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Abstract

Introduction: The purpose of this pilot study was to determine the perceptions of respiratory therapists' satisfaction with their current education level, belief in the value of advanced education, and opportunities and barriers influencing perceptions of obtaining advanced education. **Methods:** An online self-administered questionnaire was developed and distributed to approximately 1,300 respiratory therapists and program directors using a web-based survey platform. Survey responses were analyzed using descriptive statistics. **Results:** Most participants (80.0%) indicated satisfaction with their education level, and more than 70% agreed that there is value in furthering their education. Most participants (63.1%) agreed that the profession will provide future job opportunities and that furthering their education will affect other job opportunities. Participants reported that lack of time (28.2%), limited finances (25.8%), personal circumstances (20.2%), and lack of support (12.1%) were barriers to advanced education. **Conclusions:** Participants in this study had positive perceptions of obtaining advanced education for current and future job opportunities in respiratory therapy. Perceived barriers may present challenges for respiratory therapists considering advanced education at the baccalaureate and graduate levels. Future research should support the value of obtaining higher levels of respiratory therapy education for improving patient care outcomes and elevating professional growth.

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Introduction

Respiratory therapists have been integral healthcare team members for decades, but the public and other health professionals have not understood their role as clinicians. The COVID-19 pandemic changed that by highlighting the respiratory therapist's role as a healthcare professional on the frontlines caring for patients needing extensive critical care support. In addition, the recent emergence of the Advanced Practice Respiratory Therapist (APRT) as a new advanced practice provider further demonstrates the need for highly educated and skilled clinicians to provide complex cardiopulmonary care.[1] Respiratory therapists who want to become an APRT are required to obtain a minimum of a master's degree from a program accredited by the Commission on Accreditation for Respiratory Care (CoARC).[34] While the associate degree remains the most common education level for respiratory therapy entry into practice, current trends suggest that respiratory therapy education programs at the baccalaureate and graduate levels are increasing.[2-4] For nearly 30 years, the respiratory therapy peer-reviewed literature has documented the need for respiratory therapists to have increased knowledge and advanced skills to meet future healthcare needs.[5-12] In 2016, the American Association for Respiratory Care (AARC) approved recommendations from the Taskforce on Competencies for Entry into Respiratory Practice, delineating competencies needed before entry to practice and those obtained after graduation.[13] The recommendations emphasized the importance of practicing respiratory therapists continuing their development post-graduation to achieve the additional competencies. In addition, CoARC announced its revision process of the entry to practice standards to differentiate competencies based on degree level.[14]

Access to Baccalaureate and Graduate Respiratory Therapy Education

While the number of baccalaureate and graduate respiratory therapy degrees is increasing, there still needs to be more sufficient numbers of graduates to meet workforce needs. According to the National Board for Respiratory Care (NBRC), respiratory therapy programs have experienced a decrease of 27% in enrollment since 2010, with only about 10% of programs currently meeting enrollment capacity.[35] Of the 449 CoARC accredited entry-to-practice programs reported in the CoARC 2023 Report on Accreditation in Respiratory Care Education, 19% were at the baccalaureate or graduate level compared to 12% in 2011.[4] The number of baccalaureate and graduate entry to practice programs have increased 40% between 2011 and 2023. The fastest growing number of respiratory therapy programs were baccalaureate and graduate degree advancement programs, with 29 CoARC-accredited programs available, making up approximately 7% of the total number of CoARC-accredited programs in the United States.[4] In addition, in a 2023 report, five degree advancement programs with approved letters of intent and another five submitted letters of intent were set to begin the CoARC accreditation process.

The number of respiratory therapy graduates from entry-to-practice baccalaureate programs reflects the percentage of available programs. However, with the availability of degree advancement programs offered online, respiratory therapists with associate degrees have access to continue their education. Keene et al.[3] reported that among the respiratory therapists in their research study, 66.1% held a baccalaureate degree or higher. Becker and Nguyen[2] reported that among respiratory therapists who completed an entry-to-practice associate degree, nearly 21% were pursuing a higher academic degree.

Value of Baccalaureate and Graduate Respiratory Therapy Education

AARC supports the need to advance the minimum education of a respiratory therapist to the baccalaureate level to meet the increasing levels of expertise and competency required for clinical practice and leadership roles.[12] Throughout the last 20 years, evidence suggests that respiratory therapy managers prefer hiring respiratory therapists with a baccalaureate degree or higher. Becker reported that 70% of managers preferred hiring experienced respiratory therapists with baccalaureate degrees, especially respiratory therapy degree majors.[16] Kaczmarek et al.[17] found that respiratory therapy department directors had mixed preferences for hiring new graduate respiratory therapists with baccalaureate degrees or higher than an associate degree. However, most department directors (72%) favored having a baccalaureate degree or higher to advance in practice. In a more recent study, Varekojis et al.[18] indicated that among respiratory therapy department directors and managers, 70.6% preferred hiring respiratory therapists with a baccalaureate degree, with 80.6% indicating a preference for hiring new graduates with a baccalaureate degree in the next five years. Reasons for hiring baccalaureate-prepared respiratory therapists included providing value to the department, being prepared to work effectively with the interprofessional health care team, being prepared for professional advancement, being able to meet department needs, being able to provide evidence-based respiratory care, the ability to communicate effectively, and providing quality patient care. Of the department directors and managers participating in the study, 92% held a baccalaureate degree or higher.

While respiratory therapy department hiring and promotion practices are important drivers of higher levels of education among respiratory therapy staff, perceptions of personal and professional value among respiratory therapists seeking higher academic degrees may offer additional insight into the need for more respiratory therapists with baccalaureate and graduate degrees. In a study of New York respiratory therapists, most respondents agreed that growth and upward mobility (e.g., clinical ladder) followed by an increased scope of practice were necessary incentives for retention.[19] Most

participating respiratory therapists (64%) agreed that the AARC should support increasing the minimum education level to a respiratory therapy baccalaureate degree. Haan et al. reported that respiratory therapy baccalaureate degree students' perceived value of the degree, including an increased understanding of medical research, improved ability to communicate with other healthcare professionals and patients, increased confidence as a respiratory therapist, and an overall sense of pride.[20]

Most available research comprises the perceived value of baccalaureate and graduate respiratory therapy degrees. However, evidence is emerging that suggests higher levels of education have a positive impact on patient outcomes. The nursing profession continues to provide proof that having a higher proportion of baccalaureate-prepared nurses (BSN) improves patient outcomes by enhancing quality and safety, reducing readmission rates, shorter lengths of stay, and decreasing mortality.[21-26] Recent evidence suggests that higher levels of respiratory therapy education impact patient outcomes. In a pilot study, Gresham-Anderson et al. reported that clinical partners with greater than 90% of their staff with the RRT credential and greater than 33% with baccalaureate degrees were at or better than the national average on COPD 30-day mortality, pneumonia mortality, post-operative respiratory failure, and post-operative pneumothorax.[27] Kaur and colleagues found that patients with COVID-19 pneumonia receiving mechanical ventilation were more likely to be discharged home with more than 85% exposure to respiratory therapists with at least a baccalaureate or adult critical care competencies.[28] More research is needed in this area to consistently demonstrate the positive impact of respiratory therapy advanced degrees on patient outcomes.

Challenges to Obtaining Baccalaureate and Graduate Respiratory Therapy Education

The argument for obtaining higher levels of respiratory therapy education is supported by the increasing evidence of perceived and realized value in patient care and professional growth. However, respiratory therapists face challenges in pursuing further education. Badgley and Koster found that most respiratory therapists (64%) in Illinois were not interested in pursuing a baccalaureate degree regardless of their employer's availability of tuition assistance, citing lack of time, financial gain, or advancement opportunities.[29] Additional findings indicated that those respiratory therapists who participated had an average of 15 years until retirement. However, respiratory therapists with baccalaureate degrees indicated that the degree improved their bedside care and increased opportunities for advancement. Because of the perceived lack of financial gain and advancement opportunities, many respiratory therapists planned to obtain a baccalaureate or graduate degree to pursue careers as physician assistants, clinical perfusionists, or other jobs.[30] In addition, respiratory therapists considering graduate education were most concerned about the cost of education, being tired of schoolwork, family obligations, and lack of time.[31]

The ability to transition to entry-to-practice respiratory therapy baccalaureate degrees may be several years away. However, respiratory therapists can access baccalaureate and graduate degree advancement programs, with many offered online to accommodate personal and professional needs. Respiratory therapists should be strongly encouraged to pursue advanced degrees as their roles continue to evolve in the healthcare system. Understanding perceived benefits and barriers will help guide efforts to improve the perception of the value of advanced degrees to move the profession forward. This pilot study aimed to evaluate 1) Respiratory therapists' satisfaction with their current education level, 2) Respiratory therapists' perceptions of the value of advanced education, and 3) Opportunities and barriers influencing respiratory therapists' perceptions regarding advanced education.

Methods

This study used a descriptive, cross-sectional survey research design to collect data. Before data collection, the University's Institutional Review Board approved this study as exempt (#23-0394). Participant recruitment targeted respiratory therapists and respiratory therapy education program directors. An invitation was sent to respiratory therapists with active email addresses through the North Carolina Society for Respiratory Care AARConnect listserv and program advisory committee members for one university-based program requesting distribution to team members. Because of established professional relationships, North Carolina and Florida respiratory therapy program directors were included and contacted using the email addresses listed on the CoARC website. Informed consent was included at the beginning of the questionnaire before participation. The survey instrument was a self-administered online questionnaire with 17 questions (Appendix A). The survey instrument was developed, including items to collect demographic data, 5-point rating response items (strongly agree = 5 to strongly disagree = 1) to measure satisfaction and interests in professional growth, additional multiple-choice items were used to collect data on perceived benefits and barriers of pursuing higher levels of education. The survey instrument was developed based on the review of published respiratory therapy education literature related to perceived value and obstacles in obtaining higher levels of education.[20,28,29] The survey instrument was developed and evaluated for face validity by experienced researchers with expertise in respiratory therapy education and survey design. Statistical Analysis Software (SAS) version 9.4 (Cary, NC) was used to analyze the descriptive data. Descriptive statistics were used to present participant response frequencies and percentages.

Results

Of the estimated 1,300 prospective participants, 65 respiratory therapists (5.0%) responded to the survey. Descriptive statistics of the respondents are reported in Table 1. For data analysis, age ranges and years practiced were collapsed into three categories from the original six categories. When participants were asked to estimate the amount of time remaining in the profession, 56.9% indicated that they had 15 years or less remaining in the profession, with 40.5% of those individuals indicating five years or less. Most participants (46.2%) indicated that having a personal connection was the main reason for becoming a respiratory therapist, followed by financial stability (18.5%). Other reasons included a desire to pursue a medical career, caring for people, needing a career quickly, job security, and a second choice to nursing or another health profession.

Table 1 Characteristics of Participants (*n* = 65)

Characteristic		*n*	%
Age, years*	20-39	18	17%
	40-59	28	43.1%
	60 and older	19	61.5%
Female sex		40	61.5%
Highest academic degree	Associate degree	20	30.8%
	Bachelor's degree	22	33.9%
	Master's degree	21	32.3%
	Doctoral degree	1	1.5%
	Other	1	1.5%
Years practiced*	≤10 years	17	26.2%
	11-20 years	14	21.5%
	>20 years	34	52.3%

**Categories collapsed into smaller groups for reporting purposes*

To address the first aim of respiratory therapists' satisfaction with their current education level, participants were asked to rate their satisfaction by indicating the level of agreement or disagreement. Fifty-two (80.0%) participants indicated satisfaction with their education level by responding somewhat or strongly agreed. In addition, 55 (84.6%) somewhat or strongly agreed with being satisfied with the profession. The main reasons participants would consider further education included financial gain (31.3%), followed by leadership opportunities (25%). Nearly 71% of the respondents were interested in leadership opportunities. Additional items asked participants to rate their agreement or disagreement with professional growth opportunities and support (Table 2).

The study's second aim was to evaluate if respiratory therapists believed there was value in advanced education. More than 70% of participants somewhat or strongly agreed that there is value in furthering their education. The third aim was to evaluate opportunities and barriers influencing the perceptions of respiratory therapists regarding advanced degrees. Most respiratory therapists (63.1%) somewhat or strongly agreed that the profession will provide future job opportunities and that advanced education will affect other job opportunities. However, respiratory therapists in this study indicated that lack of time (28.2%), finances (25.8%), personal circumstances (20.2%), and lack of support (12.1%) were barriers to pursuing advanced education. Other comments regarding barriers included being close to retirement, experience being more important than education, lack of financial incentives, and lack of room for growth.

Discussion

This study explored respiratory therapists' satisfaction with their current education level, belief in the value of advanced education, and opportunities and barriers influencing perceptions of obtaining advanced education. Findings suggest that respiratory therapists participating in this study were satisfied with their current education level. This finding was not surprising, considering that the majority of participants held a baccalaureate degree or higher. Another consideration was time to retirement, with most participants reporting that they planned to work 15 years or less, and an even higher percentage of that group subset planned to retire within five years. Additional comments made by participants suggested that being close to retirement was a barrier to obtaining higher levels of education. The findings are consistent with previous research suggesting that respiratory therapists may only be interested in pursuing higher levels of education after a 15-year window of retirement.[29]

Table 2 Professional Growth and Support for Advanced Education (*n* = 65)

Items	Strongly agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Strongly disagree
Profession provides room to grow	16.9%	30.8%	12.3%	27.7%	12.3%
Profession values advanced education	12.3%	26.2%	18.5%	26.2%	16.9%
Professions provides support for advanced education	16.9%	30.8%	16.9%	16.9%	18.5%

Note: rows may not equal 100% due to rounding

Respiratory therapists' belief in the value of advanced education was mainly positive. One reason for the positive attitude could be related to the high number of respiratory therapists in this study already holding a baccalaureate degree or higher. Another explanation could be that most of the participants in this study may be highly engaged in the profession as members of the AARC and their state society. External drivers of perceived value may influence the motivation of respiratory therapists to seek advanced education opportunities. Research supports this notion, with respiratory therapy directors and managers reporting preferences for hiring respiratory therapists with at least a baccalaureate degree.[16-18] However, actual hiring practices may not match preferences with many respiratory therapy departments employing nearly two times the number of respiratory therapists with associate degrees compared to those with baccalaureate and graduate degrees.[18] Furthermore, the number of departments requiring new respiratory therapy graduates with an associate degree to obtain a baccalaureate within a specific timeframe remaining small.[10] Movement toward higher levels of education is happening at the respiratory care state society level, with New York and Florida advocating to require respiratory therapy baccalaureate degrees to maintain licensure or achieve a higher level of tiered licensure.[19,32]

Internal drivers of perceived value may arise from how respiratory therapists view the outward display of placing value and providing support for advanced degrees from the profession. Respiratory therapists had mixed views about the profession providing room for growth, valuing advanced education, and providing support for pursuing advanced education, with less than half indicating that they somewhat or strongly agreed. The reasons for pursuing advanced education were mostly financial gain and leadership opportunities. One participant commented on staying current and relevant in the field, which may include new knowledge and skills to keep pace with changes to provide better bedside care. Haan and colleagues[20] reported that respiratory therapists completing a baccalaureate degree advancement program reported the ability to read, understand, and articulate evidence-based medical literature more effectively. Other perceived benefits included improved oral and written communication skills, increased confidence in participating in interprofessional discussions, increased professional confidence, and improved job satisfaction.

Most respiratory therapists agree that the profession will provide future job opportunities and that advancing their education will affect other job opportunities. One study participant wanted the opportunity to become an APRT. Researchers highlighted the benefit of being ready for new opportunities for advancement, such as leadership roles, education positions as key personnel, pulmonary care consultants and navigators, and APRT.[19,29]

However, respiratory therapists face challenges that hinder achieving a baccalaureate degree or higher. Participants indicated that lack of time, finances, support, and personal circumstances were barriers to furthering their education. Other comments reinforced the mentioned barriers and added that there are no advancement opportunities, and they are close to retirement. The findings are consistent with previous research suggesting that common barriers include lack of time, additional cost with no financial gain, no advancement opportunities, personal obligations, and close to retirement.[29,31]

Limitations

The study was limited to a convenience sample of respiratory therapists in one state with email addresses on file with the state society AARConnect listserv and respiratory therapy program directors listed on the CoARC website for two states. Only an estimated number of prospective participants could be determined since the invitation could not be forwarded to other individuals. This pilot study's response rate was very low, and caution should be taken when interpreting the results. The researchers developed the survey instrument, and evidence of reliability and validity of results were not measured. The survey instrument should be evaluated for revisions prior to further use. While the findings were consistent with previous research, future studies with a larger target population should be explored to increase the sample size and measure the reliability and validity of the results obtained from the survey instrument.

Conclusion and Recommendations

This research aimed to describe perceptions of respiratory therapists' satisfaction with their current education level, belief in the value of advanced education, and opportunities and barriers influencing perceptions of obtaining advanced education. While this was a pilot study, the findings offer helpful insight regarding the perceived value, opportunities, and obstacles of obtaining respiratory therapy baccalaureate and graduate education. Initiatives are underway to revitalize the energy around pursuing respiratory therapy baccalaureate and graduate degrees with the emergence of the APRT, which may help retain respiratory therapists who otherwise may be considering other advanced education to leave the profession.[3] Kacmarek and Walsh[33] said it best by stating that "either we change radically and rapidly, or there is a real possibility that our profession will regress rather than progress. The status quo is not acceptable." We are moving in the right direction, but maybe not fast enough. Higher levels of education are needed to ensure respiratory therapists provide quality patient care that improves outcomes that will support the profession's vitality and sustainable growth. While the body of literature is increasing regarding the need for higher levels of respiratory therapy education, most of the existing research is limited to narrow geographic areas.[19,20,27-29] Research studies that span more significant geographic regions should focus on the value of obtaining higher levels of education in respiratory therapy as it relates to the impact on patient outcomes and the intrinsic and extrinsic factors associated with perceived value.

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Appendix A

Survey Instrument

1. What is your age?
   ☐ Between 20-29 years old ☐ Between 30-39 years old ☐ Between 40-49 years old
   ☐ Between 50-59 years old ☐ Between 60-69 years old ☐ 70 years old and older

2. What is your gender?
   ☐ Male ☐ Female ☐ Non-binary/third gender ☐ Prefer not to say

3. What is your highest academic degree?
   ☐ Associate degree ☐ Bachelor's Degree ☐ Master's Degree
   ☐ Doctoral Degree ☐ Other

4. How many years have you been in the respiratory therapy field?
   ☐ Less than 1 year ☐ Between 2-5 years ☐ Between 6-10 years
   ☐ Between 11-15 years ☐ Between 16-20 years ☐ 20 years or more

5. How many more years do you anticipate being in the profession?
   ☐ 1-5 years ☐ 6-10 years ☐ 10-15 years ☐ 20 or more years ☐ Until retirement

6. What made you get into respiratory therapy?
   ☐ Financial stability ☐ Personal connection ☐ Other _____

7. Are you satisfied in your profession?
   ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
   ☐ Somewhat agree ☐ Strongly agree

8. Are you satisfied with your level of education?
   ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
   ☐ Somewhat agree ☐ Strongly agree

9. What would make you want to further your education?
   ☐ Leadership opportunities ☐ Personal connection ☐ Financial benefit
   ☐ Become an educator ☐ Other _____

10. Are you interested in leadership?
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

11. Does the profession provide you with room to grow?
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

12. The profession values furthering your education.
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

13. The profession provides support when it comes to furthering my education.
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

14. Do you feel like there is value in furthering your education?
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

15. Do you feel the profession will provide future job opportunities?
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

16. Do you feel furthering your education will affect other job opportunities?
    ☐ Strongly Disagree ☐ Somewhat Disagree ☐ Neither Agree nor Disagree
    ☐ Somewhat agree ☐ Strongly agree

17. What might be a reason you would not want to further your education? (Select all that apply)
    ☐ Finances ☐ Lack of support ☐ Personal circumstances
    ☐ Time ☐ Other _____

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Utility of a Brief Electronic Cigarettes Educational Module for Health Professionals: A Pilot Study

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Abstract

Background: The current research and regulatory environment surrounding electronic cigarettes (e-cigarettes) has left patients needing more reliable information. Patients are increasingly asking healthcare providers about e-cigarettes and methods for cessation from combustible cigarettes. Further, patients' advice from healthcare providers influences their perceptions and behaviors regarding e-cigarettes. Healthcare providers need training opportunities to update their knowledge about the current evidence on e-cigarettes. However, the dissemination of evidence-based practices faces many barriers. Therefore, it is important to determine the current knowledge and attitudes about e-cigarettes, devise methods to disseminate evidence regarding e-cigarettes, and evaluate these methods. **Methods:** This study utilized a pre-test and post-test design with a brief educational intervention about the current state of e-cigarettes. Knowledge, attitudes, and self-efficacy regarding e-cigarettes were assessed, and demographic information was collected. **Results:** Data analysis sought to establish relationships between these domains and demographics. Participants were able to significantly improve their knowledge from pre-test to post-test after an intervention of a brief educational module ($p < .001$) and significantly improve their self-efficacy about e-cigarette information ($p < .001$). Further, attitudes did not change significantly ($p = .162$), indicating that healthcare providers can update their knowledge and self-efficacy regarding e-cigarettes despite the attitudes they hold. Results were largely consistent across demographics. **Conclusion:** Healthcare providers need the opportunity to receive updated training about the current evidence regarding e-cigarettes. Professional associations and/or healthcare systems provide an ideal platform for this information. Given this opportunity, improving the healthcare providers' knowledge and self-efficacy in this area may be possible.

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Introduction

Electronic cigarettes (e-cigarettes), introduced to the United States in 2006, are nicotine delivery devices that have been consistently increasing in prevalence, whereas combustible cigarette use has declined over recent years.[1] Despite this rapid growth in use, evidence-based research needs to be more comprehensive regarding the utility and health effects of e-cigarettes.[1] Due to this absence of evidence available, individuals often rely on healthcare providers for this health information. Healthcare providers remain a credible source of knowledge for those attempting to quit combustible cigarettes[2-4] and are increasingly being asked by their patients about the health risks associated with e-cigarettes.[5-8] However, there is insufficient evidence regarding the cessation utility and health impact of e-cigarettes.[9] Further, it has been demonstrated that knowledge about the effects of e-cigarettes may influence adolescents' and adults' perceptions of e-cigarettes and their willingness to use e-cigarettes.[10,11] The proportion of U.S. adults who consider e-cigarettes as harmful as combustible cigarettes is increasing.[12,13] This places the onus on the healthcare providers to provide patients with up-to-date, evidence-based information regarding e-cigarettes.

Applying evidence-based practices has been shown to improve patient outcomes across multiple disciplines.[14,15] However, the use of evidence-based practices for cessation faces many obstacles, both internal (such as institutional policies) and external (such as national clinical practice guidelines)[16,17], leading to slow and inconsistent adoption across disciplines, including among addiction specialists.[18] Therefore, healthcare providers (particularly respiratory therapists) need to be well-versed in the latest research, prepared to adjust their discussion about e-cigarettes to reflect the research consensus and the best interests of their patients, and be confident in their ability to disseminate advice to their patients. In an emergent domain that is often debated and misunderstood, research may be misrepresented or difficult to interpret, and attitudes regarding e-cigarettes may solidify earlier than the research evidence. These attitudes may conflict with healthcare providers' duty to rely on science, not personal opinion, as healthcare providers have an ethical obligation to deliver a message consistent with current literature as the evidence evolves. Competing demands for healthcare providers' time may create challenges to stay current with the latest evidence. The educational and clinical literature supports using a brief educational module to summarize scientific updates.[19-22] This study primarily sought to explore the changes in healthcare providers' attitudes, knowledge level, and self-efficacy about e-cigarettes following a brief online educational module on the current scientific evidence.

Methods

The study was a pretest-posttest design using a self-administered online questionnaire to assess the effectiveness of an educational intervention. Participants were recruited via a university-provided email listserv with instructions and a link to the consent statement and pre-test survey via an online survey. A link to the educational module was provided after the completion of the pre-test. Finally, following completion of the module, a link to the online post-test survey was provided. These surveys collected demographic information, and the data were de-identified. The study was determined exempt by the institution's Human Subjects IRB.

Population

The target population included health professionals most likely to interact with e-cigarette users: respiratory therapists, nurses, and clinical case managers employed at a large academic medical center. Due to the nature of their roles and responsibilities, respiratory therapists and nurses frequently interact with e-cigarette users and address questions from patients, and case managers often discussing discharge planning and connection to services that may include cessation. The sample was drawn via voluntary sampling.

Intervention

The educational intervention was a 10-minute module that presented the healthcare provider with conclusions from the National Academies of Sciences, Engineering, and Medicine's 2018 report[23] "Public Health Consequences of E-cigarettes" (Table 1, Appendix A). This report summarized and synthesized research related to e-cigarettes in several domains and presented conclusions based on levels of evidence. These domains included the constituents of e-cigarettes, the health effects of e-cigarettes, initiation and cessation, and harm reduction. The six levels of evidence progress through no evidence, insufficient evidence, limited evidence, moderate evidence, substantial evidence, and conclusive evidence. The module was developed as a voice-over slide presentation, and a link to the intervention was included at the end of the pre-test.

Instrument

The questionnaire adhered to researched practices to ensure validity, reliability, an optimal response rate, and minimal bias. Item generation and item reduction were utilized to generate questions with qualified researchers with expertise in research methods, curricular design, and nicotine use and dependence. Questions were presented in multi-item screen format, with clear directions and response fields. Questions used simple, neutral language, succinct in length, and tailored to address only one construct each. A team of qualified researchers evaluated face validity and content validity. The use of pilot testing and clinical sensibility testing further investigated face validity. Results from this testing were also used to address internal reliability. The questions were developed by a panel of experts, including two PhD faculty members and a doctorally prepared respiratory therapist. They were based on the conclusions reached by the National Academies of Sciences, Engineering, and Medicine's report.[23]

Twenty-four items in the pre-test and post-test assessed healthcare providers' knowledge of the current evidence related to e-cigarettes. Respondents were asked to state the degree to which evidence supports the knowledge statements on a scale of 0 (no evidence) to 5 (conclusive evidence). A higher number indicates more discrepancies and, thus, less knowledge of the evidence. Comparisons were made between each participant's indicated evidence level and that from the report. The total number of the respondents' discrepancies from the conclusions in the report was used to determine the extent to which they were knowledgeable about the current body of research on e-cigarettes.

An additional eight questions asked respondents to state the degree to which they agree or disagree with statements that reflect the healthcare provider's attitude about e-cigarettes. Attitude responses adhered to a 6-point response rating scale ranging from 1 (strongly disagree) to 6 (strongly agree). Attitudes were assessed using item and composite scores. Four of these items were reverse-coded. A lower score on any given question reflected a more negative attitude toward e-cigarettes, while a higher score reflected a more positive attitude toward e-cigarettes. One item was used to assess self-efficacy, with participants rating their confidence from 1 (not confident) to 10 (extremely confident) when disseminating e-cigarette-related information to patients. The remaining items collected demographic information (Table 2, Appendix A).

Data Analysis

All statistical analyses were conducted with IBM's SPSS Version.[24] Changes in attitudes, knowledge, and self-efficacy regarding e-cigarettes net public health impact between the pre-test and post-test were calculated. Paired-sample t-tests were used to measure the attitude change and self-efficacy, and Wilcoxon signed ranks tests were used for the knowledge assessment due to the non-parametric nature of the data. Pearson's correlations were calculated to assess whether changes in attitude, knowledge, or self-efficacy were associated with each other, using the differences between pre-test and post-test for each construct.

Results

Fifty healthcare providers employed by the large academic medical center completed the study's pre and post-surveys in the summer following the release of the National Academies of Sciences, Engineering, and Medicine's report.[23] Professional backgrounds of participants included 22 (44%) nurses, 25 (50%) respiratory therapists, and 3 (6%) clinical case managers. The gender breakdown of the participants was 41 (82%) female, 8 (16%) male, and 1 (2%) transgender. The highest level of education attained by participants was listed as: 6 associate degrees (12%), 37 bachelor's degrees (74%), and seven master's degrees (14%). The ages of the participants ranged from 22 years to 60 years old, with a mean age of 36.94 years. Table 3 (Appendix A) contains participants' responses regarding sources of information about e-cigarettes. Most participants reported that their sources were from general news outlets (45.8%).

Knowledge Assessment

Knowledge at pre-test and post-test was assessed by measuring the deviation from the level of evidence concluded by the National Academies of Sciences, Engineering, and Medicine's report.[23] The Wilcoxon signed ranks test results were used to analyze change from the pre-test (M = 42.68, SD = 9.17) to the post-test (M = 36.52, SD = 10.70). Participants could better identify the correct evidence level, reflected by a statistically significant lower discrepancy ($p < .01$) between the pre-test and the post-test. No significant differences existed between the pre-test and post-test among any demographic groups.

Attitude & Self-Efficacy Assessment

Paired sample t-tests measured change in attitude scores and found that scores at pre-test were slightly negative (M = 20.30, SD = 6.54), reflective of healthcare providers' attitudes before any educational intervention. The post-test attitude score (M = 21.68, SD = 5.98) did not significantly change from the pre-test ($p = .162$). For all participants, the difference between the self-efficacy pre-test (M = 4.22, SD = 2.64) and post-test (M = 5.88, SD = 2.17) was tested with a paired-sample t-test and reached significance ($p <.001$, $d = .888$), with participants overall expressing greater self-efficacy after the educational module intervention.

Additional Analysis

There was no correlation between changes in attitude and self-efficacy ($r = -.055$, $p = .705$) or between changes in attitude and knowledge ($r = -.191$, $p = .183$). However, the correlation between changes in knowledge and self-efficacy may suggest a small association. Still, the results did not reach statistical significance ($r = -.261$, $p = .067$), indicative of the practicality of a brief educational module.

Discussion

Although current knowledge of the evidence base for e-cigarettes is limited, this study demonstrated that learning can be enhanced through a brief online educational module. These findings are consistent with the literature regarding continuing medical education across disciplines[24] and brief interventions for healthcare provider training in multiple disciplines.[19-22]

At baseline, knowledge of the evidence did not strongly adhere to the available evidence-based findings as concluded by the National Academies of Sciences, Engineering, and Medicine's report.[23] This is concerning considering that patients are increasingly seeking information from healthcare providers regarding e-cigarettes,[5-8] though not surprising considering the estimated 17 years it takes for evidence-based findings to reach clinical practice.[25]

However, after a brief intervention consisting of an educational module presenting the current research evidence regarding e-cigarettes, participants improved their knowledge of the evidence base for e-cigarettes. These findings indicate that healthcare providers can update their understanding of the evidence regarding e-cigarettes when given the correct information, even if given a brief educational module. The short module could apply to continuing education, position statements from professional organizations, or other training materials summarizing and disseminating evidence-based information. There are resources available for healthcare providers, parents, and adolescents, and information can be found on the CDC, FDA, Surgeon General's Report, and American Lung Association website, as well as other websites that provide printable information about health, cessation, and information about e-cigarettes. The importance of providing these summarizing training materials to healthcare providers is further highlighted by the fact that only five participants decided to click through to visit the executive summary of the National Academies of Sciences, Engineering, and Medicine report at the survey's conclusion.

Overall, participants also improved their self-efficacy from the pre-test to the post-test. Since self-efficacy is a mediating variable between knowledge acquisition and practice change in the context of continuing medical education for healthcare providers,[26] this result further supports the utility of healthcare providers increasing their knowledge about e-cigarettes due to a brief educational module. Further, since evidence-based practices have been shown to improve patient outcomes across multiple disciplines,[14,15] this may lead to better patient outcomes regarding counseling patients about e-cigarettes.

Attitudes at the pre-test toward e-cigarettes trended toward negative and were consistent across all demographics. Regardless of demographics, these attitudes did not significantly change between the pre-test and post-test, though knowledge and self-efficacy did. This may indicate that healthcare providers can successfully detach their attitudes about e-cigarettes from their understanding of the evidence about e-cigarettes. This is encouraging since healthcare providers are ethically obligated to disseminate evidence-based information to their patients instead of their personal opinions.[27]

Further, changes in knowledge and self-efficacy between the pre-test and post-test revealed a small, nonsignificant correlation, possibly indicating that those who best improved their knowledge from the educational module also most improved their self-efficacy. This aligns with the related literature regarding education and self-efficacy.[26] Changes in attitude were not correlated with knowledge or self-efficacy.

Limitations to this pilot study include the small sample size and reliance upon self-report. Additionally, further evaluation of the reliability and validity of the individual items on the instrument would have strengthened the analysis. Further, as a short-term study, there is the limitation of whether any changes observed between the pre-test and post-test will be enduring or affect subsequent behavior in the clinical setting. Further research should expand upon the preliminary findings of this study and replicate this study with a more prominent and representative sample. This should focus on investigating long-term changes in knowledge, attitude, and self-efficacy with regard to e-cigarettes among healthcare providers. Research should also investigate whether these changes improve adherence to evidence-based practices when disseminating patient advice.

Conclusion

As a trusted source of information regarding healthy lifestyles and smoking cessation, healthcare professionals, and specifically respiratory therapists, are increasingly called upon for information regarding e-cigarettes and are ethically obligated to provide evidence-based information. While current knowledge about the individual health effects and net public health impact of e-cigarettes is limited, healthcare providers may be able to increase their knowledge and self-efficacy regarding the research about e-cigarettes with a brief educational intervention.

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Appendix A

Table 1 Outline of E-cigarette Educational Module

Topic	Content
Scope of the Problem	▪ Tremendous growth in popularity ▪ Ever-evolving product ▪ Uncertain and lax regulatory environment ▪ Conflicts in research ▪ Conflicts in messages from experts
NAS report levels of evidence	▪ No evidence, Insufficient, Limited, Moderate, Sufficient, Conclusive ▪ Based on number and strength of studies
Addictive Potential	▪ Nicotine exposure to user is variable ▪ Nicotine exposure can rival combustible cigarettes ▪ E-cigarettes are likely addictive ▪ E-cigarettes are possibly not as addictive as combustible cigarettes
Constituents of E-cigarettes	▪ E-cigarettes emit potentially toxic substances ▪ These substances vary depending on the device and user ▪ It is likely this exposure is less than combustible cigarettes
Gateway Effects of E-cigarettes	▪ E-cigarettes likely increase progression to smoking status ▪ E-cigarette use likely increases frequency and intensity of combustible cigarette use ▪ E-cigarette use likely increases duration of combustible cigarette use
E-cigarettes as a Cessation Device	▪ E-cigarettes may be effective aids to promote smoking cessation ▪ Insufficient evidence compared to FDA-approved treatments ▪ E-cigarettes with nicotine are likely more effective than those without nicotine ▪ Use of e-cigarettes is likely associated with increased likelihood of cessation
Harm Reduction	▪ Completely switching from combustible cigarettes to e-cigarettes reduces exposure to toxins and carcinogens ▪ Completely switching also likely reducing short-term health risks ▪ There is not enough research investigating health outcomes of dual-use
What We Don't Know	▪ Short-term and long-term health effects ▪ Utility as cessation device ▪ Net public health impact ▪ What to tell healthcare providers

Table 2 Assessment and Demographic Items

	Knowledge Assessment
1	The nicotine content of e-cigarettes depends on the device and how it is operated
2	E-cigarette vapor contains numerous potentially toxic substances
3	The toxicity of e-cigarette vapor depends on the device and how it is operated
4	Switching from combustible cigarettes to e-cigarettes reduces exposure to numerous toxicants and carcinogens
5	E-cigarettes can result in nicotine exposure comparable to combustible cigarettes
6	E-cigarettes contain fewer toxins than combustible cigarettes
7	E-cigarette aerosol contains metals
8	E-cigarette use results in symptoms of dependence on e-cigarettes
9	E-cigarette use increases risk of initiation to combustible tobacco cigarettes in youth
10	Switching completely to e-cigarettes from combustible cigarettes reduces short-term adverse health outcomes
11	E-cigarettes have less risk and severity of dependence compared to combustible cigarettes
12	Risk and severity of dependence of e-cigarettes depends on the type of e-cigarette and e-liquid
13	Diastolic blood pressure increases after use of e-cigarettes
14	E-cigarette use increases symptoms of asthma for those who do not use combustible e-cigarettes
15	E-cigarette use increases the frequency and intensity of combustible cigarette use among youth
16	More frequent use of e-cigarettes is associated with increased cessation from combustible cigarettes
17	Switching from combustible cigarettes to e-cigarettes will result in improved lung function in people with asthma
18	Switching from combustible cigarettes to e-cigarettes results in decreased exacerbation in people with chronic obstructive pulmonary disease (COPD)
19	E-cigarettes are associated with long-term changes in heart rate, blood pressure, and cardiac function
20	E-cigarettes are more effective as a combustible cigarette cessation aid than no aid at all
21	E-cigarettes are as effective as FDA-approved methods for combustible cigarette cessation
22	E-cigarettes are associated with cardiovascular diseases
23	E-cigarettes are associated with cancer endpoints in humans
24	E-cigarettes are associated with respiratory diseases in humans

Table 2 Assessment and Demographic Items *continued*

Attitude Assessment	
1	E-cigarettes are beneficial to public health overall
2	E-cigarettes should not be regulated the same as combustible cigarettes
3	E-cigarettes do not cause long-term adverse health outcomes
4	E-cigarettes are effective for combustible cigarette cessation
5	E-cigarettes are not a gateway to combustible cigarettes
6	E-cigarettes do not cause short-term adverse health outcomes
7	E-cigarettes should be recommended for combustible cigarette cessation
8	Harm reduction is a viable treatment option for addiction
Self-Efficacy Assessment	
1	I feel confident in my ability to provide evidence-based information to patients regarding e-cigarettes
Demographics	
1	How old are you?
2	What is your gender?
3	What is your highest level of education attained?
4	What is your profession?
5	What is your political affiliation?
6	What is your typical source of e-cigarette related information?
7	How often do you encounter the opportunity to discuss e-cigarettes with patients?

Table 3 Sources for Information about E-cigarettes

News Source	*Responses (n = 35)*	%
General news outlets	16	45.8%
Public health organizations	8	22.8%
Colleagues	6	17.1%
Clinical guidelines	5	14.3%
E-cigarette advocacy groups	0	0

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Navigating Peer-Reviewed Literature: Practical Tips for Respiratory Therapy Students and Practitioners

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Abstract

Respiratory therapy students and practitioners utilize peer-reviewed literature to guide clinical decision-making and care delivery across the healthcare continuum. However, navigating peer-reviewed literature requires a unique skill set that requires time and effort to develop. Peer-reviewed literature can be complex in many instances, and a standardized yet practical approach may improve the reviewer's confidence. More resources are needed to support effective strategies to build and maintain these skills specific to respiratory therapy students and practicing clinicians. However, there is literature to support various aspects of scholarly writing. The authors of this review utilized the Respiratory Care journal and Google Scholar as primary sources to mine peer-reviewed journals on the topic of peer review, scientific literature, and, specifically, how to read peer-reviewed scientific literature. This review aims to provide respiratory therapists (RTs) and other health professionals with tips for effectively reviewing scientific literature. Actively consuming available literature can support individual student and clinician growth, prepare health professionals to support evidence-based care delivery, and support quality and safety improvement initiatives in their respective care areas.

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Introduction

Respiratory therapy students are tasked with reading and consuming large amounts of information throughout their academic programs. Students quickly review information from various sources, including lecture notes, textbooks, slide decks, and scientific journals containing peer-reviewed papers. Additionally, all these various content domains are provided to students in multiple formats, including physical print and electronically as a PDF, which may be viewable on the student's PC, laptop, tablet, and smartphone. While undergraduate students at community colleges and universities are expected to read and retain essential material to garner competence and understanding to persist in their medical program, many are also being introduced to scientific journals.[1]

Students routinely enter a respiratory therapy program with varying reading literacy levels and backgrounds. These levels may range from enjoying fiction to nonfiction and peer-reviewed scientific literature. The shift to being a consumer of scientific literature requires developing skills, such as critical evaluation and comprehension of peer-reviewed research, which takes significant time and practice to develop. In many instances, a programmatic requirement of accredited respiratory care programs includes a responsibility to introduce students to scholarly work. Accreditation agencies like the Commission on Accreditation for Respiratory Care (CoARC) recognize the importance of critically assessing scientific literature and have stated in Standard 4.03 that part of the scope of practice of a respiratory therapist (RT) is "promoting evidence-based practice by using established clinical practice guidelines and by evaluating published research for its relevance to patient care."[2] That said, there is often an unfamiliarity with peer-reviewed scientific literature among students as they enter their RT program and early on in the program, causing students to feel potentially discouraged and incompetent, which may hinder their academic progress.[3]

Many papers have been published informing students and practitioners about important skills necessary to conduct research and how to craft a well-written manuscript (Table 1).[4-18] Despite the literature available, there needs to be more information that guides students and clinicians on effective reading and comprehension of scientific literature.

Table 1 Overview of Key Research and Methodology Articles in Respiratory Care

Title of the Paper	Description	Author(s)
Research and Publication in Respiratory Care[4]	Explores the impact and methodologies of research in the field.	Hess
Getting Started in Research: The Role of Mentorship, Forming the Team, and Developing a Process[5]	Discusses the roles of mentorship and team dynamics in research initiation.	Miller
Formulating the Research Question and Framing the Hypothesis[6]	Highlights the importance of defining clear research questions and hypotheses.	Willis
Submitting a Manuscript to a Scientific Journal[7]	Guides through the manuscript submission process, emphasizing strategic considerations.	Moore
An Overview of Survey Research[8]	Offers insights into conducting survey research, with a focus on methodological considerations.	Goodfellow
How to Conduct a Systematic Review and Meta-Analysis: A Guide for Clinicians[9]	Provides a step-by-step guide for clinicians on conducting systematic reviews and meta-analyses.	Zaccagnini, Li
How to Write an Abstract for Presentation at a Scientific Meeting[10]	Details the key elements of writing an effective abstract for scientific presentations.	Miller
Observational Studies[11]	Explores observational study designs, their strengths, limitations, and application.	Hess
An Overview of How to Search and Write a Medical Literature Review[12]	Discusses strategies for searching medical literature and writing comprehensive reviews.	Goodfellow
How to Present Your Research Findings at a Scientific Meeting[13]	Covers the essentials of effectively presenting research findings at scientific conferences.	Willis
How to Write the Methods Section of a Research Manuscript[14]	Emphasizes the importance of a detailed methods section for study reproducibility and validity.	Willis
How to Write an Effective Discussion[15]	Guides on crafting discussion sections that highlight study findings and implications.	Hess
How to Conduct a Randomized Controlled Trial[16]	Outlines the components and considerations in conducting randomized controlled trials.	Kaur, Li
Moving From Abstract to Manuscript[17]	Provides insights on transitioning from abstract submission to full manuscript preparation.	Miller
An Overview of Data Management in Human Subjects Research[18]	Discusses key aspects of data management in research involving human subjects, emphasizing ethical and practical considerations.	Miller, Lipscomb, and Hornik
Statistics for the Non-Statistician: How to Read the Respiratory Care Literature[57]	Discusses basic statistical concepts for readers and reviewers of scientific literature.	Hess

Disclosure: This table was generated with assistance from OpenAI. (2023). ChatGPT with GPT-4 architecture.

Thus, this review aims to highlight effective strategies that will prepare RT students and practitioners to assess peer-reviewed literature related to clinical practice effectively.

What is Peer Review?

Peer review is quality assurance and assessment for scholarly writing and reporting.[19] Peer review evaluates scientific merit and is the primary system for assessing scientific reporting.[20] As far back as the 17th century, there has been a known peer-review process that examines literature utilizing content experts who review the proposed study or report before publication and ensure the overall quality of the research.[21] Various opinions exist regarding the peer-review process. Lack of universal standardization, diversity in the process causing confusion, and the lack of research on the topic itself, while others view peer review as the gold standard and hallmark of quality.[19] However, the process is in place to attempt to ensure journals are publishing the most scientifically sound articles that contribute broadly to society through knowledge dissemination. Such publications may also contribute to the approval of grant funding and career advancement for the authors. The peer-review process relies on experts not employed by the journal staff to provide feedback on submitted work and recommendations to the editor regarding whether the paper warrants publication. This process is viewed as an integral part of the scientific process.

Specific duties of the peer reviewers during the peer review process include detecting fraud or gross errors and offering important feedback to the authors supporting improvement before publication.[22] The main characteristics of peer-reviewed literature are that it includes papers critiqued by content experts and determined as credible, presented in good faith, free of flawed research methods, and verified as meeting the publishing journal's standards. Readers may feel confident that their reading is accurate and has been thoroughly reviewed before publication; however, many students and practitioners find reading scientific works challenging.[23]

Challenges of Reading Peer-Reviewed Research and Why They Matter

Peer-reviewed literature has been characterized as challenging, with reasoning focused on the specialized vocabulary and structure of scientific writing.[22] Scientific writing requires the author to be tactical and deliberate with word choice, which may add difficulty for the reader. A 2017 study by Hubbard and Dunbar identified perceptions among individuals at various career stages. Of those in the undergraduate arena, scientific papers' methods and results sections were the most challenging.[24]

As consumers of scholarly work, RT students and clinicians should consider that by sharing their work, many authors are doing so to provide a roadmap for others to replicate their research reliably. For this reason, authors are challenged to use clear and succinct language that best describes their research. Additionally, authors often assume a certain level of expertise, making it challenging for those unfamiliar with the topic or students who have yet to gain mastery or exposure to key concepts. For example, an author writing a paper evaluating closed suction systems with tube-scraping technology assumes that the reader has, at a minimum, a cursory understanding of the topic.[25] RT students reading complex scientific journals are doing so because specific articles have been assigned to them by their instructor or because they are actively seeking out a particular topic to gain mastery to improve their professional practice.[26] Often, however, the articles are written at levels that are understandably difficult for students (and, in some cases, clinicians) to understand without additional training and education.

Motivating RT students to read complex scientific literature can be challenging. College instructors are responsible for providing students with reading material related to subjects being taught within their courses while also considering the students' abilities to read and comprehend the information provided. Hubbard and Dunbar encourage instructors to evaluate undergraduate students' approach to scientific literature, which they suggest may be superficial.[24] Additionally, the authors posit that educators should acknowledge the potential for low self-efficacy and provide strategies to read complex material early on in a program. This can be a challenge for instructors because introducing students to articles that may be difficult to understand or not interesting may intimidate them as individual learners. Without careful consideration, this could decrease the motivation and interest of the student(s) regarding the topic or assignment.

It is plausible that students struggling with reading and understanding scientific literature may devalue the assignment posed by the instructor. This phenomenon is termed task value, one component of the Expectancy Value Theory.[27] There are four noted components associated with task value. These are attainment value, intrinsic value, utility value, and cost value.[29] If learners perceive the value and relevance of scholarly articles to their overall educational objectives and outcome, such as the successful completion of licensure examinations or achieving high academic performance, they are more likely to engage in the coursework.[30] Conversely, the lack of motivation stemming from the self-perception of the inability to understand complex materials or the perceived futility of the assignment can significantly diminish their willingness to engage in the material.[30]

Respiratory therapists are required to complete ongoing education to obtain continuing educational units (CEUs) needed to maintain state licensure and nationally recognized credentials. For some, the only time a concerted effort is made to learn about advancements in their profession and review up-to-date evidence, including best practice guidelines, is when they attend an annual conference or an in-service hosted at their facility. Continuous professional development and training not only fulfills licensure and credentialing requirements but also serves to combat the high rates of burnout among healthcare professionals who might be at high risk.[31] Recent studies suggest that increased professional knowledge attainment is associated with a decreased incidence of burnout.[31] For instance, a 2021

survey looking at instances of burnout among RTs found that 72% admitted to experiencing burnout.[32] Another study highlighted that a symptom of burnout is lower perceived personal achievement. A proven solution to combat burnout and perceptions of lower personal achievement is to increase staff professional development days.[33] Aside from these examples, healthcare professionals may need to review scientific literature to understand better and learn about specific topics pertinent to their role or patients under their care (i.e., an RT working primarily in the Pediatric Intensive Care Unit [PICU] may review updated guidelines specific to Pediatric ARDS [PARDS]). As healthcare continues to evolve and care delivery is guided by scientific inquiry, ensuring healthcare professionals possess scientific literacy, such as RTs, understanding how to search and review the available literature is of the utmost importance.

The American Association for the Advancement of Science (AAAS) describes scientific literacy as being able to formulate or identify questions and reach conclusions based on evidence through reliable scientific literature.[34] A 2019 study by Shaffer, Ferguson, and Denaro found that basic reading skills are vital in developing scientific literacy.[35] If an adult only reads an occasional novel, social media posts, or leisurely magazines, the scientific literacy nurtured back in college may revert to the previously underdeveloped form.[34] In examples like this, the reader may require some much-needed conditioning, which can take time.

Why RTs Should Read Peer-Reviewed Research

RTs are crucial for patient care, particularly in managing those with severe respiratory disorders. It has been shared that these professionals often care for individuals who are disproportionately sicker.[36] To excel in the profession and keep complex and critically ill patients safe during care delivery, it is imperative for RTs to be scientifically literate. From the literature available discussing the importance of making use of scientific literature in one's professional practice, five reasons why RTs should read peer-reviewed research include:

1. Keeping abreast of advancements[36]
2. Ensuring up-to-date evidence-based professional practice knowledge[4]
3. Fine-tuning critical thinking and analytical skills[37]
4. Supporting professional development[38]
5. Focusing on quality improvement and patient safety initiatives[39]

Continual learning ensures that RTs provide the most effective and up-to-date, quality care to their patients; in fact, the Institute of Medicine (IOM) in the United States has stated that having well-educated healthcare professionals has a direct link to medical advancements and patients having a longer lifespan and greater quality of life.[40]

The second reason RTs should read peer-reviewed work involves ensuring evidence-based practice. Evidence shows that when clinicians engage in outcomes-based professional development and put the tools they learn in the literature to practice, the clinician's performance and patient outcomes improve.[41] The ability to read scientific literature empowers RTs to embrace evidence-based practice(s).

The third reason is concerned primarily with developing critical and analytical skills among RTs. Unusual patient responses, equipment malfunctions, and other rare instances require critical thinking from the RT to pivot and modify therapy,[42] rather than waiting for an essential outcome that could otherwise be avoidable if the RT can change its course of action quickly.[43] To benefit significantly from reading peer-reviewed articles, RTs must be able to take in complex information, assess research methods, and interpret results when reading. For instance, the use of high-flow nasal cannula (HFNC) oxygen therapy is primarily associated with treating patients with hypoxia to prevent more critical and invasive measures from being necessary.[44] As the use of HFNC has become more prevalent, advancements in research and application have also progressed. Research has looked at HFNC and pediatric asthma,[45] bronchodilator efficacy using a vibrating mesh nebulizer with HFNC,[46] feeding practices while using HFNC,[47] and other applicable topics related to HFNC. Without encouraging a curious mindset for research among healthcare practitioners, these advancements may not have occurred, and future discoveries may not happened.

The fourth reason is professional development. Competence and increased self-efficacy in reading scientific literature are integral to professional development.[48] This development among RTs creates opportunities for attending conferences and, in many instances, presenting and contributing to scholarly discussions surrounding advancements in respiratory care or other health science practices. When someone passes their respective boards and becomes credentialed and licensed as an RT, this allows them to practice respiratory care. Merriam-Webster Dictionary highlights that the practice of medicine means to be 'professionally engaged in.'[49] A professional respiratory care practitioner should strive to be engaged with research for the sake of their patients, the growing complexities of a diverse patient population, and rapid advancements in healthcare technologies.

The last reason to consider is the opportunity to support quality improvement (QI) initiatives. Scientific research often identifies areas for improvement in clinical practice. RTs, armed with the ability to read and understand peer-reviewed papers critically, can spearhead quality improvement initiatives or collaborate on QI teams within their facility, which may improve care delivery, quality of care, and patient safety. Significant time and resources in healthcare facilities are frequently dedicated to enhancing patient outcomes, minimizing hospital-acquired infections, and reducing expenses related to treatments like the infection control of small volume nebulizers, maintenance of endotracheal tube cleaning devices, and application of bronchoscopy, among others.[50,51,52] RTs are well positioned to be part of these conversations and members of QI teams as they care

for all patients in most areas of the hospital, have working relationships with many hospital staff, and possess expertise in their equipment utilization throughout various patient care settings, both in and out of the hospital.

12 Tips for Reading Peer-Reviewed Literature

This section will provide practical guidance for readers to review a peer-reviewed paper using a stepwise approach. Using recommendations from various sources, this section will provide a practical approach to reading a peer-reviewed article to understand what is being read[23,24,36,48,53-55] (Table 2). Below, the authors have created sensible tips to serve as a guide to reading an article based on the extant literature reviewed. The authors fully acknowledge that there is no right way to consume scientific literature. Still, this structure can assist the novice consumer of literature with getting over the initial, possibly daunting, nature of this important task.

Table 2 Practical Tips for Reading and Comprehending Peer-Reviewed Literature

Tips	Goals
1	Determine your purpose for reading the article
2	Be curious – have an open mind as you read
3	Annotate and summarize important aspects of the article
4	Review the abstract
5	Examine keywords and phrases throughout the abstract
6	Thoroughly read the introduction and conclusion to the paper
7	Review the study design and methods
8	Critically appraise the results section
9	Explore the discussion section and consider potential implications the study may have on practice as presented by the author(s)
10	Review the references
11	Discuss your learnings with peers and others
12	Routinely visit the literature

First, the reader needs to define their purpose and come to terms with their "why" behind reading a particular article,[36] determining the rationale, whether this is for homework, a project, a desire to stay up to date with the latest developments, or perhaps to enhance the RT's clinical practice. A clear purpose will guide the reader and set the stage for what will come. In this stage, the reader should consider what they hope to gain, consider any pre-understandings of the topic, and perhaps even jot down notes about the end goal upon reading.

The second tip is to be curious. The reader is encouraged to have an open mindset when initially reading and critiquing the paper and approach it critically. This does not mean that the reader should be suspicious of every aspect of the study, but be curious when critiquing and questioning the study's design, methodology, and conclusions.[23] Consider, for example, if a study is researching prone positioning on awake patients and the researchers are using ABGs to measure effectiveness, the reader may ask themself why the length of time on HFNC was used as an outcome. Or why pulmonary function tests (PFTs) or length of stay/admission was an outcome of interest. Being curious while appraising the literature does not take away or pose a risk to the work done by the researcher. Still, it can help inspire new ideas and motivate the reader to consume or participate in future research.[48] This curious and critical approach is essential for discerning the quality and applicability of the research.

The third tip is to read the abstract. Some articles can be lengthy, and the reader should quickly recognize if this article is what they want to spend time reading based on the contents of the abstract. By beginning with the abstract, one can quickly grasp the study's background, main objectives, methods, results, and conclusions. A key feature is that a well-crafted abstract concisely outlines what the reader will uncover in the body of the article and is usually limited in word count to less than 250 words so that the abstract can be read in its entirety somewhat quickly.[56]

The fourth tip is to examine keywords and phrases. Pay attention to keywords and phrases in the abstract. This can provide insight into the paper's focus and help the reader understand the research context. Keywords and phrases, even as early as just reading the title, can inform the reader a great deal.[36] Does this paper involve human subjects? Is this a randomized trial or a literature review? Paying close attention to the title, abstract, and introduction will save the reader time and help decide whether this paper will be worthwhile.

The fifth tip in reviewing a peer-reviewed paper is to thoroughly read the introduction and conclusion. As the reader reviews these sections, they should again consider keywords and phrasing. The introduction sets the stage for the study, while the conclusion summarizes key findings, and here, the researcher(s) tie everything together. Reading these sections before diving into the entire article more thoroughly will give the reader a quick sense of the research question(s), methods, and the significance of the results to practice. Starting here can help the reader more quickly understand, in addition to the abstract, whether this article is focused on what the reader is looking to learn about.[37]

The sixth tip is to review the methods and study design. In this phase, the reader should seek to understand the research methods employed. This includes study design, sample size, data collection, and statistical analyses. Evaluating the rigor or trustworthiness of the methods used is crucial in assessing the reliability of the study's findings. This is undoubtedly a challenge for many readers who need a background in graduate studies or experience with various research methods or statistics courses. It is essential, though, to understand that many types of articles are published in scientific journals. Readers may find published abstracts from posters presented at conferences, various types of literature reviews, quantitative research that presents data from experiments and surveys, and qualitative research that presents data from case individual or group discussions with subjects exploring lived experience, case studies, or observations.[23] For novice readers exploring scientific

literature, understanding the nature of the paper they intend to read can prove invaluable when deciding if it is an effective use of their time.

The seventh tip in reading a peer-reviewed paper is to assess the study results critically. As described in the sixth tip, this is also a daunting task to ask the reader. To evaluate the results section critically, begin by looking for statistical significance, effect sizes, and any limitations mentioned by the authors. As the reader progresses through the results sections, consider how the results contribute to the overall understanding of the topic. Interpretation of the results is not likely found exclusively in the results section, and this section may be intimidating for the average reader. Many experiments published are quantitative, and the results section will provide results that highlight a measure of significance. Admittedly, understanding statistics and interpreting results can be complex and even intimidating. However, Hess offers valuable guidance for non-statisticians on how to navigate these challenges.[57] By breaking down key statistical concepts and offering practical tips, Hess helps readers become more confident in assessing the significance and implications of study findings. We encourage the novice reader to use this resource to understand basic statistical concepts better.[57]

The eighth tip when reading involves exploring the discussion and implications of the study. The discussion section is where the author will share their interpretation of the results and discuss the implications their results may have in practice.[15] This can be an excellent section for the beginner to understand what was presented in the study design and results sections. In this section, authors will often explain the strengths and weaknesses and any limitations of their study. The authors may compare their findings with similar studies in the discussion.[36,56] This section usually highlights avenues for future research, which can be extremely valuable for researchers looking for research gaps and addressing the scientific community's needs.

The ninth tip in reading a scientific paper is to review the references. The reference list is generally viewed as a catalog of all resources used to write the manuscript of the study being read.[58] This can lead the reader to other relevant literature and help deepen their understanding of the topic, all while reducing stress associated with the literature search itself. For students tasked with writing papers, a literature search involves seeking out and compiling appropriate articles for review, and using the references of a key article may reveal similar articles, which may prove valuable during this essential step of the writing process.

The tenth tip is to take notes and summarize the main ideas. The reader is encouraged to take notes on key points, methods, and findings as they are reading. Once finished, the reader should summarize the main ideas they found interesting to reinforce their understanding and recall the information later. Readers are encouraged to take their time while reading the article and creating annotations. Rushing through the article will serve little benefit. To enhance comprehension, the reader could read the article multiple times.[23] For example, the reader could lightly skim the article to gain a preliminary understanding of its structure and themes. Then, the reader could do a more focused read to understand the content and findings of the paper comprehensively. Finally, the reader could go back and take notes that help facilitate deeper analysis and retention of the paper overall.[23]

The 11th tip in reading a scientific paper is to consider collaborative discussions. Engaging in conversations with colleagues or peers and sharing insights and perspectives can enhance the reader's understanding of the research and provide different viewpoints on the implications. Some hospitals have journal clubs where peer-reviewed articles are read and discussed. If the reader has read and enjoyed a timely article that applies to their facility, this could be an excellent opportunity to encourage others to read and discuss the findings. A helpful resource the AARC provides is the Respiratory Care JournalCast series on the AARC website. These webcasts feature the Editor's Choice of each issue of Respiratory Care and focus on the study's research design and an interpretation of the results, many of which are presented by RTs. Novice consumers of research can benefit from listening to experts in the field analyze different components of a study and discuss its outcomes, often applying a clinical context.

The final tip is to read scientific papers regularly. Though undergraduate students know that consuming scientific literature is essential as they progress in their program leading up to graduation, they tend to feel that reading peer-reviewed journals is frustrating because of advanced jargon and concepts they are unfamiliar with and accustomed to as students work to advance their scientific literacy.[26,48] By developing a habit of regularly reading peer-reviewed journals, the daunting nature of this task will gradually diminish. Ongoing practice will enhance the reader's ability to navigate scientific literature and help the reader stay abreast of the latest advancements in respiratory therapy or any field of study.

Conclusion

The ability of RTs to read and comprehend scientific peer-reviewed papers is critical for their professional growth as healthcare clinicians, encourages growth as an overall profession, and promotes quality and safe patient care delivery. Understanding the art of scholarly reading will help RTs keep informed of advancements in care delivery, embrace evidence-based practice, hone critical thinking skills, foster professional development, and ultimately contribute to QI initiatives in their respective practice areas. Additionally, this has the potential to help RTs elevate their practice and contribute significantly to the advancement of respiratory therapy as a profession. In an ever-evolving healthcare landscape with advanced medical technologies and clinical advancements, reading scientific literature is essential for those dedicated to providing optimal care to individuals with respiratory disorders.

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Deciphering Expected Student Learning Outcomes in CoARC Accredited Degree Advancement Programs

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Abstract

Background: Commission on Accreditation for Respiratory Care (CoARC)-accredited degree advancement (DA) programs are responsible for identifying expected student learning outcomes (ESLOs), articulating measurable outcomes that demonstrate mastery, collecting, analyzing, evaluating, and interpreting ESLO data, reporting findings, and implementing programmatic changes as a result. The CoARC does not currently prescribe what ESLOs programs should pursue; however, the standardized goal for DA and continued professional practice competencies should facilitate enhanced development and assessment. This investigation aims to descriptively analyze the data on the ESLOs currently being used by DA programs. **Methods:** A retrospective document review was conducted on the submitted DA ESLO Forms from 2023. Only data from either provisional or continuing accredited DA programs (n = 24) were evaluated. **Results:** The average number of reported ESLOs per program was 4.8. The most frequently reported ESLOs were related to practice-based research (100%), practice-related knowledge (91.7%), professional leadership (87.5%), professional attributes (79.2%), and interpersonal/ interprofessional communication (66.7%). Sixteen programs (66.7%) reported an institution-specific ESLO that did not reasonably fit into one of the continued professional practice competencies. The three MSRC programs were more likely to have ESLOs that reflect higher-order skills in research. **Conclusions:** Respiratory therapy faculty members are critical members of the cyclical assessment process, and professional development in this area of program administration should be sought and afforded by their respective institutions. The current outcomes-based approach to assessment in DA programs can support future competency development for both baccalaureate and master's degree programs in respiratory care.

Keywords: learning outcomes, accreditation, higher education, assessment, respiratory care

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Introduction

Expected student learning outcomes (ESLOs) are defined by The Commission on Accreditation for Respiratory Care (CoARC) as "what students are expected to be able to do, achieve, demonstrate, or know upon completion of the program."[1] These outcomes must be written so all stakeholders can easily understand them. Therefore, clear, concise language focusing on core knowledge is encouraged.[2] ESLOs should be regularly assessed (at least annually) to determine whether the educational process has achieved specific outcomes or objectives. Assessment drives learning in that it helps us better understand student needs.[2-3] Accreditation, both institutional and specialized, is a primary driver of assessment in higher education.[4] The program decides outcomes in consultation with various stakeholders, i.e., advisory committee members, and must be compatible with the sponsoring institution's mission and programmatic goals. Garfolo and L'Huillier state, "programmatic assessment should start and flow from a program's mission statement."[5]

For prospective student review, ESLOs must be made public (e.g., listed on the programmatic website) to be transparent and place the focus on learning rather than on instruction.[4] This also reflects institutions' responsibility to potential students and the community.[5] The program also determines the achievement measures, which can be collected and reported through direct (objective) and indirect (subjective) means of evidence. Direct assessments tend to be quantitative, whereas indirect measures are more qualitative, representing the perception of learning. Due to the high-stakes nature of ESLO demonstration of mastery, many data points that complement one another must be used.[3-4] The program should document where in the curriculum learning outcomes are introduced, developed/reinforced, and mastered with logical sequencing and flow. This helps to identify the progression of student performance in the identified areas because learning is both longitudinal and multidimensional.[3,5]

Programs must determine what 'mastery' of ESLOs means and identify ways for students to demonstrate it.[6] Mastery assignments should be accompanied by a specific grading rubric and made known/available to each learner enrolled in the program.[1] A rubric can be defined as a tool that "articulates the criteria for each identified learning outcome and contains a gradient of performance descriptors indicating [the] level of mastery."[5] Rubrics enable faculty and program administrators to gather the necessary output information to determine the impact on student learning and whether competence has been achieved.[4-6] Furthermore, rubrics are an effective and straightforward way to encourage authentic assessments.[4] CoARC does not currently prescribe what ESLOs programs should pursue; however, the standardized goal for degree advancement (DA) and continued professional practice competencies (CPPCs) should guide their development and continued assessment. ESLOs at the DA level must be above and beyond those of the entry-into-practice respiratory therapist (RT). CoARC provides an ESLO tool as a guide to assist programs in developing and mapping ESLOs (Appendix A).

The statement of program goals, as noted in CoARC Accreditation Standards for Degree Advancement Programs (DA 3.1), is as follows: "To provide graduates of entry into respiratory care professional practice degree programs with additional knowledge, skills, and attributes in leadership, management, education, research, and/or advanced clinical practice that will enable them to meet their current professional goals and prepare them for practice as advanced degree respiratory therapists."[1] Continued professional practice competencies encompass a wide range of skills associated with practice-related knowledge (DA 4.4), professional attributes (DA 4.5), interpersonal and interprofessional communication (DA 4.6), practice-based research (DA 4.7), professional leadership (DA 4.8), and the newly adopted professional specialty roles (DA 4.9), which can be electively obtained through a practicum experience. Currently, no DA programs have a mandatory clinical component. However, DA standard 4.9 allows transition to a specialized clinical practice role within the Registered Respiratory Therapist's scope of practice through appropriate employer supervision.[1,7] The specialty roles may also encompass nonclinical responsibilities, such as research and education.[1,8] This professional advancement in specialized areas may be captured in required graduate surveys administered and collected by the program as part of annual reporting measures.

CoARC defines degree advancement as "an educational program designed to meet the needs of practicing respiratory therapists who, having already earned an Entry into Respiratory Care Professional Practice degree, wish to obtain advanced training related to Respiratory Care."[9] Since the inception of CoARC-accredited DA programming in 2017 (three programs sought and received provisional accreditation: two BS and one MS), programs have been required to complete and submit the following documents: 1) The DA Reporting Tool 2) The DA Resource Assessment Matrix (RAM) and 3) the ESLO Form. These documents include information about the composition of the program, characteristics of the students, and determination of ESLO achievement. This information is compiled through various strategies, including student and graduate surveys. Through this reporting, the CoARC has an established database of reported ESLOs from accredited DA programs. This investigation aimed to descriptively analyze the data on the ESLOs currently being used by DA programs as related to the continued professional practice competencies. Furthermore, a distinction between ESLOs of baccalaureate (BS) and graduate-level (MS) DA programs is reported to help establish the framework for standardizing outcomes and competencies for each degree level pursuing professional advancement.

Methods

A retrospective document review was conducted with the submitted DA ESLO Forms (Appendix B) from 2023.[10] The form requires the program director or dedicated preparer to list each ESLO, changes to the assessment plan, corresponding effectiveness measures, assessment methodology (when, where, and how), and performance indicators/outcomes. The ESLO Form also allows for a reflection on the continuous improvement of student learning and any changes necessitated to achieve those goals. The reviewers are members of the Board of Commissioners and CoARC Executive Staff. They are also members of the DA subcommittee and would commonly have access to the information for required operational duties. However, this data has not been descriptively or qualitatively examined until now. The Primary Investigator's (PI) Office of Research Compliance determined this project does not meet its definition of human subject research on February 28, 2024. Therefore, a formal protocol application for approval was not required. The ESLO Forms, which contain publicly available programmatic information, are due to the CoARC by July 1 each year. After the Director of Operations and Technology had collected and compiled the documents, they were sent to the PI.

The ESLOs from each form were copied and pasted verbatim into a spreadsheet with the corresponding program number and program type (bachelor's or master's degree). This allowed the study team to import qualitative data (narrative from organizational reports) into a quantitative program (Google Sheets®) for analysis. Only data from either provisional or continuing accredited DA programs (n = 24) were evaluated. The review did not include programs that had approved letters of intent to start an accredited DA program at the time of the study. Upon identifying the respective ESLOs, the PI performed an initial review and hand-coded them into the closest matching continued professional practice competency (CPPC) based on specific terms and verbiage used in the ESLO and the DA standards. The CPPCs include Practice Related Knowledge (DA 4.4), Professional Attributes (DA 4.5), Interpersonal and Interprofessional Communication (DA 4.6), Practice-Based Research (DA 4.7), and Professional Leadership (DA 4.8). An additional category was included as a miscellaneous or institution-specific outcome that did not reasonably fit into one of the other predefined competency areas.

It should be noted that data from DA 4.3 (Practice Specific Knowledge and Skills) could not be evaluated solely based on the ESLO form, as there is no question specific to what summative measure is being pursued in the DA program. Likewise, DA 4.9 (Professional Specialty Roles: Practicum) could not fully be captured due to the new standards becoming effective June 1, 2023, and the annual report being due by July 1, 2023. Furthermore, the DA programs were labeled by the state in which the program is housed and the number of ESLOs per program.

Co-investigators sent the preliminary data to determine agreement with the categories (continued professional practice competencies as expected predetermined codes) chosen. The study team examined the data and provided comments or suggestions. The investigators then met synchronously to discuss the rationale for any suggested changes to the categorization of ESLOs. A consensus was obtained before the descriptive analysis of the reported data (i.e., intercoder agreement). Lastly, the data abstractors analyzed the ESLOs for specific verbs that could be identified in Bloom's Taxonomy.[11] The verbs were broken into three tiers that encompassed 1) knowledge and comprehension, 2) application and analysis, and 3) synthesis and evaluation. These tiers reflect the progressive nature of the ESLOs related to program type. Two of the study team members teach in or are administrators of an accredited DA program; therefore, the other investigators analyzed these programs more in-depth to reduce or eliminate bias in categorization. However, this DA oversight and teaching experience provided a great deal of context for how other programs reported ESLOs and interpreted the chosen outcomes. The variables were then descriptively calculated, and differences between subgroups were evaluated.

Results

ESLO data via the submitted ESLO forms for 24 DA programs were reviewed. The distinction in program type is reported in Figure 1, and the number of reported ESLOs is displayed in Figure 2. The average reported ESLO number per program was 4.8 (SD = 1.4). The number of DA programs per state is depicted in Figure 3, on the following page, with the most located in Ohio (n = 5) followed closely by North Carolina (n = 3). Each state with a Master's DA program also reported one Bachelor's DA program from the same institution/university.

Figure 1 DA Program Type (*n* = 24)

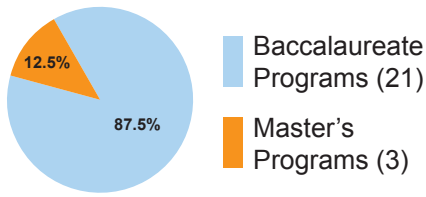


Figure 2 Number of ESLOs per Program (*n* = 24)

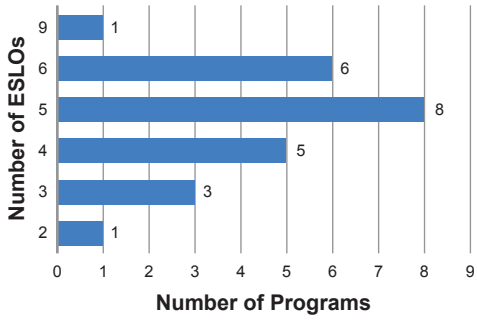
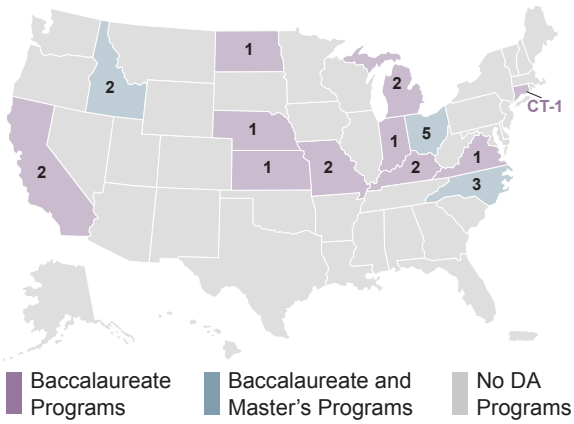


Figure 3 Number of DA Programs by State (as of July 2023) (*n* = 24)



100% (n = 24) of the DA programs reported an ESLO in the realm of research. This umbrella term is mentioned in DA standard 3.1 (program goal) and standard 4.7 (professional practice competency). However, there was variability in what programs expected students to be able to know or do in this category. Learning outcomes included the ability to formulate a clinical question to investigate, identify, and select relevant medical literature, evaluate the credibility and applicability of the literature, apply evidence-based medicine to clinical practice, compose/develop research proposals, abstracts, and manuscripts, and then disseminate this research to the medical and academic communities. Upon review, the ESLOs were classified based on action verbs in Bloom's Taxonomy. No lower-level knowledge and comprehension outcomes were reported for this competency identified by the reviewers. Ten ESLOs fell under Tier 2 (all BS programs), and 14 ESLOs fell under Tier 3 (11 BS and all 3 MS programs). Examples of ESLOs for each tier of competency are located in Table 1.

Table 1 Practice-Based Research Learning Outcomes

Tier Level of Competency	Example ESLO
Tier 1: Knowledge and Comprehension	None noted.
Tier 2: Application and Analysis	Evaluate evidence-based best practices through research and the critique and interpretation of professional scientific literature; Apply knowledge learned to specific areas of respiratory therapy through independent research. Students will demonstrate the ability to access, interpret, and review relevant medical literature associated with respiratory care and/or related to management, clinical practice, or education.
Tier 3: Synthesis and Evaluation	Students will develop and/or disseminate scientific information for the general public and the academic community in respiratory therapy practice, administration, and research. Draw on multiple sources of analysis, research, and critical thinking to address a problem and construct an applicable project focused on Respiratory Care.

91.7% (n= 22/24) of programs explicitly reported an ESLO specific to DA standard 4.4, Practice Related Knowledge. This particular competency focuses on caring for patients with cardiopulmonary disease and examines pathophysiology, pharmacology, monitoring, diagnostics, and advanced interventions. Competency ranged from understanding critical care concepts, deciding on preferred therapeutic interventions given the relevant patient clinical status, and ultimately, potential success on specialty credential exams demonstrating mastery. Four ESLOs were categorized into Tier 1 (three BS, one MS program), 10 ESLOs into Tier 2 (nine BS, and one MS program), and eight ESLOs into Tier 3 (seven BS, one MS program). ESLO categorization for each tier of competency is in Table 2.

Table 2 Practice-Related Knowledge Learning Outcome

Tier Level of Competency	Example ESLO
Tier 1: Knowledge and Comprehension	Demonstrate knowledge in advanced respiratory critical care. Demonstrate an enhanced level of knowledge related to the practice of respiratory care that is above that of entry into the profession.
Tier 2: Application and Analysis	Explain advanced concepts relating to critical care pathophysiology, disease management, clinical management, and care coordination. Apply and evaluate information in relation to the advanced medical treatment of the critically ill adult patient relevant to his/her role as an advanced-level respiratory therapist.
Tier 3: Synthesis and Evaluation	Integrate pertinent clinical data into recommendations for appropriate critical care interventions. Perform the duties and functions of an advanced practitioner in neonatal, pediatric, and adult critical care; Successfully pass professional credentialing exams including Adult Critical Care Specialist, Neonatal and Pediatric Specialist, Asthma Educator (NAEB), and the Registered Pulmonary Function Technologist national board exams.

The next most reported ESLO pertained to DA standard 4.8, Professional Leadership. Verbiage related to managerial/administrative roles and advocacy efforts was included in this category. 87.5% (n= 21/24) explicitly reported ESLOs associated with this competency. Leadership topics included public policy, quality improvement, decision-making, teamwork, respect, and reasoning. Five ESLOs were categorized under Tier 1 (all BS programs), 10 ESLOs under Tier 2 (eight BS, two MS programs), and six ESLOs under Tier 3 (five BS, 1 MS programs). Examples of ESLOs for each tier of competency are located in Table 3.

Table 3 Professional Leadership Learning Outcome

Tier Level of Competency	Example ESLO
Tier 1: Knowledge and Comprehension	Students will become proficient in expanding their healthcare knowledge past that of an entry-level practitioner as they explore the responsibilities associated with management positions and other advanced roles within respiratory therapy. Students will comprehend the role of leadership and management as it relates to state healthcare policies that affect patient care, and professional practice.
Tier 2: Application and Analysis	Apply leadership and management theory through the lens of change theory to both the educational and clinical environments. Examine effective leadership techniques and practices used in the healthcare setting.
Tier 3: Synthesis and Evaluation	Effectively lead a group of professionals to promote patient advocacy and or advocacy of the profession. Students will demonstrate effectively the ability to lead a group of professionals in an ethical manner, promoting patient advocacy.

Professional attributes, as defined in DA standard 4.5, were the fourth most reported ESLO at 79.2% (n= 19/24). Professional characteristics assessed by programs included professional behavior, empathy, cultural competency, commitment to ethical practices, professional development, and lifelong learning. Four ESLOs fell under Tier 1 (three BS, 1 MS program), 11 ESLOs under Tier 2 (nine BS, two MS programs), and four ESLOs fell under Tier 3 (all BS programs). ESLO categorization for each tier of competency is in Table 4.

Table 4 Professional Attributes Learning Outcome

Tier Level of Competency	Example ESLO
Tier 1: Knowledge and Comprehension	Students will articulate professional and clinical roles related to the respiratory therapy profession, such as leadership, education, and research. Understand ethical theories and principles as they apply to patient scenarios; analyze multiple perspectives on current issues in healthcare.
Tier 2: Application and Analysis	Cognizant of cultural differences within diverse patient populations and have an awareness of how those differences may affect the delivery of healthcare and outcomes. Display professional and ethical behaviors that prioritize the interest of those they serve.
Tier 3: Synthesis and Evaluation	Students will demonstrate cultural competency as a healthcare provider on an interprofessional team. Students will demonstrate the ability to solve complex healthcare situations and take into consideration the ethical concerns of all members of the team while focusing on direct and indirect patient care. Students will demonstrate a high level of responsibility, ethical practice and behavior, awareness, and responsiveness to diversity, and strict adherence to legal and regulatory requirements.

Interpersonal and interprofessional communication was the fifth most reported ESLO, reflected in DA standard 4.6. 66.7% (n=16/24) of programs explicitly mentioned written or verbal communication within at least one ESLO. This communication may occur in various contexts, and interactions such as with patients, their families, colleagues/peers, students, and the community were applicable. No lower-level knowledge and comprehension outcomes were reported for this competency either. Seven ESLOs were categorized as Tier 2 (all BS programs) and nine ESLOs as Tier 3 (seven BS, two MS programs). Examples of ESLOs for each tier of competency are located in Table 5.

Table 5 Interpersonal and Interprofessional Communication Learning Outcome

Tier Level of Competency	Example ESLO
Tier 1: Knowledge and Comprehension	None noted.
Tier 2: Application and Analysis	Students will apply professional communication and critical thinking skills/strategies when working with interprofessional teams to evaluate information, solve problems, & make decisions, incorporating all aspects necessary to deliver effective, patient-centered care. Demonstrate effective written, oral, and visual communication skills by presenting arguments, recommendations, and research with relevant sources used for support with proper citation.
Tier 3: Synthesis and Evaluation	Students will develop a health promotion project and work collaboratively to communicate effectively as members of an interprofessional team. Utilize effective oral and written communication skills consistent with professional communication as may be published in a peer-reviewed journal or presented at a professional conference.

The final category of ESLOs was combined to encompass institution-specific learning outcomes or those that did not logically fit into one of the other predefined areas. Sixteen programs (66.7%) have an ESLO within this bracket. Upon thematic analysis of the reported outcomes, the primary topics included information technology, protocol development (only included here if the research ESLO had already been identified), education (patient and peer), disease management, pulmonary rehabilitation, and those that could be considered faith based. Examples of these miscellaneous ESLOs are in Table 6.

Table 6 Miscellaneous Learning Outcome

Topic Area	Example ESLO
Information Technology	Incorporates information technology skills in a variety of healthcare settings. Demonstrate proficiency in the skills necessary to utilize current technologies such as EMR/EHR computer and online charting and data collection systems/services and applications appropriate for respiratory management, respiratory education, and research.
Protocol Development	Students will become proficient in the development of their own proposed research protocols to challenge issues encountered in healthcare and the event of a mass causality emergency. Students will plan, execute, and evaluate, treatment protocols that enhance the departments and patients that they serve.
Patient/Peer Education	Apply educational theory practice to implement education programs for pulmonary disease patients. Effectively teach other professionals, patients, and their families.
Disease Management	Participate as a multidisciplinary team member in patient education and disease management of acute and chronic illnesses. Students will participate as multidisciplinary team members, providing education and disease management to acute and chronically ill patients and their families, along with understanding the expanded roles that respiratory therapists hold.
Pulmonary Rehabilitation	Assess current issues and trends in healthcare, including public policy, access, quality improvement, and legal and ethical topics; Illustrate understanding of the importance of pulmonary rehabilitation and its impact on cardiopulmonary disorders; Develop respiratory education through the diagnosis, management, and treatment of patients affected by cardiopulmonary disorders. Demonstrate strategies to enhance patient education and rehabilitation.
Faith-Based	Integrate a biblical worldview within the healthcare environment.

Discussion

The average number of reported ESLOs per program was 4.8, which aligns with recommendations from both Garfolo & L'Huillier and Swarat et al., which imply a range of four to seven is ideal for assessing the most crucial outcomes.[4-5] The learning outcomes can evolve depending on the strategic initiatives of the program or institution and, therefore, may need routine updating. Modifications should also take place when the scope of practice in disciplines evolves. However, the overarching goal of assessment should be student growth and success. Respiratory care faculty members are critical to the assessment process and should contribute to identifying ESLOs. To be faculty-designed and driven, professional development in writing learning objectives, articulating measurable outcomes, and collecting and analyzing the data should be afforded to the faculty responsible for this task.[2] Institution administration should be aware of the significant commitment expected of this process and provide the necessary release time to key personnel for each step in the cyclical assessment process. Because each accredited MSRC DA program also had a BSRC DA program, this may signal to other baccalaureate granting institutions the feasibility of opening a graduate-level program. With the knowledge and experience of degree advancement and the current overlap in accreditation standards, these programs could be well-suited to offer more advanced programming. Furthermore, the number of graduates from master's degree programs was down by 2.6% in 2023.[12] Though the number of states wherein a DA program is offered has grown because of recent approvals in letters of intent and/or provisional accreditation, there are still more than 30 states that do not have a DA program. A DA program may provide a logical pathway for advanced degree completion in states with only associate degree programs for entry into practice.

ESLOs pertaining to practice-based research were the most frequently reported, and no lower-level learning outcomes were identified. This is likely because entry into practice standards includes "evaluating published research for its relevance to patient care" as a competency.[13] Additionally, research is explicitly mentioned in the required program goal for bachelor's and master's degree respiratory therapy programs, and therefore, learning experiences are expected to be incorporated into the curriculum. Goodfellow recently noted that all entry-level RTs have a basic awareness of research methods and should be consumers of research led by curiosity and the desire to improve patient outcomes.[14] The concept and importance of having respiratory therapists actively involved in research in some capacities have long been discussed. Barnes et al. included this in their "2015 and Beyond" paper in Competency Area III: Evidence-based Medicine (EBM) and Respiratory Care Protocols.[15] This was a seminal publication in the profession and could be why many ESLOs fall into this category. Reviewing and critiquing published research and applying EBM to clinical practice were frequent themes noted in the review of the ESLOs. The development and use of respiratory-driven protocols were also noted in the miscellaneous category when another ESLO was more specific to practice-based research. It was noted that master's degree programs were more likely to have students conduct or perform research (Tier 3), corresponding to higher-order thinking expectations. This coincides with many who report formal research training taking place in graduate-level programs.[14] Though learning outcomes related to research could logically serve as a summative measure (DA 4.3), only one program explicitly mentioned the term 'Capstone' in an ESLO. The Director of Clinical Practice Guidelines for the American Association for Respiratory Care (AARC), Lynda Goodfellow, has been noted as saying, "Just as the teeth of a zipper interlock to connect, research education can and should be intertwined throughout the RT undergraduate curriculum for knowledge transfer to post-graduate clinical evidence-based practice."[14]

A couple of programs (n = 2) reported a practice-related knowledge ESLO, which led to completing a National Board for Respiratory Care (NBRC) specialty credential. Anecdotally, key personnel have reported difficulty confirming and tracking this information for DA students upon graduation. The onus has been on the graduate to report this achievement to the program or for program faculty to check the NBRC website and verify credentials earned routinely. This can be time-consuming depending on the number of graduates and may result in positive outcomes potentially missed. Instead of having this listed as an outcome, it may be better to report this as an indicator of professional advancement on graduate surveys (DA 3.6).

Furthermore, some programs report mandatory institution-specific learning outcomes. While ideally, these outcomes complement each other well, respiratory care programs are quite distinct and require very tailored verbiage in developing their ESLOs to enhance professional practice. A few programs used verbatim language from the DA standards, which is not prohibited but should be stated in a way that is both understandable and measurable.

Communication as an ESLO resulted in a few interesting findings. First, no lower-level actions on Bloom's Taxonomy related to this competency were reported. It can be assumed that DA students, who are, by definition, already practicing healthcare providers, are expected to be able to communicate effectively. With the prevalence of medical misinformation and the potential for medical errors, communication could arguably be the most critical competency for health-related fields of study. Communication failures can negatively impact patient outcomes, such as the occurrence of a sentinel event.[16] It was encouraging to see DA programs building upon the learners' prior knowledge and incorporating opportunities to apply written and verbal communication into the curriculum meaningfully. One MSRC program did not report an ESLO specific to interpersonal and interprofessional communication. It is both possible and likely this competency is integrated into the curriculum but wasn't chosen as one of the key learning outcomes to assess. Additionally, communication skills could

be interwoven into other competencies requiring this skill, such as leadership, research, and disease management/ patient education.[15]

There were overlaps in the professional attributes section of the ESLOs and the American Association of Colleges and Universities (AAC&U) VALUE Rubrics.[17] For instance, intercultural knowledge and competence, critical thinking, ethical reasoning, and problem-solving are characteristics desired by respiratory care practitioners and graduates of higher education.[1,13,17] This open educational resource could benefit baccalaureate programs developing their ESLOs. The acronym VALUE refers to Valid Assessment of Learning in Undergraduate Education. There are 16 published VALUE Rubrics, including oral/written communication and teamwork.[17] Furthermore, for programs that focus on interprofessional collaborative practice, the Interprofessional Education Collaborative (IPEC) Core Competencies of values/ethics, roles/responsibilities, communication, and teams/teamwork may also guide ESLO development.[18] The miscellaneous category of ESLOs also overlaps with several of the CPPCs. For instance, the use of information technology was listed under professional leadership (4.8). Competencies related to patient education could be found under practice-related knowledge (4.4), communication (4.6), and leadership (4.8). Likewise, disease management was mentioned in practice-related knowledge (4.4) and communication (4.6). Pulmonary rehabilitation is cited as a potential avenue for a practicum experience (4.9), though the ESLOs related to this topic reflected more knowledge versus performance of this role. The ESLO was placed in the institution-specific category because the closest matching CPPC had already been reported.

The CoARC is accredited by the Council for Higher Education Accreditation (CHEA), which, "ensures that colleges and universities and their programs provide academic quality for students and accountability to the public."[19] Accreditation bodies expect a culture of assessment.[2] Currently, the DA standards support an outcomes-based approach to assessment. Nodine defines outcome-based programming as demonstrating learning through students' actions and performances that embody and reflect competence.6 Outcomes-based program assessment can then support competency development.[20] Goodfellow has noted that efforts to define national standards for degree-level research competencies should be sought.[14] It is common for programs to adopt predetermined student learning outcomes, especially in softly applied disciplines, such as nursing.[4] They are also comfortable with assessment practices due to the development of protocols and procedures in that field, unlike respiratory care. There are opportunities in online programming for working adults to achieve worthwhile educational credentials, and accredited DA programs in respiratory care can offer both quality assurance and accountability in their pursuit.

Limitations

As noted before, this review of reported ESLOs may not reflect each competency area being introduced or reinforced in the program curricula, simply the ones formulated into a measurable learning outcome. Likewise, due to the choice of language, ESLOs could apply to more than one category or competency area. This highlights the need for greater emphasis on clear and concise written outcomes that are specific. Furthermore, 'professionalism' can be subjective, impacting how it is observed, assessed, and measured. Leadership attributes were another difficult area to assess due to its many facets and expectations. Adeptness in information technology, patient education, and cultural competence could all be linked to professional leadership. Finally, some verbs were listed in more than one category of Bloom's Taxonomy. For instance, 'describe' could be found in the lower-level tier (knowledge and comprehension) and the higher-level tier (synthesis and evaluation). Therefore, the study team required an analysis of the context of the reported ESLO. Lastly, it has been noted that the term 'assessment' lacks exactness,[5] making the entire process more arduous. However, an imperfect assessment can still be meaningful.[2]

Conclusion

This retrospective review of reported ESLOs for CoARC-accredited DA programs highlights the similarities in the number and content of program-chosen learning outcomes. Additionally, it describes the subtle differences between and among baccalaureate and graduate degree respiratory care programs. Assessment is meaningful when an improvement in learning is apparent, and the student experience is enhanced. Identifying and training program faculty to complete the assessment process is paramount to determining the program's overall effectiveness and its graduates' ultimate success. As healthcare-related professional practice evolves, student learning outcomes, competencies, instructional practices, and assessment should also be expected.

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Appendix A

Developing and Implementing Your DA Program ESLOs

ESLO Development

ESLO #1: Insert your 1st expected student learning outcome.

Introduce: Where in the curriculum do you introduce the ESLO?

Develop: Where in the curriculum is the ESLO developed?

Master: What assignment in the curriculum offers the ability to master the ESLO?

*(list an associated assignment(s) within a course)

The direct measure for this ESLO is:

- Example: 80% of the students assessed will achieve a score of “acceptable” or higher on the mastery assignment.

The indirect measure for this ESLO is:

- Questions on your graduate survey that address each ESLO.

*Continue for each identified ESLO

ESLO Mapping

You can use this mapping tool to identify courses in the DA curriculum wherein the ESLOs will be embedded (DA 4.1). Courses and ESLOs can be added or removed from this document to reflect individual programs’ goals and curricula. It is recommended that there be a clearly defined entry and exit point in the program. There must be a program-defined summative measure (DA 4.3).

	RC__	RC__	RC__	RC__	RC__	RC__	RC__	RC__	RC__	RC__
ESLO 1										
ESLO 2										
ESLO 3										
ESLO 4										
ESLO 5										
ESLO 6										

Helpful tips/reminders concerning mapping ESLOs:

*At a minimum, at least one course should be identified that introduces, develops, and masters the learning outcome, which should have a logical progression in the overall curriculum (i.e. mastery will likely not be achieved in the first course in the program).

*Place an “I” for introduction to the ESLO, “D” for developed, and “M” for mastery in the appropriate box. Learning opportunities related to more than one ESLO can occur in each course as applicable.

*One culminating experience may demonstrate mastery of all programmatic learning outcomes. However, it is common to have mastery occur over various summative measures in courses and assignments.

Appendix B

Excerpt from CoARC DA Expected Learning Outcomes (ESLO) Form

Program Number:

Program Name:

Reflection on the Continuous Improvements of Student Learning

1. List the changes and improvements your program planned to implement as a result of last year's student learning outcomes assessment data.
2. Were all of the changes implemented? If not, please explain.
3. What impact did the changes have on student learning?

Student Learning Outcome 1
(Knowledge, skill, or ability to be accessed)

1. Explain Learning Outcome 1
2. **Changes to the Student Learning Outcomes Assessment Plan:** If any changes were made to the assessment plan (which includes the Student Learning Outcome, Effectiveness Measure, Methodology, and Performance Outcome) for this student learning outcome since your last report was submitted, briefly summarize the changes made and the rationale for the changes.
3. **Effectiveness Measure:** Identify the data collection instrument, e.g., exam, project, paper, etc. that will be used to gauge the acquisition of the student learning outcome and explain how it assesses the desired knowledge, skill, or ability.
4. **Methodology:** Describe when, where, and how the assessment of this student learning outcome will be administered and evaluated. Describe the process the department will use to collect, analyze, and disseminate the assessment data to program faculty and to decide the changes/ improvements to make based on the assessment data.
5. **Performance Outcome:** Identify the percentage of students assessed who should be able to demonstrate proficiency in this student learning outcome and the level of proficiency expected. Example: *80% of the students assessed will achieve a score of "acceptable" or higher on the Oral Presentation Scoring Rubric*.
6. Based upon your data included in this annual report, what changes/improvements will the program implement during the next year to improve performance on this student learning outcome?

*Continue for each identified ESLO