamilton County covers 696.4 square

miles and has a population of approximately 347,467 people (U.S. Census Bureau, 2022). Most residents are white (86.6%), with 6.5% Asian, 4.5% African American or Black, 4.3% Hispanic or Latino, 2.1% with two or more races, and 0.2% American Indian and Alaska Native (U.S. Census Bureau, 2022). A little over 26% are under 18 years of age, while 51.2% are female, 96.8% have at least a high school diploma, and 59.3% have at least a bachelor's degree. The median household income from 2015-2019 was $98,173, and the unemployment rate was 0.8% (U.S. Census, 2022; BLS, 2022).

The providers were given two choices to receive the education: live during a lunch and learn, or an electronic version. Both formats had the same content. The live education was delivered via PowerPoint, a projector, and a speaker in a conference room. The pre-recorded presentation was given to the participant following an informed consent electronic receipt.

Population

The subject sample was determined by the number of providers willing to participate in the education intervention. This was a convenience sample, and the goal was to include six providers in the outpatient pulmonary clinic and 20 providers in the outpatient primary care clinics. Multiple emails and live visits were executed to gain interest and participation. The pulmonary care office set up a lunch and learn. The primary care clinic directors were contacted to set up lunch and learns and to attend any clinic meeting. Unfortunately, the primary care providers all opted for the electronic version due to providers' schedules and enormous patient demands during this study. For the study, there were a total of nine provider participants.

The exclusionary and inclusionary criteria were considered during the study's planning and execution. Inclusion criteria included the following: current employment status; not planning to leave the institution during the timeframe of the study; and current prescriber, which included

nurse practitioner (NP), physician assistant (PA), medical doctor (MD), or Doctor of Osteopathic Medicine (DO). The collection included the following: how many years of experience in the outpatient clinic setting? which type of clinic? and what type of provider?

Ethical Considerations

The human subjects for this study were protected during the research process. The Doctor of Nursing Practice project team completed research ethics training to ensure the safety of human subjects. The project lead participated in the Collaborative Institutional Training Initiative (CITI); the certificate is provided in Appendix B. Participants' rights were individually protected by receiving informed consent. The informed consent was either printed off and hand-delivered to each participant with their packet or electronically delivered via Google Forms. The consent provided each participant with detail of the content, purpose, and education intervention for the project. Every participant had the right to decline participation and withdraw at any time. The informed consent is in Appendix I.

Participant participation confidentiality was established and maintained. Participants did not divulge any information that would be deemed as a personal identifier on their tests. All tests were shredded after data collection. All screening tools collected did not contain any prescriber identifiers. Information that was collected and stored on a laptop computer was password protected. All information collected for the education intervention will be held for three years and then destroyed. The approval from the Institutional Review Board (IRB) at Liberty University is included and displayed in Appendix G. The approval letter from the site is in Appendix H.

Data Collection

The project leader performed the data collection for this education intervention. All primary care and pulmonary care providers included in the education intervention provided demographic data, which included age, title, and years of experience. All participants were asked if they had received any prior education on PAP. The pretest and posttest assessed the knowledge of the identification of presenting signs and symptoms of PAP, the utilization of the differential diagnostic algorithm, the test(s) needed to determine the correct type of PAP, the prescribing treatment, referral, or clinical trials, and the available patient resources. After the posttest, the prescribers were asked to read and review a case study and identify the correct type of PAP utilizing the differential diagnostic algorithm. For this education intervention, there were five questions for the pretest and the same for the posttest. The pretest is in Appendix K and the posttest is in Appendix M.

Tools

As there are no pathways, guidelines, or standards of care with PAP, a questionnaire for gathering information on PAP also does not exist. The tools created and implemented for this education intervention were the pretest, the education slides, and the posttest. All questions were focused on PAP disease awareness, presenting signs and symptoms, and the availability of the differential diagnostic algorithm. The questions were all multiple choice based upon a Likert-type scale, with one being not confident, two being somewhat confident, three being mildly confident, four being moderately confident, and five being very confident. The differential diagnostic algorithm and the case study that was used during the education intervention were approved by the authors for use.

Intervention

The education intervention was developed and led by the project leader. IRB approval was obtained from Liberty University and the site before implementation. After informed consent was signed and received from the prescribers, the pre-education questionnaire was delivered, which gathered demographic information and whether the participants had received prior education on PAP. A pretest was also given before instruction. The PowerPoint presentation was prerecorded so that the same content was provided whether the prescribers chose the live lunch and learn or electronic delivery. The education intervention began by discussing the importance of education on rare diseases.

Next, a case study was reviewed, which included the patient's laboratory test results, pulmonary function results, and imaging results. The differential diagnoses for the case study included the following options: bronchioloalveolar carcinoma; infectious pneumonia; non-specific interstitial pneumonia; eosinophilic pneumonia; pulmonary edema; and diffuse alveolar hemorrhage, which are current options. After the case study, the prescribers were introduced to PAP, which was not on the differential but was indeed what the patient had. PAP education included the following information: what PAP is; the prevalence of PAP; what causes PAP; the types of PAP; PAP survival rates; issues regarding the delay of diagnosis; and the current availability of the PAP differential diagnostic algorithm. The PowerPoint presentation included where to send serum for precise laboratory workup, which is only available at three United States locations. The two primary clinical centers of excellence and other additional sites that see PAP patients were provided in the presentation. The end of the PowerPoint focused on PAP treatment options, clinical trials, and current patient resources. The slides that were utilized for the education intervention are in Appendix L.

Following the education, participants took the posttest. The same five questions were asked. In addition, the participants were given a case study to read and review. Based on the case study, the participants were asked to utilize the differential diagnostic algorithm and identify the type of PAP the patient had found on the workup and laboratory tests.

Eight weeks after the education intervention, participants were given a follow-up questionnaire measuring long-term education impact. The follow-up questionnaire also addressed whether the prescribers referred, tested, or utilized the PAP differential diagnostic algorithm since receiving education on PAP. The eight-week follow-up test is in Appendix N.

Timeline

The project timeline describes the complete process for the study. Study delays between July and October were due to the lag in the accrual process. Since the study incorporated an eight-week follow-up, the data analysis was not started until the final data collection was complete.

Table 1

Project Timeline

Step 1: Review Scholarly Project process, sequence, and timelines	January 10, 2022
Step 2: Design research study with clinic staff and chair	January 17, 2022
Step 3: Complete CITI training	February 2, 2022
Step 4: Develop the first draft of the proposal and submit to chair for review; Complete literature review, level of evidence summary, and summary matrix	February 6, 2022
Step 5: Complete final draft of proposal	April 5, 2022
Step 6: Defend Scholarly Project proposal	April 6, 2022
Step 7: Obtain IRB approval for proposed project	May 2, 2022
Step 8: Obtain permission for study	May 2, 2022
Step 9: Initiate Scholarly Project	May 9, 2022
Step 10: Complete the initial draft	July 13, 2022
Step 11: Complete data analysis	October 1, 2022
Step 12: Submit completed first draft with discussion and conclusions	October 23, 2022
Step 13: Submit to editor	By October 26, 2022

Step 14: Request final defense appointment	By November 15, 2022
Step 15: Submit final PowerPoint for defense	By November 15, 2022
Step 16: Final defense	By December 10, 2022
Step 17: Submit to Scholar's Crossing	By December 16, 2022

Feasibility Analysis

Supporting personnel for this project included the project chair, the site coordinator, and an editor. The project chair ensured a timely approach to data gathering and write-up. The site coordinator confirmed that the staff took the time to be involved and was an excellent resource for navigating the facility. The editor supported the project by ensuring the document was formatted and grammatically correct. In addition, the editor prepared the document for publication submission to scholars crossing.

The project leader utilized MS Word, MS PowerPoint, MS Excel, Google Forms, and Google Slides for data. The PowerPoint presentation was delivered using a personal laptop computer, a projector, and a speaker. Google Slides were given recorded audio, so that consistency of education was maintained. SPSS software was purchased and used with Microsoft Excel for data analysis.

The lunch provided as a part of the lunch and learn, was the most significant part of the budget, but cost less than ten dollars per person. The prescribers who chose the online option were given a ten-dollar coffee card at the end of the posttest. Other minimal costs included printing and purchasing the SPSS software from Liberty University.

Data Analysis

The project leader conducted the data analysis. Descriptive statistics were analyzed. A Wilcoxon rank-test was used to measure and determine if there was statistical significance between the values in the two data sets. The IBM SPSS software was used for analysis. For this

project, the pre-questionnaire was categorized as test one, and the post-questionnaire was classified as test two.

The student cost of the project was minimal. Costs included printing the informed consent, the pretest, the posttest, the case study, the differential diagnostic algorithm, and the eight-week follow-up questionnaire. If the prescriber chose the electronic version of the study, then the site allowed provider participation during working hours or after hours. A conference room was available at the site to deliver the education intervention.

SECTION FOUR: RESULTS

The demographic portion of the questionnaire included three questions: what type of provider, what type of outpatient clinic, and how many years of experience in their respective type? The result showed that four providers were physician assistants, three were medical doctors, and two were nurse practitioners. Fifty-six percent of participants worked in the pulmonary care outpatient clinic, and 44% worked in the primary care outpatient clinic. The participants in the project ranged in experience, with 34% having three to six years, 33% with zero to two years, 22% with greater than 10 years, and 11% with seven to 10 years. Regarding former education on PAP, 78% had reported not receiving any education, while 22% reported that they had received education on PAP in the past. Nine people completed the pre and posttest questionnaires. Figure 1 shows the cumulative results from the pretest. Figure 2 shows the cumulative results for the posttest.

Figure 1

Pretest all Respondents' Results

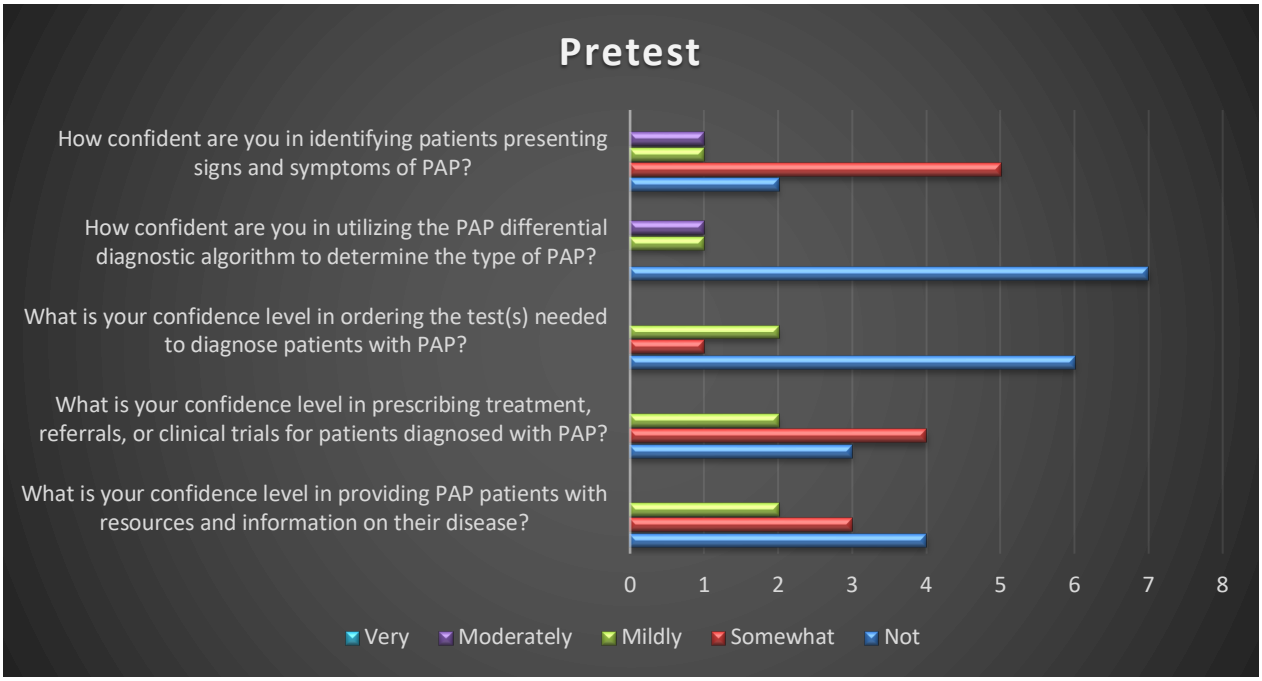
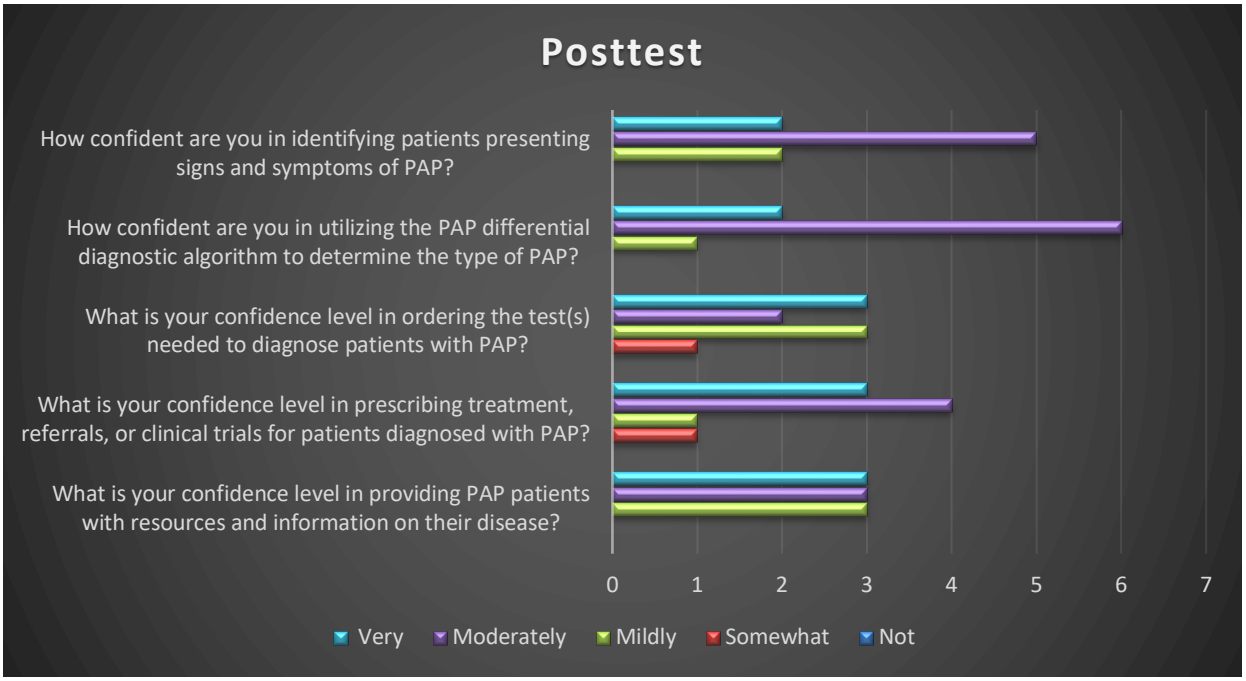


Figure 2

Posttest all Respondents' Results

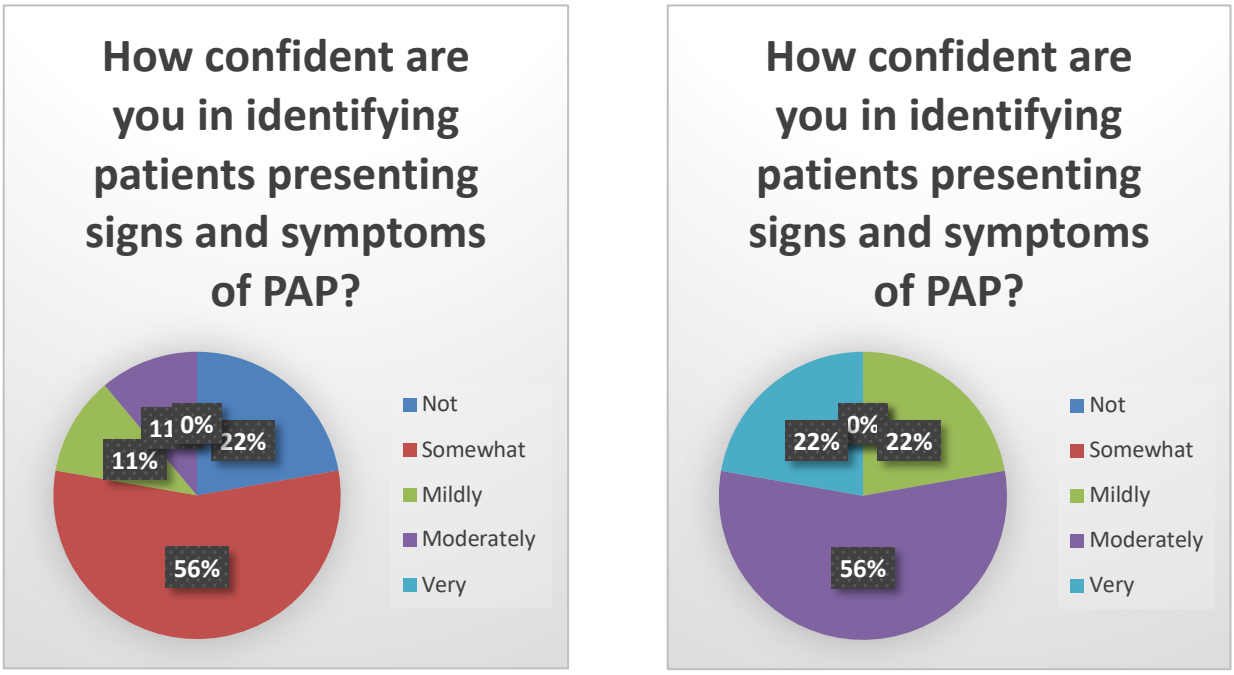


Measurable Outcome 1

The first measurable outcome was that providers would have increased confidence in identifying patients with signs and symptoms associated with PAP. The pretest versus the posttest results is in Figure 3. The Wilcoxon signed-rank test was conducted utilizing the SPSS software to determine if there was a significant difference between the pretest and posttest scores. The results concluded a significant increase in prescribers' *confidence in identifying patients with signs and symptoms associated with PAP with a p-value of <.05* (see Table 2).

Figure 3

Pretest Question Versus Posttest Question 1

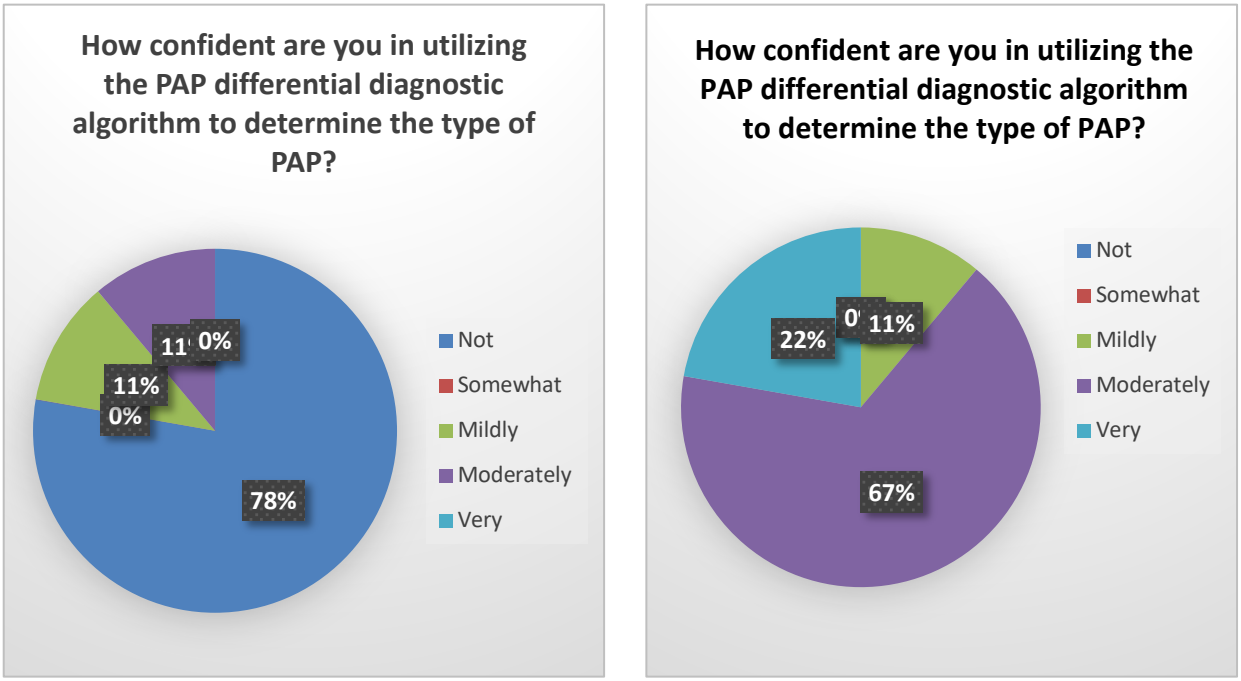


Measurable Outcome 2

The second measurable outcome was that providers would be more confident utilizing the differential diagnostic algorithm tool. The pretest versus posttest results for question two is in Figure 4. The Wilcoxon signed-rank test was conducted utilizing the SPSS software to determine if there was a significant difference between the pretest and posttest scores. Results show a significant increase in prescribers' *confidence in using the PAP differential diagnostic algorithm to determine the type of PAP* with a *p*-value of <.05 (see Table 2).

Figure 4

Pretest Question versus Posttest Question 2

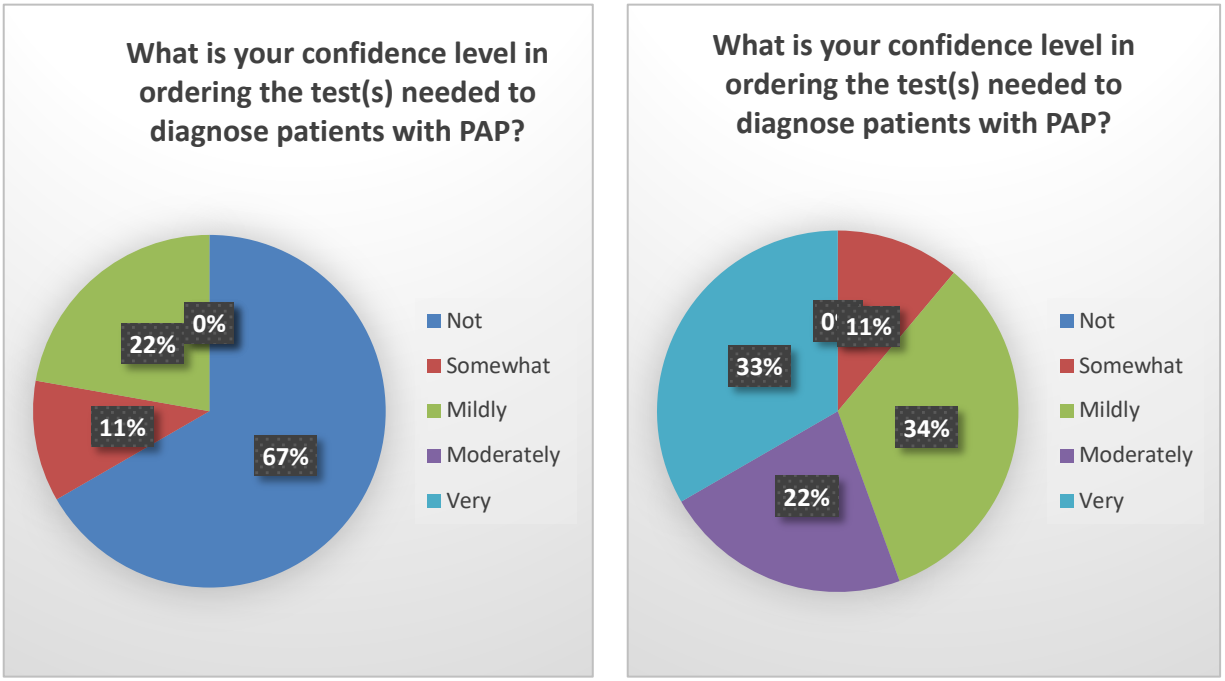


Measurable Outcome 3

The third measurable outcome was that providers would have increased confidence in ordering the test(s) needed to determine the correct type of PAP. The pretest versus the posttest results for question three is in Figure 5. The Wilcoxon signed-rank test was conducted utilizing the SPSS software to determine if there was a significant difference between the pretest and posttest scores. Results show that there was a significant increase in prescribers' *confidence in ordering the test(s) needed to diagnose patients with PAP* with a *p*-value of <.05 (see Table 2).

Figure 5

Pretest Question Versus Posttest Question 3

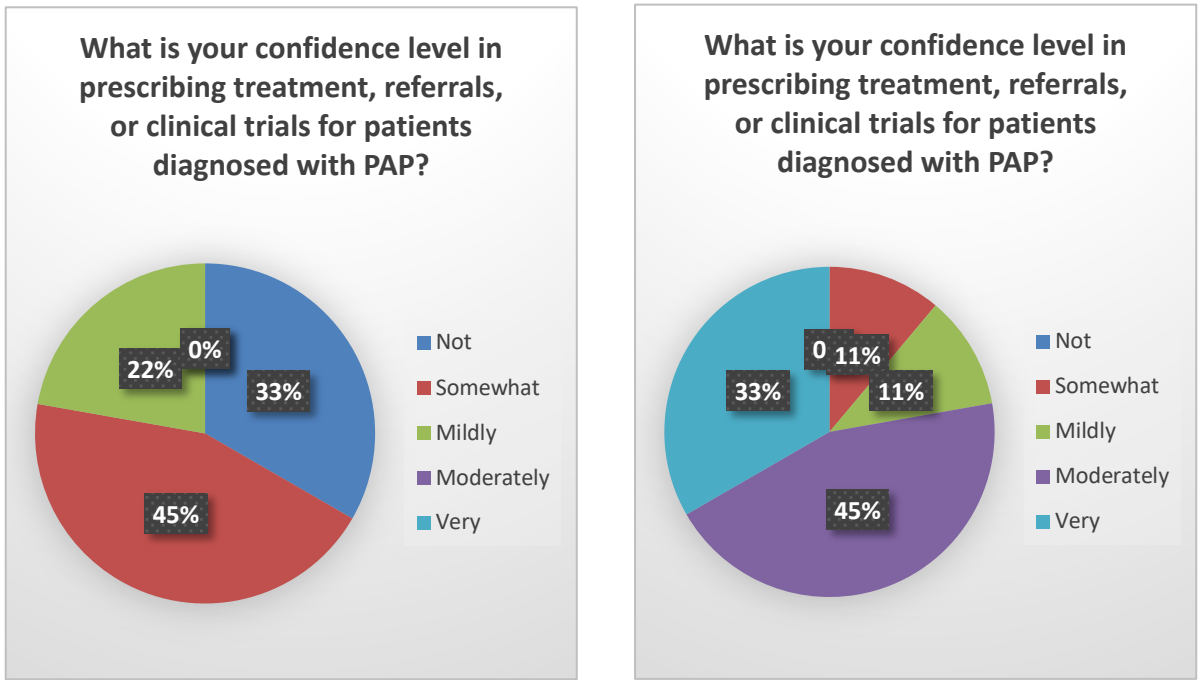


Measurable Outcome 4

The fourth measurable outcome was that providers would have increased confidence in treatment, referral, and clinical trials. Figure 6 shows the pretest versus the posttest results. The Wilcoxon signed-rank test was conducted utilizing the SPSS software to determine if there was a significant difference between the pretest and posttest scores. Results show a significant increase in prescribers' *confidence in prescribing treatment, referrals, or clinical trials for patients diagnosed with PAP* with a *p*-value of <.05 (see Table 2).

Figure 6

Pretest Versus Posttest Question 4

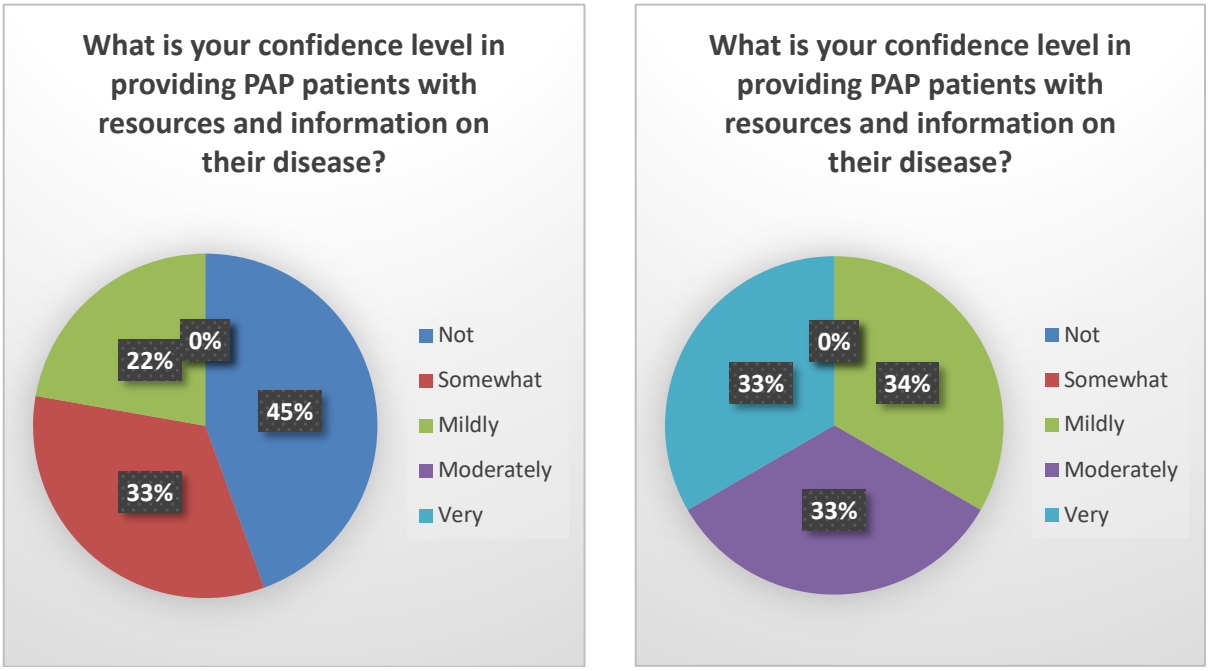


Measurable Outcome 5

The fifth measurable outcome was that providers would have increased confidence in providing PAP patients with patient resources and information on their disease. The pretest versus the posttest results for question five is shown in Figure 7. The Wilcoxon signed-rank test was conducted utilizing the SPSS software to determine if there was a significant difference between the pretest and posttest scores. Results show a significant increase in prescribers' *confidence in providing PAP patients with resources and information on their disease* with a *p*-value of <.05 (see Table 2).

Figure 7

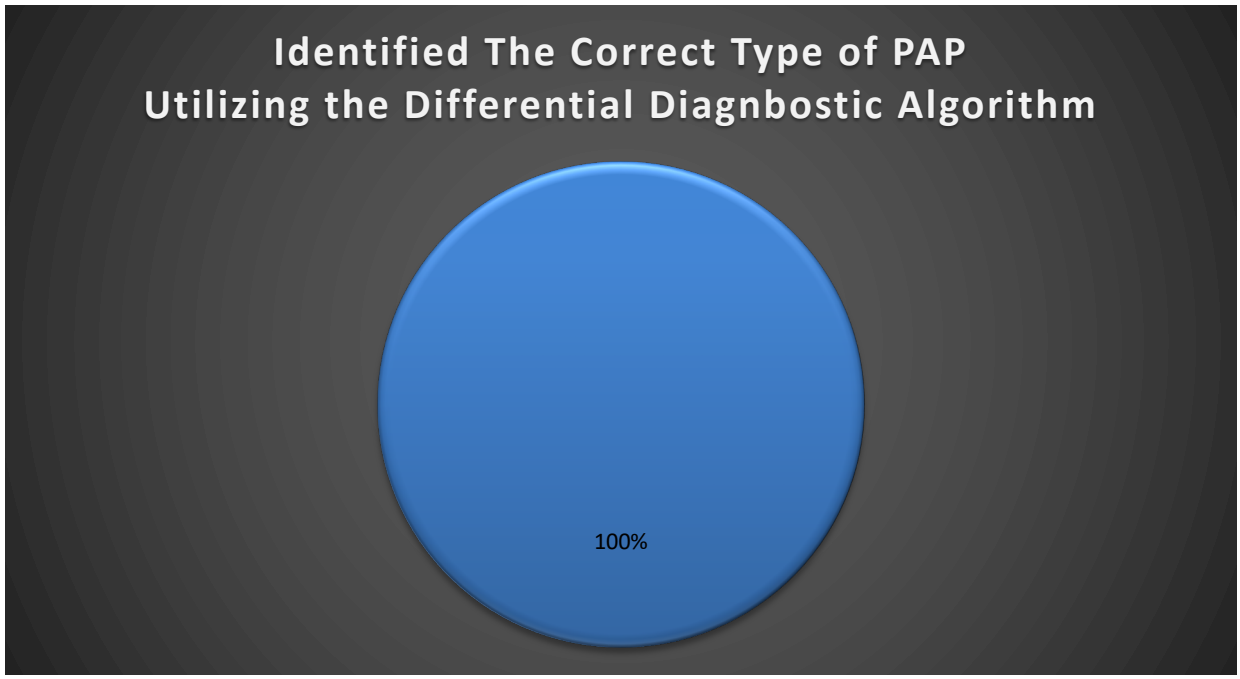
Pre-Test Versus Posttest Question 5



At the end of the five posttest questions, all participants were given a case study approved for distribution by the case author. All nine participants read and reviewed the case study. After the case study was read, the participants were asked to utilize the differential diagnostic algorithm to identify the correct type of PAP that this patient in the case study had based on their diagnostic workup. Out of the nine participants, 100% responded correctly by identifying the correct type of PAP, which was aPAP (see Figure 8).

Figure 8

Percentage of Clinicians who Correctly Identified the Type of PAP from the Case Study Utilizing the Differential Diagnostic Algorithm

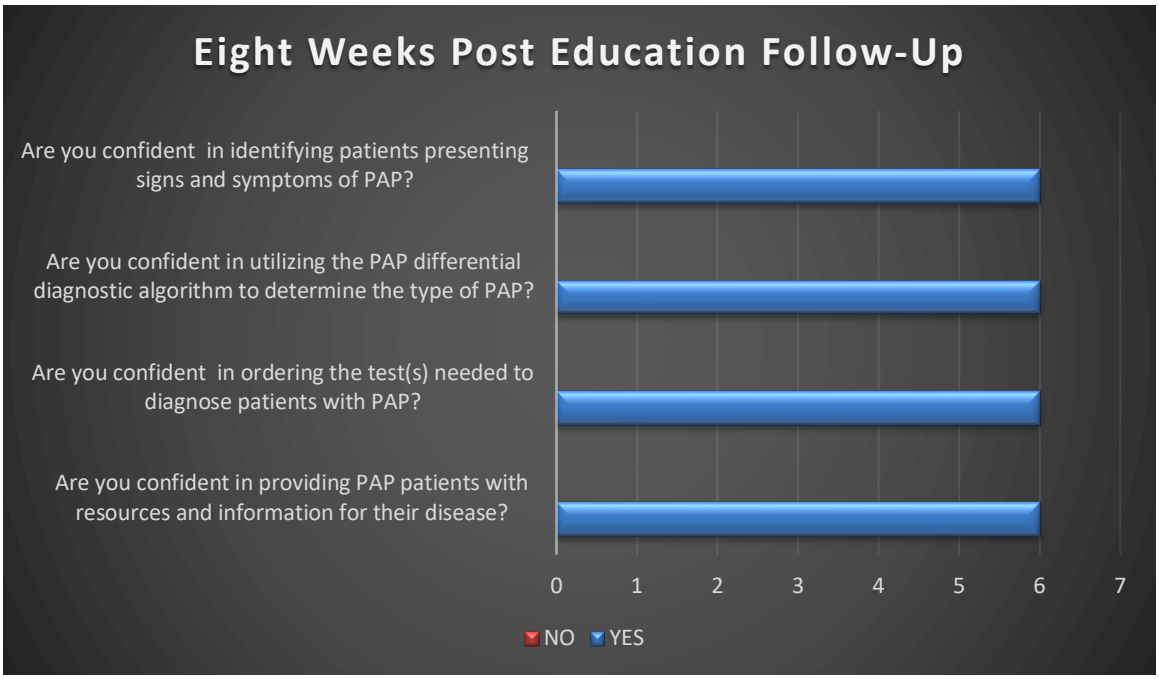


Eight weeks after the education intervention, post-education follow-up was obtained. Six of the participants completed the eight-week post-education questionnaire. The data collected was like the pretest and posttest but intentionally meant to be quick, and the answers were in the form of a yes or no. The questions for the follow-up included if they were confident in identifying patients presenting signs and symptoms of PAP, confident in utilizing the PAP differential diagnostic algorithm, confident in ordering the tests needed to diagnose patients with PAP, and confident in providing PAP patients with resources and information for their disease. The cumulative results are in Figure 9. Out of the six participants, for question one, 100% were confident identifying patients presenting with signs and symptoms of PAP. Regarding question two, 100% of respondents were confident in utilizing the PAP differential diagnostic algorithm

to determine the type of PAP. For question three, 100% responded that they were confident in ordering the test(s) needed to diagnose patients with PAP. Lastly, question four resulted in 100% confidence in providing PAP patients with resources and information for their disease.

Figure 9

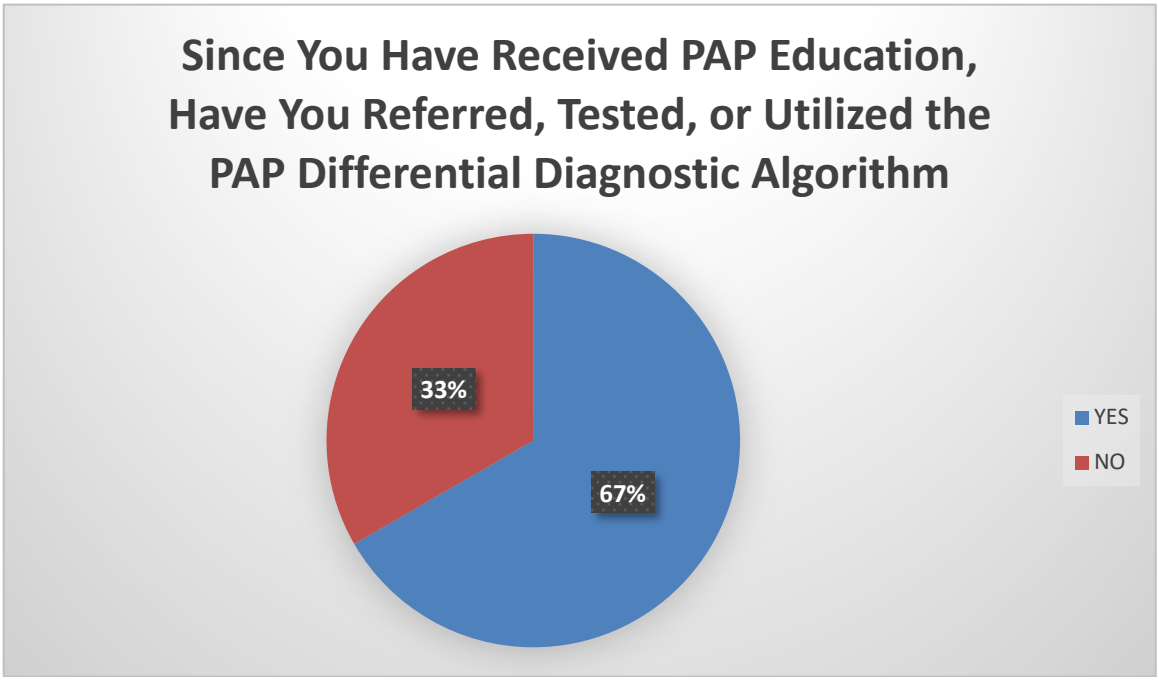
8-week Follow-up of all Respondents



After the education intervention, the final eight-week follow-up question asked the providers if they had identified a PAP patient. Mainly, this question sought if they had referred, tested, or utilized the PAP differential diagnostic algorithm. Six participants answered this question. As a result, 67% of responders said yes, and 33% said no (see Figure 10).

Figure 10

PAP Differential Diagnostic Algorithm Utilization



Descriptive Statistics

The Wilcoxon signed-rank test, a nonparametric test, was utilized to compare the two sets of scores from the study participants (Laerd Statistics, 2022). For this project, the Wilcoxon signed-rank test met all three assumptions. The dependent variable was measured at the ordinal level, utilizing a Likert scale to answer the questions. The independent variable was measured with two related groups as the same subjects were used. Lastly, the differences were examined between the same matched subjects through analysis of the pretest and the posttest utilizing the same dependent variable. Table two shows the Wilcoxon signed-rank for all questions. The total equaled nine, corresponding to the number of participants who completed both the pretest and the posttest questionnaires.

Table 2

Wilcoxon Signed-Rank Test

		N	Mean Rank	Sum of Ranks
PRETEST_1 - POSTTEST_1	Negative Ranks	8[a]	4.50	36.00
	Positive Ranks	0[b]	.00	.00
	Ties	1[c]		
	Total	9		
PRETEST_2 - POSTTEST_2	Negative Ranks	8[d]	4.50	36.00
	Positive Ranks	0[e]	.00	.00
	Ties	1[f]		
	Total	9		
PRETEST_3 - POSTTEST_3	Negative Ranks	7[g]	4.00	28.00
	Positive Ranks	0[h]	.00	.00
	Ties	2[i]		
	Total	9		
PRETEST_4 - POSTTEST_4	Negative Ranks	8[j]	4.50	36.00
	Positive Ranks	0[k]	.00	.00
	Ties	1[l]		
	Total	9		
PRE_TEST_5 - POST_TEST_5	Negative Ranks	7[m]	4.00	28.00
	Positive Ranks	0[n]	.00	.00
	Ties	2[o]		
	Total	9		

Utilizing SPSS software, the Wilcoxon signed-rank test analyzed and calculated the pretest, and the posttest questionnaire results. Table three shows the cumulative results of all five questions. All pretest versus posttest questions established statistical significance as they were all less than 0.05. Therefore, the Wilcoxon signed-rank test revealed a significant difference between the scores. In addition, Figure 11 provides a summary of pre and post-questions with median answer results.

Table 3

Statistical Results with the Wilcoxon Signed-Rank Test

Test Statistics[a]

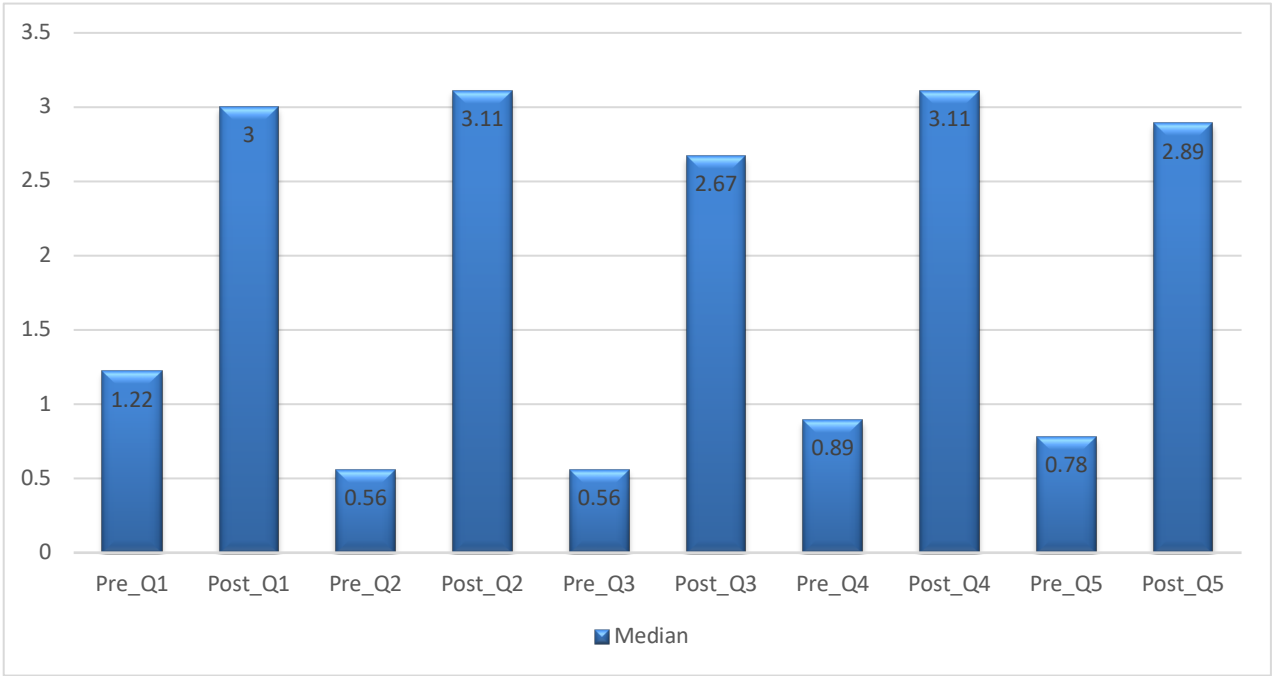
	PRETEST_1 - POSTTEST_1	PRETEST_2 - POSTTEST_2	PRETEST_3 - POSTTEST_3	PRETEST_4 - POSTTEST_4	PRE_TEST_5 - POST_TEST_5
Z	-2.549[b]	-2.555[b]	-2.401[b]	-2.533[b]	-2.401[b]
Asymp. Sig. (2-tailed)	.011	.011	.016	.011	.016

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Figure 11

Summary of Pre and Post questions with Median Answer Results



SECTION FIVE: DISCUSSION

Implications for Practice

Over 7,000 rare diseases remain challenging to diagnose since their clinical presentation can share similar diagnoses and present with similar symptoms (Morgenthau et al., 2022). Multiple studies have emphasized the medical community's need for education surrounding rare diseases (Ministry Reports, 2017; Haspel, 2021; NORD, 2019; Yaneva-Deliverska, 2011). This project affirmed the importance of rare disease education. Delivering education on the rare disease PAP and awareness of the differential diagnostic algorithm showed statistical significance. In addition, 100% of those who participated in the post-education case study utilized the differential diagnostic algorithm to correctly identify the type of PAP.

Furthermore, the pulmonary care providers that participated in the education intervention had not seen any PAP patients in their offices in nearly 20 years. Within the same week after receiving the education intervention, the pulmonary care prescribers identified a patient that presented with PAP and was able to utilize the differential diagnostic algorithm for subsequent laboratory workup. Due to this workup, the prescribers could classify the type of PAP the patient had.

On a larger scale, continuing and expanded education across the organization could bring greater awareness and impact to rare diseases and their diagnoses. Due to the infrequency of rare diseases, it would be advantageous for healthcare systems to build rare disease education modules. Highlighting rare diseases could benefit this healthcare system and others as it did with PAP and this education intervention.

Limitations

Limitations of this study include the small sample size. Only nine prescribers participated in the education intervention. Multiple attempts were made to expand the educational opportunity, including discussions with the outpatient practice administrator, the vice president of outpatient services, and the chief medical officer of the health system. Unfortunately, participation was low due to summer vacations, limited staff, and a high patient census. Therefore, a more extended enrollment period and a larger sample size may impact the education intervention differently. Another limitation of this study is that the sample was obtained from only one healthcare system.

Sustainability and Dissemination Plan

The results of this project were shared with the key stakeholders in the health system. The education modules will be available for the healthcare system to educate and train prescribers who could not participate in the study. In addition, the differential diagnostic algorithm was printed and used as a resource and reference in the pulmonary outpatient clinic.

Conclusion

This scholarly project supports the need for ongoing education for prescribers on rare diseases. Prescribers in a non-academic facility encounter rare diseases infrequently. Specifically, PAP is rarely seen in community practices, and patients and their families can suffer immensely. Furthermore, healthcare is impacted due to time to diagnosis and increased healthcare costs. The results of this project add to the current body of evidence that education on rare diseases affects prescribers. In addition, education on a differential diagnostic algorithm to aid in the correct PAP diagnosis adds to the prescriber's armamentarium of tools to apply to practice. As this project showed, by providing education, tools, and a sample case study,

prescribers improved their confidence levels in recognizing, diagnosing, treating, and providing patients with resources. Education on multiple types of rare diseases should be considered in community practices.

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Uchida, K., Nakata, K., Carey, B., Chalk, C., Suzuki, T., & Sakagami, T. et al. (2014). Standardized serum GM-CSF autoantibody testing for the routine clinical diagnosis of autoimmune pulmonary alveolar proteinosis. *Journal Of Immunological Methods*, *402*(1-2), 57-70. https://doi.org/10.1016/j.jim.2013.11.011

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U.S. Department of Health and Human Services. (2022). *National Institutes of Health*. Genetic and Rare Diseases Information Center. Retrieved October 24, 2022, from https://rarediseases.info.nih.gov/about

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Vandeborne, L., van Overbeeke, E., Dooms, M., De Beleyr, B., & Huys, I. (2019). Information needs of physicians regarding the diagnosis of rare diseases: A questionnaire-based study in Belgium. *Orphanet Journal Of Rare Diseases*, *14*(1). https://doi.org/10.1186/s13023-019-1075-8

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Appendix

A. Strengths of Evidence Table
B. CITI Certificate
C. Permission to Use Iowa Model
D. Permission to Reprint and Utilize the Differential Diagnostic Algorithm
E. The Differential Diagnostic Algorithm for Pulmonary Alveolar Proteinosis
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Appendix A

Strength of Evidence Table

Article Title, Author, etc.	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would Use as Evidence to Support a Change? (Yes or No) Provide Rationale
Alasiri, A., Alasbali, R., Alaqil, M., Alahmari, A., Alshamrani, N., & Badri, R. (2021). Autoimmune pulmonary alveolar proteinosis successfully treated with lung lavage in an adolescent patient: a case report. *Journal Of Medical Case Reports*, *15*(1). https://doi.org/10.1186/s13256-021-02906-2	A 15-year-old boy not known to have prior medical illness presented to our hospital emergency department (ED) with a history of shortness of breath upon climbing stairs and blue discoloration of his lips and extremities. There was no	Case study Of a 15-year old.	A qualitative case-study.	PAP is a rare interstitial lung disease with multiple types and clinical presentations. aPAP is not the usual form in children and adolescents. However, it should be considered in the differential diagnosis after excluding more common causes such as	Level six.	Small sample size and level six evidence.	Yes – this is one case study but provides information regarding the length of time to diagnosis in this rare disease state.

	history of cough, chest pain, palpitation, fever, or constitutional symptoms. Cyanosis was first noted by his parents on his hands three months before the recent presentation.			congenital and secondary forms. WLL should be the first-line treatment with or without inhaled rhGM-CSF.			
Ariel, B., Dvorakovskaya, I., Novikova, L., & Ilkovich, M. (2019). Pulmonary alveolar proteinosis: Own experience of diagnosis and treatment. *Journal Of Rare Diseases Research & Treatment*, *4*(2), 1-6. https://doi.org/10.29245/2572-9411/2019/2.1172	To discuss several key questions of diagnosis and treatment of this lung pathology again, using our new observations in comparison with the results that were	From 1977-2018, 85 cases of pulmonary alveolar proteinosis. 59 patients (69%) were male. Their mean age was 38± 9.8 years. 60 patients (71%) were smokers. In the	Mini review of cases.	The period from the first symptoms to biopsy taking was four-92 (average 34) months. Before the correct diagnosis of PAP every fourth patient was diagnosed with either	Level 5: literature review of case reports.	The authors didn't clearly describe if these patient were from multi-centers. The sample size was small; however, this is a rare disease.	This does provide some good information regarding the delay in diagnosis and the delay in treatment that these patients go through.

	published earlier.	anamnesis of 47 patients (55%) there were indications of the long-term work with acids, alkalis, gasoline.		pneumonia, tuberculosis, or sarcoidosis, in several rare cases – Langerhans' cells histiocytosis, idiopathic fibrosing alveolitis, and amyloidosis. The diagnosis of "double pneumonia" caused the administration of the massive antibacterial therapy for the duration of one month (on average), and sometimes much longer (up to 10 months).			

				As a rule, after a long period of unsuccessful pneumonia treatment, the diagnosis was revised in favor of tuberculosis, which resulted in the administration of a long specific chemotherapy and had negative effects on the patient's general condition. In addition, hepatotoxicity and other side effects has been often noted, hand in hand with increased			

				respiratory failure, etc. Fourteen patients (16%) were diagnosed wrongly with idiopathic fibrosing alveolitis. They received corticosteroid treatment for six months (on average). That caused pronounced adverse effects such as hyperglycemia, Cushing's syndrome, hypertension, etc. seven patients (8%) received, in addition, the immunosuppre			

				ssive treatment. Thus, along with clinical, radiological, biochemical studies etc. histological investigation was one of the most important stages of our work on the complex PAP diagnostics.			
Carey, B., McCarthy, C., Klingler, M., Greenberg, H., Chalk, C., & Toth, A. et al. (2019). US National Pulmonary Alveolar Proteinosis Registry: Update on Differential Diagnosis, Clinical Manifestations, and Current Therapy. *B103. ILD: THERAPY*. https://doi.org/10.1164/ajrccm-	To inform the diagnosis, epidemiology, presentation, pathogenesis, and treatment of PAP-causing diseases.	Initiated collaboratively by the Rare Lung Diseases Consortium and PAP Foundation in 2015. 143 patients who provided informed consent, completed questionnaires,	National Registry Questionnaire.	Autoimmune PAP was the most common PAP-causing disease and dyspnea was the most common symptom at presentation. A lung biopsy cannot identify any PAP-causing disease	Level five.	Not a randomized control trial but provides good information.	Yes – this is specific to the population aPAP in this rare disease state. This is a national registry of data to draw from.

conference.2019.199.1_meetingabstracts.a4084		granted access to medical records, and participated in a study to validate a novel GM-CSF autoantibody test for diagnosis of autoimmune PAP. Among registrants who completed the National Registry Questionnaire (n=84), the diagnosis of PAP was delayed by 1.1 0.3 years (mean SEM) after the onset of symptoms. Although lung biopsies fail to		and fails to identify the presence of PAP in some patients. In contrast, a blood test that is 100% sensitive and specific for autoimmune PAP is available for routine clinical use. Lung lavage remains the most common therapy of PAP, but GMCSF has been used in one-third of patients.			

		identify any PAP-causing disease, medical record review of 68 participants indicate that 51 (75%) of patients underwent lung biopsy (surgical 47%, transbronchial 43%, or both 10%) as part of their initial evaluation; 13% of biopsies failed to identify PAP. The median serum GM-CSF autoantibody level was 95 (IQR 54-185) mcg/ml in					

		autoimmune PAP patients and <3 mcg/ml in healthy controls. Epidemiology. Autoimmune PAP was the most common PAP-causing disease, accounting for 87% of registrants. Over half of autoimmune PAP patients (51.2%) had a history of smoking.					
Feld, L., Jennings, J., Fiorino, E., & Harris, M. (2019). Pulmonary Alveolar Proteinosis. *Pediatric Emergency Care*, *37*(9), e571-e573.	A case study of a profoundly hypoxemic 16-year-old girl who presented in minimal distress, with oxyhemoglobi	A 16 year old girl who was recently diagnosed with Raynaud syndrome, presented to the pediatric	A qualitative case study.	Pulmonary alveolar proteinosis is a rarely encountered cause of profound hypoxemia that	Level six.	Only one patient reviewed from only one institution.	Yes – this is a rare disease and presents valuable information on the length of time to a

https://doi.org/10.1097/pec.0000000000001820	n saturation of 63% on room air.	emergency department after being referred by her pediatrician. She had recently presented to her pediatrician with a six-month history of exertional dyspnea, cough, and a 13-lb unintentional weight loss.		is both diagnostically and therapeutically challenging. Initial therapeutic focus should be aimed at reversing the hypoxemia via supplemental oxygen along with positive pressure as necessary. Chest CT findings may be suggestive, but early consultation with pediatric pulmonary medicine is necessary as BAL to identify the typical milky appearing			diagnosis in PAP.

				proteinaceous lavage fluid is diagnostic.			
Hawkins, P., Chawke, L., Cormican, L., Wikenheiser-Brokamp, K., Fabre, A., Keane, M., & McCarthy, C. (2021). Autoimmune pulmonary alveolar proteinosis: a discrepancy between symptoms and CT findings. *The Lancet*, *398*(10296), e7. https://doi.org/10.1016/s0140-6736(21)01254-x	An important clinical feature of PAP is a discrepancy between the severity of chest CT findings and patients' symptoms—as seen in our patient whose symptoms were mild despite a markedly abnormal chest CT. GM-CSF autoantibody levels in serum are reported to be close to 100% sensitive and specific for autoimmune	A 50-year-old man with a two-year history of a dry cough and mild exertional dyspnea was referred to our lung disease clinic.	A qualitative case-study.	Taken together, the findings were consistent with a diagnosis of pulmonary alveolar proteinosis (PAP) syndrome. Serum concentration of antibodies to granulocyte-macrophage colony-stimulating factor (GM-CSF) was raised at 33 μg/mL (normal <5), confirming the diagnosis. Over the	Level six.	Case study of only one patient and one institution.	Yes – this provides valuable information on the importance of testing as it is 100% sensitive and specific to an aPAP diagnosis.

	PAP, and their measurement can prevent delay in the diagnosis.			subsequent 12 months, the patient reported increasing dyspnea on exertion and his pulmonary function tests declined. He is under consideration for whole lung lavage or inhaled recombinant GM-CSF therapy.			
Huaringa, A., & Francis, W. (2016). Pulmonary alveolar proteinosis: a case report and world Literature review. *Respirology Case Reports*, *4*(6). https://doi.org/10.1002/rcr2.201	A 52-year-old white male with a 60 pack-year history of cigarette smoking presented with progressive dyspnea on	Case report of a man who developed PAP syndrome following a two-year exposure to silica dust and subsequently reviewed the	Case report.	Our review of the world literature that includes 363 cases reported until now, reflects the evolution of science and technology in	Level six.	Case study of only one patient and one institution.	Yes – although this is level six, it sheds valuable information on the world literature review of 363 cases and the

	exertion for 18 months.	world literature where 363 cases were found.		determining different etiologies and diagnostic tests that lead to an improved perspective in the life of these patients.			improved diagnostic tests available.
Iftikhar, H., Nair, G., & Kumar, A. (2021). Update on Diagnosis and Treatment of Adult Pulmonary Alveolar Proteinosis. *Therapeutics And Clinical Risk Management*, *Volume 17*, 701-710. https://doi.org/10.2147/tcrm.s193884	This is a review to discuss the etiopathogenesis, diagnosis and treatment options available and emerging for PAP. PAP has an insidious onset and can, in some cases, progress to severe respiratory failure.	In a registry from Japan, only two-thirds of the patients were symptomatic at the time of diagnosis. Isolated dyspnea was the most common symptom, occurring in 39% of symptomatic patients, followed by dyspnea and	Review of descriptive studies.	Early diagnosis and targeted treatment remain the cornerstone of the management of PAP. The presence of circulating antibodies to GM-CSF is specific to auto-immune PAP and helps distinction from other types of PAP.	Level five.	There is a scarcity of randomized control trials in patients with PAP, given the rarity of the disease, making data interpretation difficult.	Yes -although this is a level five for evidence, this has valuable information to support the testing of serum GM-CSF autoantibody testing for an aPAP diagnosis.

		cough (11% of the symptomatic patients) and cough only (10% of the symptomatic patients). Other infrequent symptoms included fever and weight-loss.[3] The prevalence of smokers (56–80%) and occupational exposure to various inhaled dusts (23–39%) is high, especially with secondary PAP. Due to the role played by GM-CSF in immune mediated functions of		Circulating GM-CSF antibody titers may also predict response to treatment. It is noteworthy, though, that GM-CSF antibody can be found in healthy individuals. However, concentration less than 10 µg/mL in serum has a good negative predictive value to rule out disease, whereas concentration greater than 19 µg/mL is specific to auto-immune			

		alveolar macrophage function, patients with PAP are also at higher risk for systemic infections. Physical examination includes inspiratory crackles in about half of the patients, cyanosis is present in one-quarter of patients, and digital clubbing in a small percentage.		PAP. The latex agglutination test used for the detection of GM-CSF antibodies has a diagnostic sensitivity of 100% and specificity of 98%. This laboratory test is performed only at highly specialized centers.			
McCarthy, C., Avetisyan, R., Carey, B., Chalk, C., & Trapnell, B. (2018). Prevalence and	To determine the prevalence, and healthcare utilization and costs	Between 2004 and 2018, 249 patients confirmed to have PAP were	Interrogation of a large health insurance claims	Considering the high diagnostic accuracy of serum GM-	Level four.	None noted.	Yes – this could be utilized to support the project.

healthcare burden of pulmonary alveolar proteinosis. *Orphanet Journal Of Rare Diseases*, *13*(1). https://doi.org/10.1186/s13023-018-0846-y	associated with PAP.	evaluated to identify the PAP-causing disease; 91.5% had autoimmune PAP, 3% had hereditary PAP caused by GM-CSF receptor mutations, 4% had secondary PAP, and 1.5% had congenital PAP.	database containing comprehensive data for approximately 15 million patients in the United States. We also evaluated data from a referral-based diagnostic testing program collected over a 15-year period.	CSF autoantibody testing and predominance of autoimmune PAP, these results emphasize the importance of utilizing blood-based testing in PAP syndrome to identify the PAP-causing disease rather than invasive lung biopsies, resulting in earlier diagnosis, reduced morbidity, and lower healthcare costs.			
Nakata, K., Sugi, T., Kuroda, K., Yoshizawa,	As the ability to measure the level of GM-	78 patients with aPAP were	Case controlled study.	The logistic regression analysis of	Level four.	The presence of a few patients with	Yes – this provides a test that is reliable

K., Takada, T., & Tazawa, R. et al. (2020). Validation of a new serum granulocyte–macrophage colony-stimulating factor autoantibody testing kit. *ERJ Open Research*, *6*(1), 00259-2019. https://doi.org/10.1183/23120541.00259-2019	CSF autoantibody (GMAb) in the serum is required to decide the indication for this therapy, we developed a high-performance GMAb testing kit for clinical use.	prospectively enrolled at 12 hospitals. For the control, 90 healthy subjects were enrolled in this study on random basis as age- and sex-matched pairs with patients in this study.	An operator-blinded study with logistic regression analysis. As in the validation study, serum samples from another 213 patients with aPAP were also blinded and evaluated in an operator-blinded manner against external samples from patients with other types of PAP and patients exhibiting various ground-glass opacities on	these validation data sets revealed values of 97.6% and 100% for specificity and sensitivity, respectively. Thus, this new GMAb testing kit is reliable for the diagnosis of aPAP and differential diagnosis of other lung diseases.		conditions other than aPAP and positivity for serum GMAb cautions us against diagnosing aPAP based exclusively on GGO findings on HRCT and the concentration of GMAb in the serum, without other clinical features including pathological evidence.	and valid to test and diagnose aPAP.

			chest high-resolution computed tomography that require discrimination from PAP.				
Nishimura, M., Yamaguchi, E., Takahashi, A., Asai, N., Katsuda, E., & Ohta, T. et al. (2018). Clinical significance of serum anti-GM-CSF autoantibody levels in autoimmune pulmonary alveolar proteinosis. *Biomarkers In Medicine*, *12*(2), 151-159. https://doi.org/10.2217/bmm-2017-0362	Examine the relationship between αGMAb levels and the natural clinical course of aPAP.	Obtained sera from 50 healthy controls, 46 aPAP patients, 50 with sarcoidosis, 52 with idiopathic interstitial pneumonia and 75 with pneumoconiosis. The clinical course of aPAP patients was assessed by scoring computed tomography images in 19 patients.	Retrospective Study.	The cut-off level of anti-GM-CSF IgG for discrimination between aPAP and other diffuse lung diseases was 2.8 μg/ml with 100% sensitivity and 98% specificity. Antibody levels at baseline were significantly lower in the improved group than in	Level 3: retrospective trial.	There were significant differences in sex distribution, ages, and respiratory function among study populations. But those differences were essential due to variation inherent to individual populations. However, since there was a	Yes – this provides valuable information on GMAb sensitivity for the diagnosis of aPAP.

				the unimproved group (p = 0.008). Results indicate the existence of threshold levels of serum anti-GM-CSF IgG for the development and persistence of aPAP.		significant positive correlation between αGMAb and ages in HC, slightly elevated αGMAb levels in pneumoconiosis patients could be explained by the relatively high median age of this population.	
Oudah, M., & Slack, D. (2021). Mild dyspnea presenting as 'crazy-paving' on chest computed tomography. *Journal Of Community Hospital Internal Medicine Perspectives*, *11*(2), 273-276.	Investigation revealed the presence of serum anti-granulocyte-macrophage colony-stimulating factor (GM-CSF) auto-antibody	46-year-old man, former smoker, was admitted to the hospital initially with alcohol intoxication. He reports drinking 'large amount' of	A qualitative case study.	Autoimmune pulmonary alveolar proteinosis was suspected based on his initial CT findings and confirmed by subsequent pathologic and	Level six.	Only one patient.	No – this is level six evidence but does provide some context to the issue in this rare disease state.

https://doi.org/10.1080/20009666.2020.1860443	diagnostic of protein alveolar proteinosis. He had mild symptoms and was managed conservatively. Follow-up in four months revealed continuous mild shortness of breath with exertion not meeting the criteria for whole lung lavage.	alcohol at his friend's house the night before. He consumes one pint of tequila per week. During his admission for alcohol detoxification, he endorsed progressive dyspnea on exertion that started four months ago with a non-productive cough. Cough was dry with no hemoptysis or wheezing. He used to run every morning but recently noticed he cannot run as far as before.		serologic testing. The presence of IgG anti-GM-CSF antibodies is highly sensitive and specific for autoimmune PAP. Given our patient's mild symptoms, he was managed conservatively. Follow-up in four months revealed continuous mild shortness of breath with exertion still not meeting the criteria for whole lung lavage. Familiarity with the key clinical and			

				diagnostic features of pulmonary alveolar proteinosis will help raise awareness and potential new treatment options.			
Salvaterra, E., & Campo, I. (2020). Pulmonary alveolar proteinosis: from classification to therapy. *Breathe*, *16*(2), 200018. https://doi.org/10.1183/20734735.0018-2020	To update knowledge about a rare respiratory syndrome, pulmonary alveolar proteinosis, to promote early diagnosis and correct management. To highlight recent treatment options based on	Classification and therapy.	Expert Opinion.	Considering that autoimmune PAP is the most frequent cause of PAP syndrome, serum GM-CSF autoantibody titration should be the first diagnostic test his diagnostic test shows a sensitivity and specificity of 100% for	Level seven.	n/a	Although not a strong level of evidence, this provides valuable information regarding the 100% specificity to the GMAb testing and early diagnosis.

	pathogenesis and disease severity.			autoimmune PAP. Early diagnosis and subsequent appropriate management could result in a marked clinical improvement for the affected patient. Primary PAP is led by a granulocyte–macrophage colony-stimulating factor (GM-CSF) signaling disruption; the autoimmune form is driven by the presence of anti GM-CSF autoantibodies			

				and represents 90% of all the PAP cases.			
Sheng, G., Chen, P., Wei, Y., Chu, J., Cao, X., & Zhang, H. (2018). Better approach for autoimmune pulmonary alveolar proteinosis treatment: inhaled or subcutaneous granulocyte-macrophage colony-stimulating factor: a meta-analyses. *Respiratory Research*, *19*(1). https://doi.org/10.1186/s12931-018-0862-4	To evaluate whether GM-CSF therapy, including inhaled and subcutaneous GM-CSF have therapeutic effect in aPAP patients.	Ten observational studies involving 115 aPAP patients were included.	Meta-analysis to analyze 10 studies searched from PubMed, EmBase, Web of Science, Wiley Online Library and Cochrane Collaboration databases to evaluate the pooled effects of GM-CSF treatment in aPAP patients.	The pooled analyses of response rate (81%, $p < 0.001$), relapse rate (22%, $p = 0.009$), PaO_2 (13.76 mmHg, $p < 0.001$) and P(A-a)O_2 (19.44 mmHg, $p < 0.001$) showed that GM-CSF treatment was effective on aPAP patients. Further analyses showed that inhaled GM-CSF treatment was more effective than	Level one.	Drawbacks of this study were the differences in baseline measurement among included studies, containing age, gender, disease severity, treatment dose and duration etc. Second, aPAP is a rare disease with low prevalence, most research of this disease	Yes – level one provides the highest level of evidence as this is a synthesis of evidence from all randomized trials.

				subcutaneous GM-CSF therapy, including a higher response rate (89% vs. 71%, $p = 0.023$), more improvements in PaO_2 (21.02 mmHg vs. 8.28 mmHg, $p < 0.001$) and P(A-a) O_2(19.63 mmHg vs. 9.15 mmHg, $p < 0.001$).		were studies with small sample. More large-scale samples and long-term follow-up studies are needed in the future. Third, all the studies included were observational studies, three abstracts of randomized controlled trials (RCTs) were found, however, full texts of these RCTs were not available.	

Skov, I., Bendstrup, E., & Davidsen, J. (2018). Pulmonary alveolar proteinosis – a crazy presentation of dyspnea. *European Clinical Respiratory Journal*, *6*(1), 1552065. https://doi.org/10.1080/20018525.2018.1552065	A 44-year-old man with an active smoking history of 50 pack-years was referred to the local Department of Respiratory Medicine due to at least one year of declining general condition with recurrent episodes of acute respiratory worsening interpreted as pneumonias, weight loss of 10 kg, fatigue, dry cough, and progressive dyspnea.	This case report of a 44-year old man, presenting with recurring clinical pneumonias during a period of over one year.	Case report.	PAP often debuts with insidious dyspnea at exertion and dry cough which resembles a wide range of respiratory differential diagnoses. Patients with PAP related symptoms are at high risk of years of delayed diagnostics. Once diagnosed, it is recommended that the patients are managed and followed in specialized expert centers.	Level five.	Only one case at one institution.	Not a high level of evidence but does provide valuable information regarding the one year delay in diagnosis.

				In this case report, we describe that a crazy paving pattern in combination with specific blood assays and bronchoscopic examination made the diagnosis of the rare syndrome PAP.			

Sugino, K., Ando, M., Mori, K., & Tsuboi, E. (2018). Autoimmune pulmonary alveolar proteinosis presenting peripheral ground-glass opacities. *Respirology Case Reports*, *7*(1), e00385. https://doi.org/10.1002/rcr2.385	Autoimmune pulmonary alveolar proteinosis should be considered in the differential diagnosis of peripheral ground-glass opacities.	A 41 year old man that presented for his annual checkup. No history of smoking.	Case Report.	Pulmonary alveolar proteinosis should be considered in the differential diagnosis of peripheral GGO. Patients with aPAP were often misdiagnosed as other interstitial lung diseases and treated with corticosteroids. As indicated by Akasaka et al., corticosteroid therapy may worsen the disease severity in aPAP and increase the risk of infections.	Level five: case report.	None reported.	Although this is a level 5, this provides great information that shows delay in diagnosis and how patients can be put on medication that can worsen disease.

Tazawa, R., Ueda, T., Abe, M., Tatsumi, K., Eda, R., & Kondoh, S. et al. (2019). Inhaled GM-CSF for Pulmonary Alveolar Proteinosis. *New England Journal Of Medicine*, *381*(10), 923-932. https://doi.org/10.1056/nejmoa1816216	To test the hypothesis that inhaled GM-CSF would improve oxygenation, findings on lung imaging, and levels of serum markers in patients with mild-to-moderate pulmonary alveolar proteinosis. The primary end point was the change in the alveolar–arterial oxygen gradient between baseline and week 25, as described previously.	64 patients with mild-to-moderate autoimmune pulmonary alveolar proteinosis were deemed to be eligible to participate in the trial and were randomly assigned to either the GM-CSF group (33 patients) or the placebo group (31 patients).	A double-blind, placebo-controlled trial of daily inhaled recombinant human GM-CSF (sargramostim), at a dose of 125 μg twice daily for seven days, every other week for 24 weeks, or placebo in 64 patients with autoimmune pulmonary alveolar proteinosis who had a partial pressure of arterial oxygen (Pao_2) while breathing ambient air of	The change in the mean (±SD) alveolar–arterial oxygen gradient was significantly better in the GM-CSF group (33 patients) than in the placebo group (30 patients) (mean change from baseline, −4.50±9.03 mm Hg vs. 0.17±10.50 mm Hg; P=0.02).	Level two.	Only one dose of GM-CSF was tested. Only one type of nebulizer was used for inhalation therapy. The lyophilized formulation of recombinant human GM-CSF that was used in this trial required patients to dissolve the agent in saline before inhalation.	Yes – level two provides a high level of evidence to support its use.

	This end point was compared between the GM-CSF group and the placebo group.		less than 70 mm Hg (or <75 mm Hg in symptomatic patients).				
Trapnell, B., Inoue, Y., Bonella, F., Morgan, C., Jouneau, S., & Bendstrup, E. et al. (2020). Inhaled Molgramostim Therapy in Autoimmune Pulmonary Alveolar Proteinosis. *New England Journal Of Medicine*, *383*(17), 1635-1644. https://doi.org/10.1056/nejmoa1913590	The primary end point was the change from baseline in the alveolar–arterial difference in oxygen concentration (A-aDo_2) at week 24. Key secondary end points that informed direct patient benefit included the mean change from baseline	The trial was conducted at 34 sites in 18 countries. 138 patients underwent randomization; 46 were assigned to receive continuous molgramostim, 45 to receive intermittent molgramostim, and 47 to receive placebo.	A double-blind, placebo-controlled, three-group trial, we randomly assigned patients with aPAP to receive the recombinant GM-CSF molgramostim (300 μg once daily by inhalation), either continuously or	Improvement was greater among patients receiving continuous molgramostim than among those receiving placebo (−12.8 mm Hg vs. −6.6 mm Hg; estimated treatment difference, −6.2 mm Hg; P=0.03 by comparison of least-squares means).	Level two.	An important limitation of the trial was that, in four patients, 82measurement related to the A-aDo_2were obtained while supplemental oxygen was being administered. Another limitation of the trial was the short (24-	Yes – this is a randomized control trial that was well represented in 18 countries.

	to week 24 in functional health status.		intermittently (every other week), or matching placebo.	Patients receiving continuous molgramostim also had greater improvement than those receiving placebo for secondary end points, including the change from baseline in the St. George's Respiratory Questionnaire total score at week 24 (−12.4 points vs. −5.1 points; estimated treatment difference, −7.4 points; P=0.01 by comparison of		week) duration of the blinded intervention period Further studies are needed to define the duration of treatment required for maximal treatment benefit and to evaluate the potential use of differential dosing for induction and maintenance therapy.	

				least-squares means).			
Uchida, K., Nakata, K., Carey, B., Chalk, C., Suzuki, T., & Sakagami, T. et al. (2014). Standardized serum GM-CSF autoantibody testing for the routine clinical diagnosis of autoimmune pulmonary alveolar proteinosis. *Journal Of Immunological Methods*, *402*(1-2), 57-70. https://doi.org/10.1016/j.jim.2013.11.011	The purpose of the present study was to optimize the GMAb ELISA with respect to reagents, experimental protocol, and analysis methods, and then validate it by rigorously establishing its sensitivity, accuracy, precision, and ruggedness to support its clinical use for the diagnosis of autoimmune PAP.	Participants included patients with autoimmune PAP (n = 96; 45.8 % male; 37.3 ± 15.7 years of age at evaluation. Healthy people (n = 58; 22.4 % male; 30.6 ± 7.0 years of age at evaluation) who were nonsmokers with no history of major illness and symptom-free at the time of evaluation.	Case-control study. The GMAb ELISA was evaluated using serum specimens from autoimmune PAP patients, healthy people, and GMAb-spiked serum from healthy people.	The assay performed very well in distinguishing patients with autoimmune PAP from healthy people. These results facilitate the comparison of serum GMAb concentration testing obtained in different laboratories thereby facilitating research on this rare disease.	Level four.	One limitation of the GMAb ELISA is that it measures both neutralizing and non-neutralizing GMAbs.	Yes – this presents positive information that contributes to the diagnosis of aPAP.

				These results help establish a basis for the routine clinical use of the GMAb ELISA for diagnosis of autoimmune PAP.			

Appendix B

CITI Certificate

Appendix C

Permission to Use Iowa Model

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.

The Iowa Model Revised (2015)

Reference: Iowa Model Collaborative. (2017). Iowa model of evidence-based practice: Revisions and validation. *Worldviews on Evidence-Based Nursing, 14(3), 175-182. doi:10.1111/wvn.12223*

Appendix D

Permission to Reprint and Utilize the Differential Diagnostic Algorithm

Good morning [redacted]- I am a Doctor of Nursing student at Liberty University.

For my scholarly project, I want to educate advanced practice providers on the PAP differential diagnosis algorithm you have created and published.

Would you be willing to grant me approval to print and utilize this algorithm as a part of the scholarly project? Moreover, potentially publishing the results? If yes, could you email your approval to me, please?

Thank you.

Cathy

Cathy Poisson MSN RN CNS CCRN
M: [redacted]
E: [redacted]

Hi Cathy,

I spoke with [redacted] this morning about your question.
He says that you have permission to use the algorithm.

Thank you.

[redacted]

Appendix E

The Differential Diagnostic Algorithm for Pulmonary Alveolar Proteinosis

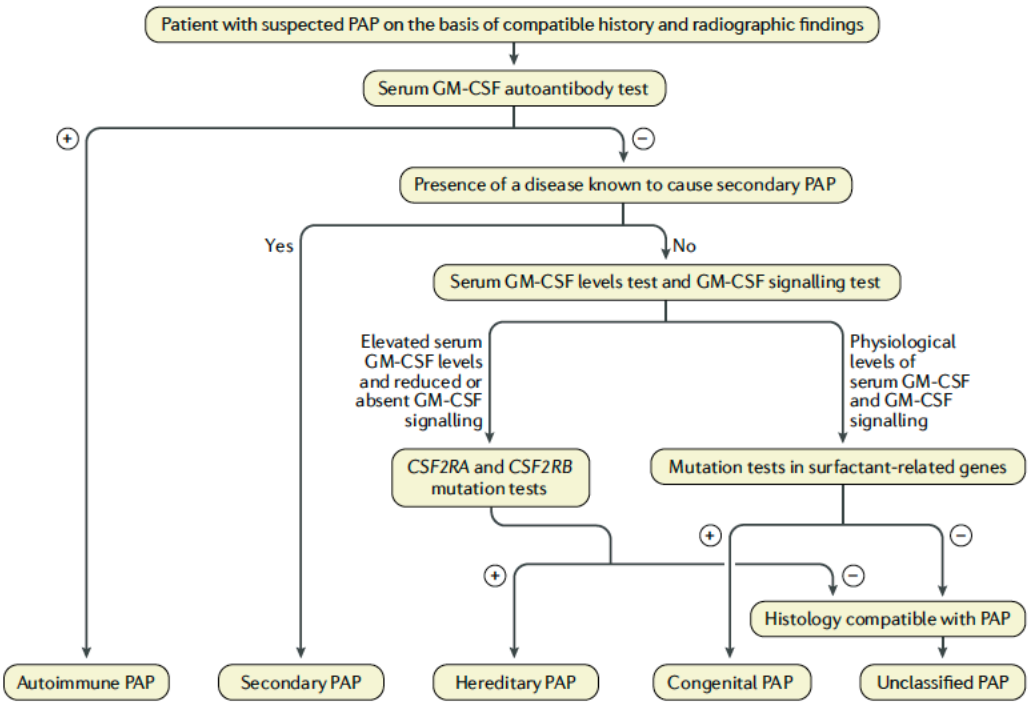


Fig. 2 | **Algorithm for the differential diagnosis of PAP.** The presence of pulmonary alveolar proteinosis (PAP) is suspected on the basis of a compatible history, typical radiological findings and bronchoalveolar lavage cytology findings. A granulocyte–macrophage colony-stimulating factor (GM-CSF) autoantibody test should be performed first: a positive test confirms the diagnosis of autoimmune PAP. Patients with a negative GM-CSF autoantibody test who have a disease known to cause PAP are diagnosed with secondary PAP. If an underlying causative condition cannot be found, patients should undergo a blood-based GM-CSF signalling test and serum GM-CSF levels test; high concentrations of serum GM-CSF and no or reduced GM-CSF signalling should prompt further tests for *CSF2RA* and *CSF2RB* mutations to identify hereditary PAP. Patients with physiological levels of serum GM-CSF and GM-CSF signalling should undergo further tests for other gene mutations to diagnose congenital PAP. If no PAP-causing mutation can be found, the patient is diagnosed with unclassified PAP and a transbronchial or surgical lung biopsy for lung parenchymal histopathological examination may be needed to confirm diagnosis. This diagnostic algorithm reflects an ideal setting in which physicians have unrestricted access to the appropriate diagnostic tools and tests.

Appendix F

Permission to Use the Case Study

[redacted]

Mon 5/2/2022 10:20 PM

Hi Cathy,
I apologize for the delay in returning your email. Please go ahead and use the article as you wish.
Best,
[redacted]

On Mon, May 2, 2022, at 1:48 PM, Poisson, Cathy J [redacted] wrote:

From: Poisson, Cathy J
Sent: Wednesday, April 20, 2022, 9:17 AM
To: [redacted]>
Subject: Case Study Utilization

Good afternoon [redacted] - I am a student at Liberty University completing my Doctor of Nursing Practice program.
I would like to utilize your case study from Pediatric Emergency Care, September 2021, Volume 37 (9), p e571–e573, DOI:10.1097/PEC.0000000000001820.

For my scholarly project, I would use this case study in conjunction with an evidence-based learning module in primary and pulmonary care clinics.

Could I gain your approval to utilize this case study? If yes - would you be so kind responding to this email with your approval?

Thank you.

Cathy Poisson
[redacted]

Appendix G

IRB Approval From Liberty University

Date: 5-12-2022

IRB #: IRB-FY21-22-815
Title: AN EDUCATION INTERVENTION PROJECT IN COMMUNITY CLINICS TO IMPROVE THE IDENTIFICATION OF PATIENTS WITH PULMONARY ALVEOLAR PROTEINOSIS AND TO CORRECTLY IDENTIFY THE TYPE UTILIZING THE DIFFERENTIAL DIAGNOSTIC ALGORTIHM
Creation Date: 3-1-2022
End Date:
Status: Approved
Principal Investigator: Catherine Poisson
Review Board: Research Ethics Office
Sponsor:

Study History

Submission Type Initial	Review Type Exempt	Decision No Human Subjects Research

Key Study Contacts

Member Debra Maddox	Role Co-Principal Investigator	Contact [redacted]
Member Catherine Poisson	Role Principal Investigator	Contact [redacted]
Member Catherine Poisson	Role Primary Contact	Contact [redacted]

Appendix H

Site Approval from Riverview Health

May 2, 2022
Ms. Catherine Poisson, RN, DNP Candidate

RE: Research Proposal
Dear Cathy,
On behalf of Riverview Health, we have reviewed your research proposal titled "An Education Intervention Project in Community Clinics to Improve the Identification of Patients with Pulmonary Alveolar Proteinosis and to Identify the Type Utilizing the Differential Diagnostic Algorithm Correctly." Currently, your research study is exempt from Riverview Health's Institutional Review Committee in that the research involves staff education and questionnaires and does not involve any patient data or protected information.
Should you have further questions, please do not hesitate to contact us.

Sincerely,
[redacted]
Chairperson, Institutional Review Committee Chief Medical Officer

Appendix I

Informed Consent

SCHOLARLY PROJECT: IRB-FY21-22-815. AN EDUCATION INTERVENTION PROJECT IN COMMUNITY CLINICS TO IMPROVE THE IDENTIFICATION OF PATIENTS WITH PULMONARY ALVEOLAR PROTEINOSIS AND TO CORRECTLY IDENTIFY THE TYPE UTILIZING THE DIFFERENTIAL DIAGNOSTIC ALGORITHM
Cathy Poisson Liberty University Doctor of Nursing Practice Program, School of Nursing
You are invited to participate in an evidence-based practice project to increase your awareness of Autoimmune Pulmonary Alveolar Proteinosis presenting signs and symptoms, treatment, and the availability of a differential diagnostic algorithm that determines the type and further testing. You were selected as a potential participant since you interact with patients who present with pulmonary symptoms as a part of your job. Please read this form carefully and ask any questions you may have before consenting to participate in this project.
Purpose of this Project: The purpose of this project is to deliver education to the pulmonary and primary care providers at Riverview Health's outpatient clinics on the signs, symptoms, treatment, and patient resources for pulmonary alveolar proteinosis, as well as education of the differential diagnostic algorithm to identify the type of pulmonary alveolar proteinosis. The goal is to continue to build on the excellent care already being provided to patients by providing education about this rare disease and identifying patients presenting with symptoms for an earlier diagnosis.
Participant Responsibilities: If you consent to participate in this project, you will be asked to:
1. Complete this consent form.
2. Take a pretest, review a PowerPoint presentation, and then take a posttest. The content concerns Pulmonary Alveolar Proteinosis and its signs, symptoms, treatment, and patient resources. The differential diagnostic algorithm will be introduced for PAP which identifies the type of PAP. This will take approximately 30 minutes to complete.
3. Eight weeks after completing the educational intervention, you will receive a post-follow-up survey to evaluate your learning. This will take approximately five to ten minutes to complete. All responses will remain confidential.
Risks and Benefits: There are no identified risks to you for participating in this project other than those encountered in everyday life. The direct benefits you should expect from participating in this project include improving your knowledge about pulmonary alveolar proteinosis and integrating your knowledge into your practice to optimize outcomes. This knowledge will build on the excellent care you already provide at Riverview Health.
Compensation: A lunch and learn will be provided during the PowerPoint education presentation. If you cannot attend the lunch and learn and opt for the digital learning platform, you will receive a $10.00 coffee card after completing the follow-up survey.
Confidentiality: The records of this project will be kept confidential. Any record that may be published will not include any information that will make it possible to identify a participant. Records will be stored securely with special encrypting software, and only the project leader will have access to the records. The project leader may share non-identifying data from this study to use in future research studies or with other researchers; if the data collected about you is shared, all identifying information will be removed before I share the data.
Voluntary Nature of the Project: Participation in this project is voluntary. Your participation will not affect your current or future relations with Liberty University or Riverview Health. If you decide to participate, you are free not to answer any question or withdraw at any time without affecting those relationships.
How to Withdraw from the Project: If you choose to withdraw, please contact the project leader at the email address/phone number in the next section. If you withdraw from this study, data collected from you will be destroyed immediately and will not be included in the project.
Contacts and Questions: The project leader conducting this project is Cathy Poisson, RN, MSN. You are encouraged to ask any questions you may have at this time. If you have questions later, you are encouraged to contact the project leader at [redacted] 217-460-6888. If you have any questions or concerns regarding this project and want to talk to someone other than the project leader, you are encouraged to contact Liberty University's Institutional Review Board, 1971 University Blvd., Green Hall Ste. 1887, Lynchburg, VA 24515, or email at irb@liberty.edu.

Appendix J

Pre-education Questionnaire

Pre-education Questionnaire

1. How many years of experience in the outpatient clinic setting do you have

0-2_____

3-6_____

7-10_____

Greater than 10_____

2. Which type of clinic are you in?

Primary Care_____

Pulmonary Care_____

3. What type of provider are you?

Nurse practitioner_____

Physician Assistant_____

MD_____

DO_____

4. Have you received education through a seminar or conference on pulmonary alveolar proteinosis?

YES_____

NO_____

Appendix K

Pretest

Pretest Questionnaire

1. How confident are you in identifying patients presenting signs and symptoms of PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

2. How confident are you in utilizing the PAP differential diagnostic algorithm to determine the type of PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

3. What is your confidence level in ordering the test(s) needed to diagnose patients with PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

4. What is your confidence level in prescribing treatment, referrals, or clinical trials for patients diagnosed with PAP?

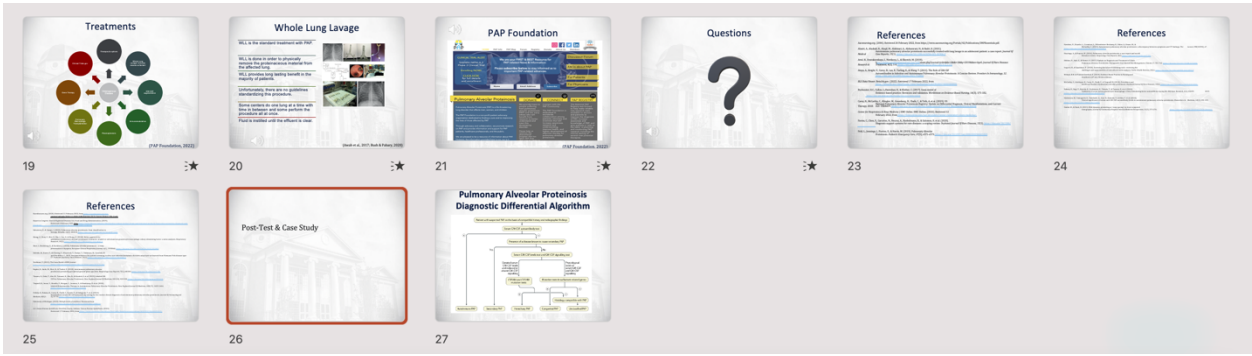
NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

5. What is your confidence level in providing PAP patients with resources and information on their disease?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

Appendix L

Intervention Education Slides



Appendix M

Posttest

Posttest Questionnaire

1. How confident are you in identifying patients presenting signs and symptoms of PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

2. How confident are you in utilizing the PAP differential diagnostic algorithm to determine the type of PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

3. What is your confidence level in ordering the test(s) needed to diagnose patients with PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

4. What is your confidence level in prescribing treatment, referrals, or clinical trials for patients diagnosed with PAP?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

5. What is your confidence level in providing PAP patients with resources and information on their disease?

NONE	SOMEWHAT	MILDLY	MODERATE	VERY
1	2	3	4	5

Appendix N

Eight-Week Follow-up Questionnaire

Eight-Week Post Follow-Up Questionnaire

1. Are you confident in identifying patients presenting signs and symptoms of PAP? YES NO
2. Are you confident in utilizing the PAP differential diagnostic algorithm to determine the type of PAP? YES NO
3. Are you confident in ordering the test(s) needed to diagnose patients with PAP? YES NO
4. Are you confident in providing patients with resources and information for their disease? YES NO
5. Since You Have Received PAP Education, Have You Referred, Tested, or utilized the PAP Differential Diagnostic Algorithm? YES NO