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## *Applied Research*



## *Original Research*



## *Point of View*

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# Predicting Graduate Performance on Selected Respiratory Care Program Outcome Measures: Development of a Correlational Model

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**Abstract**

Respiratory care education programs seek to prepare competent practitioners who possess a broad base of knowledge as well as the affective and procedural skills needed to function as respiratory therapists. Graduates must have an understanding of basic respiratory care, cardiovascular diagnosis, disease prevention and management, sleep physiology, advanced life support, patient transport, neonatology, pediatrics, and gerontology, as well as research.

## Predicting Graduate Performance on Selected Respiratory Care Program Outcome Measures: Development of a Correlational Model

According to the American Association for Respiratory Care National Consensus Conference on Respiratory Care Education (Smith, 1994), respiratory therapists of the future will be required to possess skills that will enable them (a) to build technical networks to gather information for problem solving; (b) to manage time and work more efficiently; (c) to communicate effectively; and (d) to become visionary, active leaders who are also committed followers and members of the health care team. Furthermore, Smith found that the advent of cost-containment is likely to lead to smaller, more highly trained pools of therapists and will heighten competition for jobs.

Success in achieving these goals is assessed by a variety of outcome measures, including National Board for Respiratory Care (NBRC) credentialing examinations, employers' evaluations of graduates, and graduates' evaluations of the program. The ability to reliably predict success in these and other areas is desirable but difficult to accomplish. Many educators over the years have with varying degrees of success attempted to predict successful completion of programs by entering students (Douce & Coates, 1984; Hedl, 1987; Op't Holt & Dunlevy, 1992; Posthuma & Noh, 1990; Standridge, Boggs, & Mugan, 1997; Tompkins & Harkins, 1990). Completion of an education program does not ensure competence as a practicing clinician, however, since according to Czachowski (1997), theory must be linked to daily practice. Czachowski found that patient-driven protocols demand respiratory therapists who can collect data, interpret it, and act on it in a decisive and knowledgeable way.

While Tompkins and Harkins (1990) showed that the respiratory care education program grade point average (GPA) was positively correlated with performance on the certified respiratory therapy technician (CRTT) credentialing examination, and reading ability may relate to CRTT performance (Shaw & Osterlind, 1997), there is a paucity of data in the literature regarding predictors of outcomes frequently used as measures of program success in preparing students to be professionals. It is our goal to improve our new baccalaureate degree program in respiratory care. Toward this end, we have attempted to develop a model that may potentially be useful in determining predictors of successful respiratory care education program outcomes for which we are held accountable for accreditation purposes.

### Methods

Existing records of all graduates ($n$ = 29, the first three graduating classes of 12, 8, and 9 students, respectively) of our new baccalaureate respiratory care program were reviewed to obtain the scores for specific predictor variables. Outcome measures obtained were NBRC entry-level (CRTT) credentialing examination scores, end-of-program competency assessment results utilizing a restricted version of the NBRC written registered respiratory therapist (WRRT) exam, and information-gathering (IG)/decision-making (DM) scores on the Clinical Simulation Examination (CSE) given near program completion.

Graduates and employers were surveyed to assess achievement of cognitive (CS), psychomotor (PS), and affective (AS) program standards. Independent variables included entering GPA (EGPA), program prerequisite GPA (PGPA), interview score (I), critical thinking ability (CT) as assessed by the Watson-Glaser Critical Thinking Appraisal, results of the end-of-first-year competency examination (FYEX), professional program respiratory care GPA (RCGPA), CRTT self-assessment examination (CRTTSAE), and WRRT self-assessment examination (WRRTSAE) results. Form VI of the NBRC CRTT self-assessment exam was used for the CRTTSAE scores. Form V of the NBRC WRRT self-assessment examination was used for the WRRTSAE scores.

The Watson-Glaser Critical Thinking Appraisal evaluates subjects' ability to make inferences, recognize assumptions, perform deduction, and interpret and evaluate arguments (Berger, 1985). The Watson-Glaser test generates an overall CT score. Interview scores were generated using a rating scale where 5 = *priority admit* (outstanding potential), 4 = *admit* (good student), 3 = *alternate*, 2 = *low priority*, and 1 = *unacceptable.* The FYEX consisted of a 140-item, teacher-made, multiple-choice test covering the major objectives of the junior year of the program, with content being similar to that found on the NBRC CRTT examinations. The graduate and employer evaluations of graduate achievement of cognitive, psychomotor, and affective program standards used a rating scale where 4 = *excellent*, 3 = *good*, 2 = *average*, 1 = *acceptable*, and 0 = *unsatisfactory.*

The data were analyzed with the STATISTICA (1998) software package for microcomputers. Pearson product moment correlations were performed for predictor and outcome variables. A significant correlation ($p < 0.05$) would indicate a relationship or association between two variables (Ary, Jacobs, & Rzavieh, 1985). Forward stepwise multiple regression analyses, which included all independent variables from the foregoing correlations as predictors, were then performed. Outcome variables for the regression analyses were CRTT, WRRT, IG, DM, and employer and graduate survey scores for achievement of CS, PS, and AS program standards. A coefficient of multiple correlation ($R$) significance level of $p < 0.05$ would indicate the ability of the predictor variables, when used in combination, to predict a specific program outcome (Kerlinger & Pedhazur, 1973).

A significant $t$ test of the partial regression coefficients ($p < 0.05$) for each variable in the regression equations would indicate that particular variable's ability to predict a specific program outcome after the other variables had already contributed to the prediction. $R^2$ was then reviewed to determine the amount of variance in the outcome scores accounted for by the independent variables (Kerlinger & Pedhazur, 1973).

## Results

Tables 1 and 2 contain the results of the correlational and regression analyses. As shown in Table 1, CRTT examination scores were significantly correlated with EGPA, PGPA, CT, FYEX, RCGPA, and CRTTSAE. WRRT scores were significantly correlated with EGPA, PGPA, FYEX, RCGPA, and WRRTSAE. IG was significantly correlated with CRTTSAE, and DM with I, FYEX, RCGPA, CRTTSAE, and WRRTSAE. Graduate evaluations for CS and PS were significantly correlated with FYEX, and AS with both FYEX and CRTTSAE.

Table 1
*Pearson Product Moment Correlation Coefficients Comparing Predictor and Outcome Variables*

| Outcome measures | | | Clinical simulation | | Graduate evaluations | | | Employer evaluations | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Predictor variables | CRTT | WRRT | IG | DM | CS | PS | AS | CS | PS | AS |
| Entering GPA | 54** | .44* | -.07 | -.27 | -.03 | -.11 | -.08 | .05 | .14 | .02 |
| Prerequisite GPA | .42* | .47* | -.07 | -.20 | .11 | .05 | .02 | .02 | .17 | -.08 |
| Interview score | .08 | -.03 | .12 | .47** | .10 | .13 | .30 | -.26 | -.26 | -.26 |
| Critical thinking ability | .43* | .14 | .23 | .04 | .16 | .08 | .24 | -.01 | .02 | .28 |
| First-year competency exam | .52** | .39* | .27 | .52** | .43* | .46* | .42* | -.04 | -.09 | .02 |
| Professional program respiratory care GPA | .47* | .50** | .18 | .44* | .19 | .13 | .14 | .04 | -.01 | .04 |
| CRTTSAE | .54** | .29 | .39* | .48** | .12 | .14 | .38* | -.11 | -.11 | -.10 |
| WRRTSAE | .20 | .50** | -.19 | -.37* | -.23 | -.03 | -.11 | .23 | .31 | .29 |

*Note.* GPA = grade point average; CRTT = actual certified respiratory therapy technician examination scores; WRRT = restricted version of written registered respiratory therapist examination available to programs and utilized as a required end-of-program competency examination; IG = information-gathering scores on a Clinical Simulation Examination (CSE) given near graduation; DM = decision-making scores on a CSE given near graduation; CS = cognitive standards; PS = psychomotor standards; AS = affective standards (professional characteristics); CRTTSAE = CRTT self-assessment examination given during the senior year of the program; WRRTSAE = WRRT self-assessment examination given during the senior year of the program. *$p < .05$. **$p < .01$.

According to data shown in Table 2, the coefficient of multiple correlation, $R^2$, indicates that in combination, the independent variables accounted for 58% of the variance observed in CRTT scores, 61% of the variance in the WRRT, 23% of the variance in IG, and 63% in DM. For graduates' evaluations, 32% of the variance in CS, 34% of the variance in PS, and 19% of the variance in AS was explained.

Predictors of CRTT performance, based on regression analysis, included the CRTTSAE, EGPA, CT, RCGPA, and I, with the strongest predictor being EGPA ($p$ =

Table 2
*Forward Step-Wise Multiple Regression Analysis Utilizing the Independent Variables to Predict Program Outcomes*[a]

| Multiple regression results | | | | |
|---|---|---|---|---|
| Outcomes | *R* | $R^2$ | *F* | *p* |
| CRTT | .76** | .58 | 5.81 | .002 |
| WRRT | .78** | .61 | 8.65 | .0002 |
| IG | .48* | .23 | 3.56 | .04 |
| DM | .80** | .63 | 5.75 | .001 |
| Graduate CS | .56* | .32 | 3.55 | .03 |
| Graduate PS | .58* | .34 | 3.95 | .02 |
| Graduate AS | .42* | .19 | 5.41 | .03 |
| Employer CS | .32 | .10 | 1.40 | .27 |
| Employer PS | .39 | .15 | 2.10 | .14 |
| Employer AS | .45 | .20 | 1.96 | .15 |

*Note.* CRTT = actual certified respiratory therapy technician examination scores; WRRT = restricted version of written registered respiratory therapist examination available to programs and utilized as a required end-of-program competency examination; IG = information-gathering scores on a Clinical Simulation Examination (CSE) given near graduation; DM = decision-making scores on a CSE given near graduation; CS = cognitive standards; PS = psychomotor standards; AS = affective standards (professional characteristics).
[a]Independent variables entered into the regression analysis included entering GPA (grade point average), prerequisite GPA, interview scores, critical thinking ability, results of the end-of-first-year competency examination, professional program respiratory care GPA, and CRTT and WRRT results.
*$p < .05$. **$p < .01$.

0.04). Predictors of WRRT performance included PGPA, RCGPA, WRRTSAE, and I, with RCGPA and WRRTSAE being the strongest predictors ($p = 0.02$ and $p = 0.004$, respectively). Predictors of clinical simulation IG performance included CRTTSAE and

WRRTSAE scores, with the CRTTSAE being the best predictor ($p = 0.02$). Predictors of clinical simulation DM scores included FYEX, WRRTSAE, I, EGPA, CRTTSAE, and PGPA. Of these variables, WRRTSAE scores were the strongest predictors of DM performance ($p = 0.04$).

Regression analyses for graduate survey results indicated that CS was predicted by FYEX, WRRTSAE, and CRTTSAE. Graduate PS scores were predicted by FYEX, CRTTSAE, and RCGPA. Graduate AS scores were predicted by FYEX. FYEX was the strongest predictor for graduate survey scores for CS, PS, and AS ($p < 0.03$). Based on regression analyses, there were no significant predictors for employer survey scores for CS, PS, or AS ($p > 0.05$).

## Discussion

It is our responsibility as educators to produce competent respiratory therapists with the knowledge, skills, and attitudes necessary for successful practice in the profession. Indeed, we are held accountable by our accreditation agency for providing such training and education. Based on this study, it may be possible to predict graduate performance on the entry-level NBRC CRTT examination and the WRRT examination, as well as the information-gathering and decision-making components of the CSE. Furthermore, graduates' evaluations of how well they measure up to program standards may also be predicted.

The results of the study indicate that it may be possible to predict performance on the CRTT and the WRRT based on students' GPA. It further shows the potential for the pre-program interview score to predict performance on DM of the CSE. Students' CT and FYEX scores tend to be correlated with CRRT performance, and FYEX was also positively correlated with WRRT, DM, CS, PS, and AS. RCGPA, in addition to being correlated with CRTT and WRRT, positively correlated with performance on DM. The CRTTSAE was correlated with CRTT, IG, DM, and AS, and WRRTSAE was correlated with WRRT and DM.

While a number of positive correlations exist between CRTT and WRRT examination scores and predictor variables, as well as for the DM component of the CSE, only the CRTTSAE exhibited a positive zero-order correlation with students' scores on IG. When combined with WRRTSAE scores, we were able to account for 23% of the variance in IG scores. This finding may be due to the small number of subjects in our study. However, we suspect that it is relatively easy to teach students of varying ability to perform well on the IG section of the CSE. Consequently, there may be little relationship between IG scores and student performance on other measures.

It was encouraging to be able to demonstrate that there may be a number of correlations with student performance on the DM portion of the CSE. Our study indicated that I, FYEX, RCGPA, WRRTSAE, and CRTTSAE scores all correlated significantly with students' DM performance. Together the predictor variables were able to account for an impressive 63% of the variance in DM.

Interestingly, performance on the WRRTSAE was negatively correlated with DM

($R$ = -0.37), while there was a positive correlation between CRTTSAE and DM ($R$ = 0.48). The CSE is designed to measure patient-management skills and clinical problem-solving ability. This is probably a different construct from what is assessed by the WRRT. Previous studies have shown a weak or absent relationship between general critical thinking ability and decision-making performance on the CSE (Shelledy, Mishoe, Lawson, & Murphy, 1997; Shelledy, Valley, Murphy, & Carpenter, 1997). This fact provides some evidence that the construct measured by the DM section of the CSE is, in fact, different from that assessed by other measures.

Not surprisingly, student performance on the pre-program interview was not particularly useful in predicting program outcomes. Interview scores have had little predictive value historically (Op't Holt & Dunlevy, 1992; Posthuma & Noh, 1990); however, we did find a moderate correlation between our students' pre-admission interview scores and their performance on the decision-making portion of the CSE. This finding may be due to the subjective nature of the interview and to the interviewer's ability to discern which prospective students appeared to be decisive and self-directed. Based on regression analysis, interview scores also were of some value in predicting CRTT and WRRT performance.

End-of-first-year competency exam results were correlated with the students' evaluations of their cognitive, psychomotor, and affective skills. There also was a weak, though significant, correlation between results on the CRTTSAE and graduates' evaluations of achievement of affective skills. None of the independent variables predicted the results of employers' evaluations. Our inability to predict employers' evaluations of graduate performance was disappointing. However, review of individual scores given by employers demonstrated very high ratings for all graduates, with little variation. This may account for the lack of correlation between the predictor variables and employer rating scores.

## Conclusion

In summary, we found a significant correlation, and therefore predictive potential, between EGPA, PGPA, and RCGPA and performance on the CRTT and WRRT. Interview scores were significantly correlated with DM, as were FYEX with performance on the CRTT, the WRRT, DM, and the CS, PS, and AS components of graduate evaluations of the program; CT with CRTT performance; RCGPA with WRRT and DM performance; CRTTSAE with performance on the CRTT, IG, and DM, as well as the AS component of graduate evaluations of the program; and WRRTSAE with performance on the WRRT and DM.

A substantial amount of time and resources is invested in each student enrolled in an accredited respiratory care education program. Development of a correlational model for assessment of program outcomes may help respiratory care programs choose appropriate criteria for student selection, as well as serve as a predictive tool for identifying students who are likely to successfully meet desired program outcomes.

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# Construction and Validation of an Instrument to Assess Critical Thinking in Respiratory Care: An Empirical Process

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**Abstract**

The purpose of this study was to investigate and establish the reliability and validity of an instrument to measure critical thinking among respiratory therapists. Mishoe's (1995) identification of critical thinking skills served as the theoretical framework for this study. Questions derived from Mishoe's study, expert respiratory therapists, and the literature. After content validity was established, a pilot instrument was mailed to 100 random registered respiratory therapists. A 60% return rate was achieved. Response variance was analyzed and possible redundancies were noted by intercorrelations. Instrument reliability was estimated at 0.94 using Cronbach's alpha. With minor revisions, this instrument can be used to measure critical thinking in respiratory care.

## Construction and Validation of an Instrument to Assess Critical Thinking in Respiratory Care: An Empirical Process

Critical thinking helps us decide what really matters, what is important, and how to achieve our goals and aspirations. Critical thinking is an important ability that is required for all professionals, most certainly in the health care professions. Basic technical skills may no longer be enough to process and use information. Health care practitioners today must become thinkers who know a great deal and who can continually adapt, refine, and use their knowledge.

There is a need to investigate critical thinking in professional practice and to be able to make summarizations about the nature of critical thinking that can be tested in further research. But how one specifically measures critical thinking behaviors in clinical practice is not well understood. The purpose of this study was to develop a reliable and valid instrument to measure critical thinking in respiratory care practice.

### Theoretical Framework

Mishoe's (1995) study focused on the expert practice of 18 respiratory therapists employed in acute care settings. To Mishoe, critical thinking in the practice of respiratory therapy is the cognitive process described by logical reasoning, problem solving, and reflection. This working definition incorporates the reflective, communicative, practical, and experiential aspects of critical thinking. Mishoe determined that critical thinking in respiratory care practice involves the abilities to prioritize, anticipate, troubleshoot, communicate, negotiate, reflect, and make decisions.

The traits that affect critical thinking in practice include willingness to reconsider and challenge others, appreciation of multiple perspectives and continued learning, understanding of departmental and professional perspectives that impact the profession, and openness to continuing change in one's personal and professional lives (Mishoe, 1995). The when, how, and why respiratory therapists are able to use these critical thinking skills is influenced by dispositional traits and organizational factors. Mishoe (1996) further reports that the work context and the role of the organization, including managers, must be addressed when attempting to explain or facilitate critical thinking in respiratory care practice.

Mishoe's (1995) study can be shown to overlap the critical thinking described in the expert practice of nurses (Benner, 1984) and the professional performance goals of physicians (Miller, 1980). Given these works, the antecedent relationship of critical thinking and critical thinking skills to expert practice was suggested.

### Instrument Development Process

Survey research is considered to be a branch of social scientific research and is used to accurately assess the characteristics of whole populations of people (Kerlinger, 1986). This

is the intent when using a survey instrument to measure the critical thinking skills of respiratory therapists. Since an appropriate instrument that would gather desired data from the population and sample to be studied could not be found, a survey questionnaire was developed for this study. By developing an instrument to evaluate critical thinking in the practice of respiratory care, the specific findings of Mishoe (1995) could be tested on a large sample.

Several sources were used in generation of the item pool. An in-depth interview with Mishoe and review of her work (1995) generated several items. From the literature, Benner's (1984) study on the novice-to-expert practice among nurses and Brookfield's (1987) four stages of the critical thinking process were helpful.

Other sources used for item generation and for content validity came from an expert panel of six respiratory therapists who currently work in various specialized areas of respiratory care. These experts were chosen based on recommendations by Nunnally and Bernstein (1994) that participants in content validation efforts should be as representative as possible of the types of individuals who will eventually be studied with the instrument. The expert panel consisted of a technical director of a large urban research-based hospital from a metropolitan area, two respiratory care educators from a baccalaureate respiratory therapy school housed in a state university, a neonatal/perinatal specialist, a pulmonary

Table 1
*Overview of Instrument Development and Validation Process*

| Step | Methods | Results |
|---|---|---|
| Item pool development | Literature review | 27 items |
| | In-depth interview and review of Mishoe's (1995) dissertation | 70 items |
| | Expert panel | 118 items |
| | | Total of 215 items |
| Item pool refinement | Review for redundancies | 50 items eliminated |
| | | Total of 165 items |
| Content validity | Expert survey | 95 items eliminated |
| | | Total of 70 items |
| Construct validity | Modified Q sort | 22 items eliminated |
| | | Total of 48 items |
| Item pool refinement | Re-sort | 3 items eliminated |
| | | Total of 44 items |
| Instrument validation | 100 mailed surveys | Coefficient alpha = .9442 |

function laboratory supervisor, and a clinical coordinator for a respiratory home health company that covers a third of Georgia. These particular individuals were chosen because they understand the practice of respiratory care and are representative of the diverse work settings found in respiratory care.

From the 215 original raw items generated from the sources mentioned above, refinement of the item pool began. Table 1 outlines the instrument development and validation process. Redundancies were deleted, which decreased the item pool to 165 questions. This process intended to find saturation among the items regarding critical thinking behaviors. Content validity was assessed by placing the remaining questions randomly on a survey instrument.

A survey was mailed to five of the expert panel participants for their input and rating of each item in terms of importance. A 6-point Likert scale was utilized, with categories ranging from *unimportant* to *essential*. This expert panel survey was necessary to decrease the number of items for possible inclusion without infusing the researchers' own subjectivity. Three of the five expert surveys were returned by the faculty member, the technical director, and the neonatal/perinatal specialist. Results were analyzed for means and rank of each item.

Two factors were established as criteria for an item to remain in the pool: (a) an item must receive a score of 4 (from a possible scale of 1 to 6) or above by all three experts and (b) the mean of all three scores for the item must be greater than or equal to 5. By process of elimination, the item pool was further decreased to 90 items. The ideal survey measurement instrument requires sufficient but not excessive indicators, because too many indicators is a wasteful measurement of the construct. Ninety total items proved to provide too many questions in some constructs, while other constructs did not have enough.

Therefore, criteria for item inclusion was further refined to no construct having less than 8 items or more than 12 items. This ranking method resulted in some ranks having more questions needed from that particular set. When these "ties" occurred, the best items from that particular rank were chosen. This resulted in a further reduction of items from 90 to 70. It was felt that the questions remaining indicated saturation of content areas for the construct.

Table 2
*Critical Thinking Skills Identified by Mishoe (1995)*

| |
|---|
| Prioritizing |
| Anticipating |
| Troubleshooting |
| Communicating |
| Decision making |
| Negotiating |
| Reflecting |

## Determination of Construct Validity

The term *construct* is used in psychology to refer to something that is not observable but is literally constructed by the investigator to summarize or account for regularities or relationships in observed behavior (Thorndike, 1997). For instance, we speak of a therapist's ability to prioritize as a way of summarizing observed consistency in past behavior in relation to patient care. This construct (prioritizing) then can be used to predict how individuals will act on future occasions. Table 2 lists the skills (constructs) identified by Mishoe (1995) used to operationalize critical thinking into measurable behaviors.

Several methods for construct validity are described in the measurement and evaluation literature (Kerlinger, 1986; Thorndike, 1997). To determine construct validity for this survey instrument, the remaining 70 items were randomized, numbered from 1 to 70 for tracking, and cut into small pieces of paper. Seven envelopes with a conceptual definition of each construct on separate envelopes were provided for a modified Q-sort procedure.

Six faculty members of a baccalaureate respiratory therapy school were asked to sort the random questions into a construct or critical thinking dimension that best identified to which construct the item belonged. This sorting procedure was different from traditional Q sorts in that there was no forced distribution of the items into an equal number per construct. The items could be sorted into a construct with no limitations on the number per construct. Five out of six Q-sort packets were returned. For an item to demonstrate construct validity, at least 4 of the 5 responses had to be sorted into a particular construct. From these results, the item pool was reduced to 48 questions. Item analysis now indicated that two of the seven constructs had too few items. After a review of the item pool, 10 more items were added and a second sort was performed. This resulted in enough items per construct, and the final item pool was decreased to 44 questions.

## Reliability and Validity of the Instrument

The research sample for this study consisted of registered respiratory therapists (RRTs) working in various clinical settings throughout the United States. These particular practitioners are well suited for this study because of their experience in respiratory care practice. This includes respiratory care in the intensive care unit (ICU), in non-ICU areas, in ambulatory care, in extended care facilities, for the homebound patient, in the emergency room, in the diagnosis of cardiopulmonary disease, and in disease management.

A random sample of 100 RRTs were drawn from a membership list obtained from the American Association for Respiratory Care. For this study, respiratory therapists were categorized by the following job responsibilities: *Assistant Technical Director, Pulmonary Function Specialist, Supervisor, Staff Therapist,* and *Rehabilitation/Home Care Therapist.*

A total of 100 surveys (see Appendix) were mailed, with two follow-up mailings for nonrespondents. A cover letter describing the research and a self-addressed, stamped envelope was included with each survey. Sixty surveys were returned for a 60% response

Table 3
*Instrument Validation Results: Means, SD, and Reliability Estimates*

| Construct | Items | Means | *SD* | Coefficient alpha |
|---|---|---|---|---|
| Total | 44 | 4.62 | .4494 | .9442 |
| Prioritizing | 7 | 4.96 | .2526 | .8360 |
| Anticipating | 5 | 4.44 | .3279 | .6634 |
| Troubleshooting | 6 | 4.10 | .9002 | .7260 |
| Communicating | 6 | 4.86 | .1921 | .8590 |
| Negotiating | 8 | 4.53 | .2613 | .8675 |
| Decision making | 6 | 4.64 | .4084 | .8094 |
| Reflecting | 6 | 4.61 | .2017 | .8500 |

rate. Respondents were mostly female (77%), and the mean age was 42 years (*SD* = 8.35). Most of the respondents held an associate's degree (62%), followed by a bachelor's degree (25%). Years of experience in respiratory care ranged from 1 to 35 years, with a mean of 15 years (*SD* = 7.85). Most of the therapists surveyed worked in a traditional hospital setting (83%). Response bias for nonrespondents was not determined.

Each question was scored from a Likert 6-point scale corresponding to how well the respondents did each of the tasks in their clinical practice. Several computations were reviewed for validation of the instrument. If an item revealed that more than 80% of the responses were clustered around one or two points on the Likert scale, then insufficient variance was indicated. Enough variance was found for all items using these criteria. Possible redundant questions were noted by intercorrelations. Five sets of questions were reviewed and two were re-worded to eliminate any potential duplication.

The determination of the reliability of the survey instrument was performed using Cronbach's alpha. Cronbach's alpha measures the internal consistency of an item to determine the extent to which items categorized within a particular critical thinking behavior measure that construct. Table 3 includes a summary of the means, standard deviations, and coefficient alpha results for the total instrument as well as for each construct.

## Discussion

The Watson-Glaser Critical Thinking Appraisal and the California Critical Thinking Skills Test have proven to be valid measures of critical thinking abilities. The California

Critical Thinking Disposition Inventory is also available to measure one's disposition to critical thinking with ongoing studies to establish validity and reliability. Despite the availability of several critical thinking instruments, only one has been found to be specific to the clinical practice of respiratory care. The Clinical Simulation Exam (CSE) from the National Board for Respiratory Care (NBRC) is considered by experts in philosophy and social sciences to be one of the few domain-specific instruments for assessment of critical thinking (Facione, 1990; Mishoe, Dennison, & Goodfellow, 1997).

This is the first attempt to develop a mechanism for assessing the critical thinking behaviors of respiratory therapists. This process demonstrates that self-assessed critical thinking behaviors are measurable and accountable by the framework described by Mishoe (1995). The results show encouraging evidence of reliability and validity for the total instrument. The results further indicate that each construct measures what it theoretically is supposed to measure. The reliability computations indicate that there is internal consistency to the instrument and that the items are homogenous. The instrument proves to rate high in all reliable assessments, which is important in determining the accuracy of an instrument; discriminant validity to determine if the constructs were free of method variance was not tested.

This methodological process was not without its disadvantages. The intention was to measure a somewhat abstract variable of activity level, i.e., a "critical thinking skill," and ask the respondents to self-rate how well they perform that activity. How one measures and validates these types of measurements is open to question (Nunnally & Bernstein, 1994). Also, the data collected represents professionals' opinions of their work rather than observations of their work itself. How respondents interpret questions is hard to control for as well. Only a second study involving direct observations of practice could corroborate the validity of what is recalled versus what is actually done.

Although the current instrument attempts to measure self-assessed critical thinking behaviors only in the profession of respiratory care, the results can encourage further research in critical thinking instrument development for other health care professions and thus enhance theory building in critical thinking. It is not known if this instrument correlates with other measures of critical thinking at this time. To firmly establish its utility and validity, more studies are needed to cross-validate this instrument with a larger sample of RRTs, certified respiratory therapists, and different populations of health care practitioners. Further studies are needed to determine if critical thinking is possibly a monolithic score like an IQ score.

Clearly the concept of critical thinking skills and critical thinking traits in the practice of respiratory care needs to be thoroughly researched. The general consensus today among educators and practitioners both is that the ability to think critically is the main proficiency necessary that will enable not only health care practitioners but all professionals to meet the demands of a rapidly changing environment.

The need for competent respiratory therapists who can think, reason, reflect, adapt, and solve problems while practicing in the profession is crucial to the delivery of effective and efficient health care. Much can be learned from investigations into particular aspects of critical thinking in respiratory care practice. It seems that the relationship that the component pieces have to the overall incidence of critical thinking in respiratory care

practice can be understood. With minor revisions, this instrument can be a useful tool for future research in assessing the critical thinking behaviors of respiratory therapists.

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## Appendix

### Critical Thinking Behaviors in Respiratory Care Practice

Directions: Please read each statement carefully and then rate yourself in response to each of the following questions. Circle the number that best describes your response. Your responses are strictly confidential.

*How well do you do each of the following in your practice?*
1-*Not well,* 2-*Fairly well,* 3-*Somewhat well,* 4-*Quite well,* 5-*Very well,* 6-*Extremely well*

1. How well do you decide which procedures can wait? . . . . . 1 2 3 4 5 6

2. How well do you prioritize in crisis situations? . . . . . 1 2 3 4 5 6

3. How well do you revise your priorities when interruptions occur? . 1 2 3 4 5 6

4. How well do you adjust your priorities when you have difficulty accessing your patients? . . . . . 1 2 3 4 5 6

5. How well do you juggle emergencies? . . . . . 1 2 3 4 5 6

6. How well do you set priorities in routine care? . . . . . 1 2 3 4 5 6

7. How well do you manage your time? . . . . . 1 2 3 4 5 6

8. How well do you anticipate emergencies? . . . . . 1 2 3 4 5 6

9. How well do you anticipate equipment failures? . . . . . 1 2 3 4 5 6

10. How well do you predict changes in patient conditions before they happen? . . . . . 1 2 3 4 5 6

11. How well do you willingly participate in training or education to anticipate changes in technology or patient care? . . . . . 1 2 3 4 5 6

12. How well do you mentally rehearse a procedure in your mind before you perform the procedure on a patient? . . . . . 1 2 3 4 5 6

13. How well do you use your troubleshooting skills when working without assistance in your work setting? . . . . . 1 2 3 4 5 6

14. How well do you use your troubleshooting skills when working with physicians? . . . . . 1 2 3 4 5 6

15. How well do you use your troubleshooting skills when working with nurses? . . . . . 1 2 3 4 5 6

16. How well do you troubleshoot chest tubes? . . . . . 1 2 3 4 5 6

17. How well do you troubleshoot blood gas analyzers? . . . . . 1 2 3 4 5 6

18. How well do you evaluate more than just the machine when you are troubleshooting? . . . . . 1 2 3 4 5 6

19. How well do you communicate with nurses when planning patient care? . . . . . 1 2 3 4 5 6

20. How well do you communicate with physicians when planning patient care? . . . . . 1 2 3 4 5 6

21. How well do you communicate with other respiratory care practitioners when planning patient care? . . . . . 1 2 3 4 5 6

22. How well do you communicate with patients when planning patient care? . . . . . 1 2 3 4 5 6

23. How well do you communicate with patient's family members when planning patient care? . . . . . 1 2 3 4 5 6

24. How well do you communicate by writing in the patient medical record? . . . . . 1 2 3 4 5 6

25. How well do you negotiate with physicians to make changes in the treatment plan for your patients? . . . . . 1 2 3 4 5 6

26. How well do you negotiate with other members of the health care team regarding patient care plans? . . . . . 1 2 3 4 5 6

27. How well do you listen to competing viewpoints when negotiating patient care? . . . . . 1 2 3 4 5 6

28. How well do you challenge erroneous or unclear orders from a physician? . . . . . 1 2 3 4 5 6

29. How well do you inform or teach physicians about procedures or techniques when negotiating changes in patient care? . . . . . 1 2 3 4 5 6

30. How well do you inform or teach nurses about procedures and techniques when negotiating changes in patient care? . . . . 1 2 3 4 5 6

31. How well do you maintain objectivity while negotiating with physicians? . . . . . 1 2 3 4 5 6

32. How well do you maintain objectivity while negotiating with nurses? . . . . . 1 2 3 4 5 6

33. How well do you use your past experience in your assessments of patient care? . . . . . 1 2 3 4 5 6

34. How well do you make decisions under time constraints as opposed to being able to think a problem completely through before making a decision? . . . . . 1 2 3 4 5 6

35. How well do you make decisions in crisis situations? . . . . . 1 2 3 4 5 6

36. How well do you ask or think "Is this information valid?" . . . . 1 2 3 4 5 6

37. How well do you make decisions based upon information from other clinicians rather than from the chart? . . . . . 1 2 3 4 5 6

38. How well do you rely on patient assessment data even when objective data suggest something different? . . . . . 1 2 3 4 5 6

39. How well do you reflect upon the consequences of your decisions? . . . . . 1 2 3 4 5 6

40. How well do you reflect on your decisions so you can learn from them? . . . . . 1 2 3 4 5 6

41. How well do you say or think "perhaps I should have done something different"? . . . . . 1 2 3 4 5 6

42. How well do you reflect on your professional growth? . . . . . 1 2 3 4 5 6

43. How well do you reflect on patient information and findings? . 1 2 3 4 5 6

44. How well do you reflect upon your actions after crisis situations? . . . . . 1 2 3 4 5 6

Part B - Please answer the following questions relating to your medical director and to the administration and climate of your work setting. Your responses are strictly confidential.

| | *Strongly disagree* | | | | | *Strongly agree* |
|---|---|---|---|---|---|---|
| 45. My medical director listens to my suggestions? | 1 | 2 | 3 | 4 | 5 | 6 |
| 46. My medical director communicates with me? | 1 | 2 | 3 | 4 | 5 | 6 |
| 47. My medical director yields decision-making powers to me in the care of my patients when appropriate? | 1 | 2 | 3 | 4 | 5 | 6 |
| 48. My medical director maintains objectivity when negotiating patient care with me? | 1 | 2 | 3 | 4 | 5 | 6 |
| 49. My medical director interacts with me as a health care team member? | 1 | 2 | 3 | 4 | 5 | 6 |
| 50. My technical director or supervisor listens to my suggestions? | 1 | 2 | 3 | 4 | 5 | 6 |
| 51. My technical director or supervisor communicates with me? | 1 | 2 | 3 | 4 | 5 | 6 |
| 52. My technical director or supervisor yields decision-making power to me in the care of my patients when appropriate? | 1 | 2 | 3 | 4 | 5 | 6 |
| 53. My technical director or supervisor maintains objectivity when negotiating with me? | 1 | 2 | 3 | 4 | 5 | 6 |
| 54. My technical director or supervisor interacts with me as a health care team member? | 1 | 2 | 3 | 4 | 5 | 6 |
| 55. Role delineations are defined very clearly between CRTTs and RRTs in my work setting? | 1 | 2 | 3 | 4 | 5 | 6 |
| 56. Role delineations are defined very clearly between RRTs and RNs in my work setting? | 1 | 2 | 3 | 4 | 5 | 6 |
| 57. I am allowed to do only certain procedures in my practice? | 1 | 2 | 3 | 4 | 5 | 6 |
| 58. A “broad” scope of practice applies to my work setting? | 1 | 2 | 3 | 4 | 5 | 6 |

59. Is your practice affected by managed care? ___Yes ___No

60. Which of the following best describes your work setting? Select the best one.

____a hospital on the general floor areas only
____a hospital in the adult ICU
____a hospital in the PICU/NICU
____a hospital covering all areas
____a home health care company
____ a physicians office
____ a sleep lab
____ an asthma clinic
____ a skilled nursing facility
____ a PFT lab
____Other, please specify_____

Part C - Background Information This information will be very helpful to us. Your responses are strictly confidential.

61. Gender: ___Female ___Male

62. Age: ___ years old

63. The highest degree you have earned:
___High School Diploma
___Associate Degree
___Bachelor's Degree
___Master's Degree
___Doctoral Degree

64. Years of experience in respiratory care? ____ years

65. Race: ____Black _____White _____Other

Thank you for your participation. Your answers are greatly appreciated.

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# Frequency with which Staff Respiratory Therapists Perform Selected Tasks

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**Abstract**

Our survey investigated how frequently staff respiratory therapists performed 33 tasks specified on the National Board for Respiratory Care Written Registry Examination outline. Of 478 potential participants who identified themselves as "staff therapists," 210 (42.2%) returned surveys. Results showed that none of the selected tasks had been performed by more than 50% of staff therapists within the past month and that only four had been performed within the past year. There was little statistical significance for the frequency of performance based on geographical region and only two tasks that were significant based on hospital size. Educators and potential employers of staff therapists should consider this issue.

**Frequency with which Staff Respiratory Therapists Perform Selected Tasks**

Evolution and change characterize respiratory therapy practice. The Lewin Group, a health care consulting firm, recently conducted an analysis of respiratory care trends that outlined a strong message for the profession (Shapiro, Levinson, Gaylin, & Mendelson, 1997). This included a recommendation that respiratory care educational programs evaluate competencies taught in order to ensure graduates have skills necessary for a shifting health care environment.

The Lewin Group determined that clinical decision-making, case management, and patient education are primary components for successful practice. These are based on changes noted in delivery sites, such as new practice settings for subacute care and physicians' offices. The report also discussed the need for educational programs to stress critical thinking, reimbursement, and disease management (Shapiro et al., 1997).

A call for new professional models has been issued due to the profound changes our profession continues to experience with health care delivery (Mishoe & MacIntyre, 1997). Respiratory care personnel have been given increasingly critical tasks to perform and, more recently, have been given considerable latitude in making critical decisions affecting patient care through patient-driven protocols. Mishoe and MacIntyre found that this new environment demands effectiveness, evolves around the patient, and manages various conditions or disease entities with critical pathways. Moreover, patient self-care, demand management (actively reducing the demand for health care), and an increased number of beds in long-term and subacute care, along with outcome assessment, evoke a call for changes in clinical education (Giordano, 1997).

What are the most important components that shape professional practice? McGuire (1993) suggested that professions based on the sciences are most affected by the increased volume and quantity of facts, concepts, and principals required for competent practice. As new knowledge grows and technology develops, curriculum must respond appropriately. Competence for respiratory therapists includes theoretical and technical knowledge in concert with the ability to apply this information to real-world problems.

Furthermore, the need to advance critical thinking through the curriculum in academic institutions has not diminished. Medical schools employ problem-based learning, while many health professions embrace critical thinking components to teach students problem-solving skills and analytic components (Wales, Nardi, & Stager, 1993).

Credentialing examination content is a defined knowledge base identified as necessary for safe practice at a given level, such as entry level or advanced practice. A national job analysis survey is conducted at approximately 5-year intervals by the National Board for Respiratory Care (NBRC) to identify current practice. As a result, a new examination content outline is released to educational programs on a regular basis. A task is placed on the content outline for the Written Registry Examination (WRE) only if more than half of the respondents stated that the task was performed by advanced level respiratory care practitioners in their facility. A task must also be rated as being either quite or extremely important (Wilson, Long, & Barnes, 1998).

The NBRC applies these selection rules to the group of respondents as a whole, as well

as to six subgroups that are formed based on geographical region, work setting, job function, length of experience, gender, and ethnicity. Failure by any one of the subgroups to rate a task as meeting the selection criteria excludes the task from the content outline. The NBRC's 1997 job analysis survey for advanced-level therapist received over 700 responses rating 402 tasks, 271 of which met the selection criteria for the WRE (Smith, 1998; Wilson et al., 1998).

The unveiling of a new credentialing matrix presents a dilemma for curriculum review and inquiry. This dilemma is characterized by decisions about curriculum delivery in order to meet defined credentialing and testing content versus expectations of the job market. Specifically, at the practical level, faculty must determine what and how to teach students in a particular context.

## Purpose

Respiratory therapy educators routinely refer to the NBRC examination content outline as an aid to curriculum construction. However, since the NBRC outline does not indicate how often the tasks it lists are performed, educators receive no guidance as to how much emphasis their curriculum should place on each task. In order to provide this information, we conducted a survey of staff respiratory therapists. The items on the survey were limited to those tasks that the NBRC content outline identified as being exclusive to the WRE. In conducting the survey, we hoped to answer the following questions:

1. How often do staff therapists perform selected tasks identified on the NBRC WRE content outline?
2. Is there a significant difference in how often the tasks are performed based on geographic region?
3. Is there a significant difference in how often the tasks are performed based on job site?
4. Is there a significant difference in how often the tasks are performed based on length of professional experience?

## Methods

### *Subjects*

The subjects for the study were members of the American Association for Respiratory Care (AARC) who identified "staff therapist" as their primary job responsibility on their 1998 membership form. At the time the survey was conducted, there were 11,474 United States residents in that category, listed in order of U.S. Postal Service zip code. A systematic random sample was obtained by selecting every 23rd name from the list, which resulted in a sample of 498 subjects.

### *Instrument*

The survey instrument (see Appendix) contained four demographic questions and a list of 33 tasks. The list of tasks was adapted from the *NBRC Combined Detailed Content*

Table 1
*Job Location of Staff Therapists*

| Region | Percent |
|---|---|
| Eastern | 24.2 |
| Southern | 28.9 |
| Midwestern | 33.0 |
| Western | 13.9 |

*Outline for Entry Level and Advanced Respiratory Therapists* (National Board for Respiratory Care, Inc. [NBRC], 1998.) Only those items identified on the content outline as appearing on the WRE but not on the entry level examination were used for the survey. Although the NBRC content outline often groups a number of tasks together (e.g., sleep studies, metabolic studies, and cardiopulmonary stress testing are grouped together as task IC2f on the content outline), we decided to "debundle" all of these tasks since there might be a great deal of difference in how often they are performed by staff therapists. A list of 99 tasks was identified by this process.

If we had retained all 99 tasks, it would have resulted in a 9- to 10-page survey, which we believed was too long to elicit a good response. In order to obtain a survey of more reasonable length, we developed a systemic sample of the tasks by using every third task from the original list of 99. For each of the 33 tasks on the survey, staff therapists were instructed to mark a box indicating when they had last performed that task: *within the last month*, *within the last year*, or *more than 1 year ago or never*. Ten staff therapists, who provided input on the layout and content, completed a first draft of the survey. A final version of the survey, which incorporated their input, was then created.

Table 2
*Length of Respiratory Experience of Staff Therapists*

| Years | Percent |
|---|---|
| 1 or less | 2.6 |
| 2 to 5 | 27.7 |
| 6 to 10 | 21.0 |
| 11 or more | 48.7 |

*Data Collection and Analysis*

The survey, along with a cover letter and a postage-paid return envelope, was mailed to the 498 subjects. Data collection ended five weeks after the surveys were mailed. Frequencies and percentages were determined for each response to each survey question. The Kruskal-Wallis test was used to determine whether there was a significant difference in how often tasks were performed based on geographic region. A Gamma value was calculated to determine whether there was a significant relationship between hospital bed size or length of professional experience and how often tasks were performed.

## Results

There were 210 useable surveys returned before data collection ended, which represented 42.2% of those surveyed and 1.8% of the total population. The Registered Respiratory Therapist (RRT) credential was held by 85.6% of the respondents; the Certified Respiratory Therapy Technician (CRTT) credential was held by 14.4%. As seen in Table 1, the subjects were distributed throughout the United States, with the largest group residing in the midwestern region and the smallest group residing in the western region. The majority of the respondents (69.7%) had 6 or more years of experience in respiratory therapy (see Table 2). As shown in Table 3, most (91.7%) of the respondents worked in hospitals.

None of the tasks described on the survey had been performed by 50% or more of the staff therapists within the last month (see Tables 4 and 5). However, four of the procedures (changed/adjusted $O_2$/$CO_2$, assembled/checked Flutter® device, recommended CBC, and mixed venous sampling) had been performed by half of the staff therapists within the last year. Those procedures that were least likely to have been

Table 3
*Primary Job Setting of Staff Therapists*

| Job setting | Percent |
|---|---|
| 1- to 100-bed hospital | 14.9 |
| 101- to 200-bed hospital | 14.4 |
| 201- to 400-bed hospital | 36.1 |
| 401-plus-bed hospital | 26.3 |
| Home care | 3.1 |
| Subacute/skilled nursing facility | 3.1 |
| Other | 2.1 |

performed within the last month were select/obtain Combitube®, select/obtain gas scavenging system, stroke volume calculation, air transport, and cardiopulmonary stress testing. With the exception of stroke volume calculation, these same procedures appeared on the list of tasks least likely to have been performed in the last year (see Table 6).

For the most part, there was no significant difference in how often tasks were performed based on geographic region. The only task that had a significant difference ($p < .05$) was "Assembled an incubator and checked for proper function." Staff therapists who practiced in the southern or western regions were more likely to have performed the task within the last month than were those who practiced in the eastern or midwestern regions. However, even in the southern and western regions, it was more than four times as likely that a staff therapist had not performed the task within the last year as opposed to having performed it in the last month.

When the staff therapist's job site was considered, we did not include the home care or subacute/skilled nursing facility categories since so few of the respondents worked in those settings. Since the remaining categories were based on hospital bed size, we were able to correlate hospital bed size with how frequently a task was performed. This analysis yielded two tasks that were significant at the $p < .05$ level. "Reviewed intracranial pressure monitoring data in the patient record" yielded a Gamma value of 0.538 ($p = .0037$), and "Selected and obtained a gas scavenging system" yielded a Gamma value of 0.588 ($p = .0332$). None of the correlations for the remaining sites were significant.

The correlation between a staff therapist's length of professional experience and frequency of performance was not significant. However, for 27 of the 33 tasks the Gamma value was negative. This suggests that those with longer professional experience were less likely to perform the task.

## Discussion

The sample for this study was drawn from AARC members who identified themselves as staff therapists, but it may be erroneous to assume that the respondents are the same as the nonrespondents or that they are representative of all staff therapists. Furthermore, we made the assumption that "staff therapist" and "advanced level respiratory care practitioner" (the term used by the NBRC) were the same. This did not seem to be an unreasonable assumption since the AARC has a separate category for "staff technician." Given the results of this survey, this may have been an erroneous assumption on our part, even though the vast majority of those who responded held the RRT credential.

Also, on its job analysis survey, the NBRC defines an advanced level respiratory care practitioner as an RRT (NBRC, 1997). A subsequent Kruskal-Wallis test revealed that frequencies for those holding the CRTT credential and those holding the RRT credential were significantly different for only one task: "Interpreted the results from the insertion of peripheral venipuncture or intravenous lines."

It may be reasonable to ask how the NBRC came to include tasks that are performed so infrequently in its WRE content. However, a review of its survey instrument reveals that it emphasizes importance rather than frequency (NBRC, 1997). Only those tasks that at

Table 4
*Percent of Staff Therapists Performing Tasks (N = 210)*

| Task | Within the last month | Within the last year | More than 1 year ago or never |
|---|---|---|---|
| Reviewed intracranial pressure monitoring data in the patient record | 20.1 | 23.0 | 56.9 |
| Reviewed pulmonary angiography data in the patient record | 12.4 | 21.5 | 66.0 |
| Recommended that a CBC be measured | 23.0 | 29.7 | 47.4 |
| Recommended that a $V_D/V_T$ be measured | 10.0 | 25.8 | 64.1 |
| Recommended cardiopulmonary stress testing | 7.2 | 18.2 | 74.6 |
| Performed bedside procedures and interpreted results to determine central venous pressure | 10.0 | 9.6 | 80.4 |
| Performed bedside procedures and interpreted results to determine pulmonary and systemic vascular resistance | 12.4 | 12.9 | 74.6 |
| Performed, measured, and interpreted mixed venous sampling | 28.2 | 22.0 | 49.8 |
| Performed, measured, and interpreted pulmonary capillary wedge pressure | 10.0 | 14.4 | 75.6 |
| Performed, measured, and interpreted fluid balance (intake and output) | 25.0 | 16.3 | 58.7 |
| Performed, measured, and interpreted cardiopulmonary stress testing | 6.7 | 7.7 | 85.6 |
| Interpreted the results from the insertion of peripheral venipuncture or intravenous lines | 17.0 | 13.6 | 69.4 |
| Selected and obtained an Esophageal Tracheal Combitube® (ETC) | 1.9 | 6.2 | 91.9 |
| Selected and obtained a gas scavenging system | 4.3 | 7.2 | 88.4 |
| Selected and obtained an $O_2/CO_2$ therapeutic gas | 19.2 | 12.0 | 68.8 |
| Selected and obtained a pulmonary artery catheter (e.g., Swan-Ganz) | 11.0 | 8.6 | 80.4 |

Table 4 Continued
*Percent of Staff Therapists Performing Tasks (N = 210)*

| Task | Within the last month | Within the last year | More than 1 year ago or never |
|---|---|---|---|
| Selected and obtained an arterial catheter | 19.6 | 15.8 | 64.6 |
| Assembled an incubator and checked for proper function | 10.1 | 16.3 | 73.6 |
| Assembled a Flutter® mucous clearance device and checked for proper function | 30.5 | 26.7 | 42.9 |
| Assembled a pulmonary artery catheter (e.g., Swan-Ganz) and checked for proper function | 7.7 | 9.6 | 82.8 |
| Assembled an arterial catheter and checked for proper function | 17.3 | 10.6 | 72.1 |
| Determined and recorded central venous pressure | 9.6 | 14.4 | 76.1 |
| Determined and recorded cardiac output | 10.5 | 15.8 | 73.7 |
| Performed a cardiac index calculation | 7.2 | 13.4 | 79.4 |
| Performed a stroke volume calculation | 6.2 | 11.0 | 82.8 |
| Calculated and interpreted $Q_S/Q_T$ | 8.1 | 14.8 | 77.1 |
| Initiated and selected appropriate settings for high frequency ventilation | 21.0 | 17.1 | 61.9 |
| Changed mode of administration, adjusted flow, or adjusted concentration of $O_2/CO_2$ | 43.0 | 15.9 | 41.1 |
| Participated in air patient transport | 6.7 | 6.2 | 87.1 |
| Acted as assistant to physician performing cardiopulmonary stress testing | 8.1 | 11.0 | 80.9 |
| Acted as assistant to physician performing insertion of chest tubes | 14.8 | 33.0 | 52.2 |
| Monitored and maintained home respiratory care equipment | 19.0 | 18.1 | 62.9 |
| Monitored graded exercise program | 9.5 | 7.6 | 82.9 |

least 50% of the respondents reported as not performed by advanced level respiratory care practitioners in their facility were excluded based on frequency. Respondents were further instructed that some tasks, although performed infrequently, could still be rated as important. Our survey did not incorporate importance.

Another major difference between our survey and the NBRC's is that we only surveyed staff therapists. The NBRC surveyed department and technical directors, supervisors,

Table 5
*Five Tasks Performed Most Often by Staff Therapists*

| Task | Percent performed within the last month |
|---|---|
| Changed mode of administration, adjusted flow, or adjusted concentration of $O_2/CO_2$ | 43.0 |
| Assembled a Flutter® mucous clearance device and checked for proper function | 30.5 |
| Performed, measured, and interpreted mixed venous sampling | 28.2 |
| Performed, measured, and interpreted fluid balance (intake and output) | 25.0 |
| Recommended that a CBC be measured | 23.0 |

respiratory care practitioners, pulmonary function practitioners, educators, and physicians (NBRC, 1997). The NBRC has not published how many of its 700-plus respondents were in each of these job function categories. Furthermore, our subjects were selected by a systematic random sample, whereas the NBRC's subjects were self-selected (George & Cohen, 1997).

The results of our survey do have implications for curriculum design. For the 33 tasks included on the survey, educators can estimate how frequently the tasks are likely to be

Table 6
*Five Tasks Performed Least Often by Staff Therapists*

| Task | Percent performed within the last month |
|---|---|
| Selected and obtained an Esophageal Tracheal Combitube® (ETC) | 8.1 |
| Selected and obtained a gas scavenging system | 11.5 |
| Participated in air patient transport | 12.9 |
| Performed, measured, and interpreted cardiopulmonary stress testing | 14.4 |
| Monitored graded exercise program | 17.1 |

performed by graduates. Although the survey does not provide an exact measure of frequency, an educator can assume that graduates are more likely to be called on to perform those tasks that a large percentage of staff therapists have performed in the last month. Conversely, graduates are unlikely to be called on to perform tasks that only a very small percentage of staff therapists have performed in the last year. This knowledge can be one of the criteria used by educators when deciding curricular emphasis.

However, task importance, even though it is a subjective rating, should not be ignored. Since there doesn't seem to be much regional difference in how often tasks are performed, a group of educators from a region could work together to find out how often the other tasks on the examination content outline are performed. For those tasks that are performed infrequently, it may not be possible to schedule clinical practice opportunities. For tasks that can only be covered in the classroom setting, employers who do require RRTs to perform them will have to provide the appropriate clinical experience.

The results of this study do raise a larger question. Does the WRE content match the job content of the average staff therapist? Since we did not test the tasks contained on the entry level examination content outline, it may be the case that that examination is more appropriate for ensuring the competency of staff therapists. Educators and employers have traditionally viewed the RRT credential, which requires passing both the WRE and the Clinical Simulation Examination, as being appropriate for staff therapists. In light of the continuous upgrading of both the entry level and advanced practitioner examination content, it may be time to reconsider this tradition. At the very least this question merits further study.

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## Appendix

### Survey of Staff Therapists

For each of the following, place an "x" in the first box if you, personally, have performed the activity in the last month. Place an "x" in the second box if it has been more than one month but less than twelve months since you have performed the activity. Place an "x" in the third box if it has been more than twelve months since you have performed the activity, or if you have never performed the activity.

| | When did you last do this? | | |
|---|---|---|---|
| | Within the last month | Within the last year | More than 1 year ago or never |
| 1. Reviewed intracranial pressure monitoring data in the patient record | ❑ | ❑ | ❑ |
| 2. Reviewed pulmonary angiography data in the patient record | ❑ | ❑ | ❑ |
| 3. Recommended that a CBC be measured | ❑ | ❑ | ❑ |
| 4. Recommended that a $V_D/V_T$ be measured | ❑ | ❑ | ❑ |
| 5. Recommended cardiopulmonary stress testing | ❑ | ❑ | ❑ |
| 6. Performed bedside procedures and interpreted results to determine central venous pressure | ❑ | ❑ | ❑ |
| 7. Performed bedside procedures and interpreted results to determine pulmonary and systemic vascular resistance | ❑ | ❑ | ❑ |
| 8. Performed, measured and interpreted mixed venous sampling | ❑ | ❑ | ❑ |
| 9. Performed, measured and interpreted pulmonary capillary wedge pressure | ❑ | ❑ | ❑ |
| 10. Performed, measured and interpreted fluid balance (intake & output) | ❑ | ❑ | ❑ |
| 11. Performed, measured and interpreted cardiopulmonary stress testing | ❑ | ❑ | ❑ |
| 12. Interpreted the results from the insertion of peripheral venipuncture or intravenous lines | ❑ | ❑ | ❑ |

| | When did you last do this? | | |
|---|---|---|---|
| | Within the last month | Within the last year | More than 1 year ago or never |
| 13. Selected and obtained an Esophageal Tracheal Combitube® (ETC) | ❑ | ❑ | ❑ |
| 14. Selected and obtained a gas scavenging system | ❑ | ❑ | ❑ |
| 15. Selected and obtained an $O_2/CO_2$ therapeutic gas | ❑ | ❑ | ❑ |
| 16. Selected and obtained a pulmonary artery catheter (e.g., Swan-Ganz) | ❑ | ❑ | ❑ |
| 17. Selected and obtained an arterial catheter | ❑ | ❑ | ❑ |
| 18. Assembled an incubator and checked for proper function | ❑ | ❑ | ❑ |
| 19. Assembled a Flutter® mucous clearance device and checked for proper function | ❑ | ❑ | ❑ |
| 20. Assembled a pulmonary artery catheter (e.g., Swan-Ganz) and checked for proper function | ❑ | ❑ | ❑ |
| 21. Assembled an arterial catheter and checked for proper function | ❑ | ❑ | ❑ |
| 22. Determined and recorded central venous pressure | ❑ | ❑ | ❑ |
| 23. Determined and recorded cardiac output | ❑ | ❑ | ❑ |
| 24. Performed a cardiac index calculation | ❑ | ❑ | ❑ |
| 25. Performed a stroke volume calculation | ❑ | ❑ | ❑ |
| 26. Calculated and interpreted $\dot{Q}_S/\dot{Q}_T$ | ❑ | ❑ | ❑ |
| 27. Initiated and selected appropriate settings for high frequency ventilation | ❑ | ❑ | ❑ |
| 28. Changed mode of administration, adjusted flow, or adjusted concentration of $O_2/CO_2$ | ❑ | ❑ | ❑ |
| 29. Participated in air patient transport | ❑ | ❑ | ❑ |
| 30. Acted as assistant to physician performing cardiopulmonary stress testing | ❑ | ❑ | ❑ |

| | When did you last do this? | | |
|---|---|---|---|
| | Within the last month | Within the last year | More than 1 year ago or never |
| 31. Acted as assistant to physician performing insertion of chest tubes . . . . . | ❑ | ❑ | ❑ |
| 32. Monitored and maintained home respiratory care equipment . . . . . | ❑ | ❑ | ❑ |
| 33. Monitored graded exercise program . . . . . | ❑ | ❑ | ❑ |

In order to help with the interpretation of the results of this survey, please answer the following questions about yourself. Check only one response for each item.

A. The setting in which I currently practice is located in:
_____ 1. MA, RI, CT, NH, ME, VT
_____ 2. FL, MD, DE, SC, NC, GA, DC, VA, WV
_____ 3. NY, NJ, PA
_____ 4. MI, OH, IL, WI, IN
_____ 5. MS, TN, KY, AL
_____ 6. MO, MN, KS, IA, NE, SD, ND
_____ 7. LA, TX, OK, AR
_____ 8. UT, NV, ID, AZ, WY, NM, CO, MT
_____ 9. CA, HI, OR, WA, AK
_____ 10. Other: _____

B. My primary job is in the following setting:
_____ 1. 1-100 bed hospital
_____ 2. 101-200 bed hospital
_____ 3. 201-400 bed hospital
_____ 4. 401 - or more bed hospital
_____ 5. home care
_____ 6. subacute/skilled nursing facility
_____ 7. Other: _____

C. The highest respiratory care credential I possess is:
_____ 1. CRTT
_____ 2. RRT (includes CRTT)
_____ 3. Neither of the above

D. My length of experience in respiratory therapy is:
_____ 1. 1 year or less
_____ 2. 2 to 5 years
_____ 3. 6 to 10 years
_____ 4. 11 years or more

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# Changes in Respiratory Care Education on the Horizon of an Associate Degree Entry Level Mandate

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**Abstract**

Implementation of the 2-year associate degree entry level is on the horizon, and respiratory care educational program changes are likely to occur. A questionnaire was sent to all 372 program directors in May 1998 to explore changes being made and changes being planned in anticipation of a 2-year entry level educational system. Two hundred fifteen program directors (58%) responded, representing 241 programs. The most common changes are adding new curricular components (61%), increasing program length (32%), changing academic outcomes (31%), adding or increasing prerequisites for admission (24%), changing accreditation status by discontinuing 1+1 designs and changing to advanced level only (24%), adding articulation agreements (22%), changing academic sponsors to degree-granting institutions (5%), and initiating consortium agreements (5%).

## Changes in Respiratory Care Education on the Horizon of an Associate Degree Entry Level Mandate

The need for 2 years of postsecondary education and an associate degree for entry into the respiratory care profession has been established (Douce, 1993; Douce & Cullen, 1993; O'Daniel et al., 1992) and endorsed by program directors (Van Scoder & Cullen, 1998) and the agencies that govern the profession (Cullen & Wiezalis, 1994; Douce et al., 1993; Douce et al., 1994; American Association for Respiratory Care [AARC], 1996; AARC, 1998). Implementation is on the horizon, and program changes are likely to occur. These changes will definitely involve programs that do not offer a degree and may also involve degree programs that adjust with the changes in the educational system and the profession.

The 1998 AARC Education Committee was charged to develop strategies for respiratory care training programs to implement the associate degree entry level requirement in concert with the actions of the Committee on Accreditation for Respiratory Care (CoARC). To partially fulfill the charge, a subcommittee was appointed to conduct a survey to determine what strategies are being used or being considered by program directors to facilitate the change. The subcommittee's working assumption was that knowing the most common strategies would benefit other program directors considering program changes and might be of interest to the agencies governing the profession. This is a report of that survey.

### Methods

The subcommittee developed a questionnaire to explore changes being made and changes being planned in anticipation of a 2-year entry level educational system. The questionnaire was fieldtested by members of the AARC Education Committee and then revised to assure clarity and completeness. The questionnaire consisted of three parts (see Appendix). Part one consisted of current demographics for the 1997-1998 academic year on accreditation, articulation, consortia, sponsor, academic outcome, program length, prerequisites, and major curricular components. Parts two and three inquired about changes already made or approved for future implementation and about changes being considered for the future.

Using the mailing list of all 372 program directors obtained from CoARC, the subcommittee mailed the questionnaire with cover letter and postage-paid return envelope on May 4, 1998. Questionnaires were returned, and responses were tabulated until June 15, 1998. Responses were entered into a spreadsheet and analyzed using Minitab® 11. Quarter credit hours were converted to semester credits by multiplying quarter hours by 1.5. Frequency counts and descriptive statistics were performed on all of the responses and on subsets of program accreditation type (technician or therapist) and academic outcome (associate or baccalaureate therapist programs).

## Results

Overall, 241 questionnaires were returned, including 168 from therapist programs and 66 from technician programs; seven respondents did not indicate accreditation type. Twenty-six responses came from second programs at the same institution; therefore, 215 institutions responded, for a 58% response rate. The respondents represent 50% of technician programs and 63% of therapist programs. The distribution of respondents is presented in Table 1, and it did not differ significantly from the distribution of accredited programs ($\chi^2 = 2.037$, $p = 0.154$).

Table 1
*Distribution of 241 Respondents*

| | Number of respondents |
|---|---|
| Accreditation type | |
| Technician | 66 |
| Therapist | 168 |
| Unspecified | 7 |
| Academic outcome | |
| Certificate or diploma | 60 |
| Associate degree | 140 |
| Baccalaureate degree | 17 |
| Unspecified | 24 |
| Academic sponsor | |
| Vocational-technical school | 34 |
| 2-year college | 149 |
| 4-year college | 46 |
| Other | 8 |
| Unspecified | 4 |

The most common changes reported are presented in Table 2. Changes include adding new curricular components, increasing program length, changing academic outcomes, adding or increasing prerequisites for admission, adding articulation agreements, changing accreditation status by discontinuing 1+1 designs and changing to advanced level, changing academic sponsors to degree-granting institutions, and initiating consortium agreements.

Respondents reported a total of 304 curricular changes approved or implemented in 1997-1998 and 390 additional curricular changes being considered for the future. Ninety-eight percent of these changes involved adding curricular content. Table 3 presents the most frequently cited curricular changes. For technician programs, the curricular components added, or being considered for addition in the future by 30% or more of the respondents, are advanced-level respiratory care, computer skills, English and communication skills, and mathematics. A few (15% to 30%) technician program respondents are planning to add perinatal/pediatrics, multiskills, subacute and skilled nursing facility (SNF) respiratory care, rehabilitation, patient assessment skills, and ethics.

For therapist programs, the curricular components added or being considered for addition by 30% or more of the respondents are multiskills, subacute and SNF respiratory care, computer skills, and patient assessment skills. A few (15% to 30%) therapist program respondents are planning to add research, statistics, and ethics.

Seventy-seven (32%) programs are adapting by changing program length. Twenty-two programs (8 technician and 14 therapist) have already changed length, and 73 (37

Table 2
*Changes in Educational Programs Before Implementation of a 2-Year Entry Level*

| *n* (% of 241 respondents) | Changes reported |
|---|---|
| 147 (61%) | Add new curricular components[a] |
| 77 (32%) | Increase program length |
| 75 (31%) | Change academic outcome |
| 58 (24%) | Add or increase prerequisites for admission |
| 57 (24%) | Change accreditation status: Discontinue 1+1 design or change to advanced level |
| 54 (22%) | Add articulation agreements |
| 13 (5%) | Change academic sponsors to degree-granting institutions |
| 13 (5%) | Initiate consortium agreements |

[a]See Table 3 for descriptions.

technician and 36 therapist) are considering a change. Of the 66 technician respondents, 46 (70%) reported using semesters with a mean of 49.3 semester credits scheduled over 3.4 semesters. Eight reported using quarter hours with a mean of 93.2 quarter credits scheduled over 6.0 quarters, and 8 reported using a mean of 1,487 clock hours scheduled over 12 months.

Thirty (45%) technician programs, mostly on semesters, have already changed or are considering a change in program length. They project average increases to 68.0 semester credits and 5.0 semesters.

Of the 168 therapist program responses, 135 (80%) reported using the semester system, 20 reported using the quarter system, and 3 use clock hours. The 140 therapist programs resulting in an associate degree reported a mean of 73.4 semester credits scheduled over 5.2 semesters or 104 quarter credits scheduled over an average of 7.3 quarters. The 17 baccalaureate therapist programs reported averages of 80.5 semester hours over 5.5 semesters.

Thirty-six (21%) therapist programs, mostly on semesters, have changed or are considering a change in program length. Nine programs are decreasing length by 16 semester credits and 1.8 semesters, and 20 are increasing length by 16 semester credits and 1.5 semesters. Seven are also increasing an average of 16.0 semester credits without

Table 3
*Curricular Changes Made or Being Considered by Technician and Therapist Programs*

| Technician programs | | Therapist programs | |
|---|---|---|---|
| Most common[a] | Common[b] | Most common[a] | Common[b] |
| Advanced-level respiratory care | Perinatal/ pediatrics | Subacute and SNF respiratory care | Research |
| Computer skills | Subacute and SNF respiratory care | Multiskills | Statistics |
| English and communication skills | Rehabilitation | Patient assessment skills | Ethics |
| Mathematics | Multiskills | Computer skills | |
| | Patient assessment skills | | |
| | Ethics | | |

*Note.* SNF = skilled nursing facility.
[a]More than 30% of respondents. [b]15% to 29% of respondents.

increasing the mean number of semesters.

One hundred and forty (58%) respondents award 2-year degrees, 60 (25%) award certificates or diplomas, and 17 (7%) award 4-year degrees. Fourteen respondents (6 technician programs and 8 therapist programs) indicated a change in academic outcome in 1997-1998 to a 2-year degree. One therapist program indicated changing to a 4-year degree, and another therapist program indicated a change to a certificate or diploma.

Fifty-nine programs are considering a future change in academic outcome. These include 35 technician and 6 therapist programs changing to an associate degree outcome, 11 therapist programs developing new 4-year degree programs, and 3 therapist programs changing from associate degree to certificate or diploma. Four respondents indicated only general changes.

One hundred and seven programs (44% of all respondents) use postsecondary prerequisites for entering the respiratory care program. Thirty-seven percent of technician programs require an average of 13.0 semester hours of prerequisites. Forty-eight percent of therapist programs require an average of 23.5 semester hours of prerequisites.

Although 98% of these 107 programs require prerequisites to earn their academic outcome, only 53 (50% of programs using prerequisites) include these prerequisites when reporting their program length. Eleven programs (5 technician and 6 therapist) increased their prerequisites in 1997-1998, 47 programs (21 technician and 26 therapist) are considering additional prerequisites in the future, and 5 therapist programs are considering a decrease in prerequisites.

Changes in accreditation status involve 53 (22%) programs. Fifteen programs indicated that their accreditation type had changed for 1997-1998 or had been approved to change, and 38 indicated a change was being considered. The most common change, reported by 25 respondents, is to discontinue technician-accredited programs in 1+1 curriculum designs. The second strategy is for technician programs to change to therapist level.

The distribution of educational sponsors included 149 (62%) two-year institutions, 46 (19%) four-year institutions, 34 (14%) vocational-technical schools, and 8 (3%) others, including hospitals and academic health science centers. Thirteen programs, mostly those sponsored by vocational-technical schools, reported the likelihood of changing educational sponsors to 2- and 4-year institutions.

Prior to 1997-1998, 85 (35%) programs had articulation agreements with degree-granting institutions. Eleven programs (1 technician and 10 therapist) added articulation agreements in 1997-1998, and 43 programs (10 technician and 33 therapist) are considering adding an agreement in the future. Prior to 1997-1998, 36 (15%) programs participated in an educational consortium. Four programs (2 technician and 2 therapist) initiated a consortium in 1997-1998, and 9 programs (3 technician and 6 therapist) are considering entering a consortium in the future.

## Discussion

The most common changes occurring in respiratory care education are adding curricular components, increasing program length, and changing academic outcome. Both therapist and technician programs report expanding curricula. Since the results of

the 1998 National Board for Respiratory Care (NBRC) job analysis were not known to the respondents, these expansions may likely be occurring due to the increasing needs of the communities of interest and the changes in the health care delivery system; they may be only coincidental to the anticipated future changes in the entry level accreditation requirements (Mishoe & MacIntyre, 1997). Changes in academic outcomes follow the increases in program length and may be more responsive to accreditation requirements.

Changing to therapist level, changing academic sponsors to degree-granting institutions, adding articulation agreements, and entering into educational consortia with a degree-granting institution seem to be in response to the accreditation requirements needed for technician programs to adapt. Other technician programs should consider these strategies.

The curricular areas being added by technician programs are consistent with changing academic outcomes from a certificate to an associate degree and from entry level to advanced. Discontinuing technician programs in 1+1 curriculum designs may have limited impact on the profession overall, if students enrolled in these programs generally continued through the second year anyway.

Therapist programs seem to be adapting in opposite ways. A few are decreasing program length and discarding curriculum components, possibly becoming entry level, while others are expanding in an effort to remain advanced level. Several respondents described changing to either 1+2 or 2+1 curriculum designs with either a year of prerequisites prior to a 2-year professional program or a 2-year entry level respiratory care program followed by a third year of advanced study.

How therapist programs adapt to a 2-year entry level requirement may reflect community needs as well as institutional policies. Some 2-year institutions may not allow postsecondary prerequisites or post-associate-degree programs. Some programs are adding prerequisites or professional courses, while maintaining program length. It is bothersome that 50% of respondent programs (mostly therapist) that require postsecondary prerequisites do not include these courses in program length. This underestimates the education required to become a respiratory therapist and misleads students and policymakers on the true duration of postsecondary education in respiratory care.

The mean number of semester hours and semesters only differed between associate and baccalaureate therapist programs by an average of 6.6 semester hours and less than 1 semester. The variability of number of semester credits and number of semesters for baccalaureate programs was remarkable, ranging from 44 to 130 credits and 4.0 to 8.5 semesters. Possibly some baccalaureate program directors only reported on their respiratory care component of the baccalaureate curriculum and did not consider the entire duration of the baccalaureate degree program. Changes in therapist programs should continue to be documented.

This survey was conducted before the NBRC announced that candidates who pass the entry level examination after 1998 would be called “therapists,” before the disclosure of the 1998 NBRC job analysis results, and before the initial draft of new “Standards and Guidelines of Accredited Educational Programs for the Respiratory Therapist” were distributed for review. Respondents did not know that all future graduates of respiratory care educational programs will share a common designation and that the detailed content

outline for the entry level examinations has expanded once again. These changes in the credentialing system will have a significant impact on educational programs and should be considered among the forces of change in the respiratory care education system.

Forty-two percent of programs did not respond to this survey and are not reflected in these results. A telephone follow-up of selected nonrespondents indicated that nonrespondents tended to have no changes to report or changes being considered. Therefore, they considered their responses of no interest or consequence. Had these nonrespondents been included, these results would have indicated that a smaller proportion of programs have initiated change in response to the new 2-year associate degree entry level requirement. This lack of planning and action by many program directors may be due to not knowing the detail of the new requirements at the time of this survey.

## Conclusion

Some respiratory care educational programs have already initiated changes in anticipation of changing accreditation standards to a 2-year associate degree entry level. Increasing program length, changing academic outcomes, adding academic prerequisites and articulation agreements, and discontinuing 1+1 curriculum designs were the most common strategies reported. Less common approaches reported included changing academic sponsors and developing educational consortia. Evolution will continue to occur in educational programs in response to changes in clinical practice and accreditation and credentialing requirements. Future changes will need to be documented.

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## Appendix

## 1998 EDUCATION COMMITTEE OF THE AMERICAN ASSOCIATION FOR RESPIRATORY CARE

## STRATEGIES FOR A 2-YEAR ENTRY LEVEL

CURRENT DEMOGRAPHICS - For the purpose of these questions, "current" means 1997-98 academic year.

1. What is the current accreditation level of the respiratory therapy educational program? (COMPLETE A QUESTIONNAIRE FOR EACH ACCREDITED PROGRAM; MAKE AN ADDITIONAL COPY, IF NECESSARY)
_____ therapist OR _____ technician

2. What type of institution currently sponsors the respiratory therapy educational program?
_____ 4-year college/university
_____ 2-year college
_____ vocational-technical school
_____ hospital
_____ other (please specify) _____

3. Do you have articulation agreement(s) with degree-granting institutions (other than the sponsoring institution)? _____ No _____ Yes

4. Is the current accredited respiratory therapy educational program part of an educational consortium? _____ No _____ Yes

5. What is the current academic outcome provided to a regular student who completes the accredited respiratory therapy educational program?
_____ certificate/diploma
_____ 2-year degree (i.e., associate of arts, associate of science, associate of applied science, etc.)
_____ 4-year degree (i.e., bachelor of arts, bachelor of science, etc.)
_____ graduate degree (i.e., master of arts, master of science, master of medical science, etc.)

6. What is the current academic length of the accredited respiratory therapy educational program?
_____ semester hours scheduled over _____ semesters OR
_____ quarter hours scheduled over _____ quarters OR
_____ clock hours scheduled over _____ months

7. Do you require postsecondary academic prerequisites for entering your respiratory therapy educational program? _____ No _____ Yes
If yes, how many credit hours of postsecondary academic prerequisites are required? _____

If yes, are these prerequisites required for the academic outcome? (#5)
_____ No _____ Yes
If yes, are these academic prerequisites included in program length? (#6)
_____ No _____ Yes

8. What are the major components of the respiratory care curriculum? (CHECK ALL THAT APPLY; CHECK ONLY THOSE THAT CURRENTLY APPLY)

_____ entry level RT
_____ advanced level RT
_____ entry level PFT
_____ advanced level PFT
_____ perinatal/pediatric specialist
_____ subacute/skilled nursing facility respiratory care
_____ cardiopulmonary rehabilitation
_____ home respiratory care
_____ multiskilled

CHANGES ALREADY MADE OR APPROVED - For the purpose of these questions, "already made or approved" means changes already in effect for 1997-98 or already approved for future implementation.

9. Is there a change in program accreditation status?

_____ No
_____ Yes. If yes, what is the new status?
_____ Discontinued
_____ Inactive
_____ Level changed to:
_____ technician OR _____ therapist
_____ Other (please specify) _____

10. Is there a change in type of institution sponsoring your respiratory therapy educational program? _____ No
_____ Yes. If yes, what type is the new sponsor?
_____ 4-year college/university
_____ 2-year college
_____ vocational-technical school
_____ hospital
_____ other (please specify) _____

11. Are there changes in articulation agreement(s) with degree-granting institutions?

_____ No
_____ Yes. If yes, what is the change?
_____ Added articulation agreement(s)
_____ Ended articulation agreement(s)

12. Is there a change in consortium arrangements for the respiratory care program?

_____ No
_____ Yes. If yes, what is the change?

_____ Started new consortium(s)
_____ Ended consortium(s)

13. Is there a change in the academic outcome?

_____ No _____ Yes. If yes, what is the new outcome?
_____ certificate/diploma
_____ 2-year degree (i.e., AA, AS, AAS)
_____ 4-year degree (i.e., BA, BS)
_____ graduate degree (i.e., MA, MS)

14. Is there a change in the academic length of the accredited respiratory therapy educational program?

_____ No _____ Yes. If yes, what is the new length?
_____ semester hours scheduled over _____ semesters OR
_____ quarter hours scheduled over _____ quarters OR
_____ clock hours scheduled over _____ months

15. Is there a change in required postsecondary academic prerequisites for your respiratory therapy educational program?

_____ No _____ Yes. If yes, what is the change?
_____ Add prerequisites
_____ Drop prerequisites

16. Is there a change in the major components of the respiratory care curriculum? (CHECK ALL THAT APPLY; CHECK ONLY THOSE ALREADY MADE OR APPROVED)

| ADDING | DELETING | |
|---|---|---|
| _____ | _____ | entry level RT content |
| _____ | _____ | advanced level RT content |
| _____ | _____ | entry level PFT content |
| _____ | _____ | advanced level PFT content |
| _____ | _____ | perinatal/pediatric content |
| _____ | _____ | subacute/SNF respiratory care |
| _____ | _____ | cardiopulmonary rehabilitation |
| _____ | _____ | home respiratory care content |
| _____ | _____ | multiskilled content |
| _____ | _____ | patient assessment skills |
| _____ | _____ | computer skills |
| _____ | _____ | ethics, legalities, economics |
| _____ | _____ | English, communication skills |
| _____ | _____ | mathematics |
| _____ | _____ | research, statistics |
| _____ | _____ | educational methods |
| _____ | _____ | management, administration |

CHANGES BEING CONSIDERED - For the purpose of these questions, "changes being considered" means changes not yet approved or implemented.

17. Is a change being considered in program accreditation status?

_____ No
_____ Yes. If yes, what might be the new status?
_____ Discontinue
_____ Inactive
_____ A level change to:
_____ entry level OR _____ advanced level
_____ Other (please specify) _____

18. Is a change being considered in type of institution sponsoring your respiratory therapy educational program?

_____ No
_____ Yes. If yes, what type might be the new sponsor?
_____ 4-year college/university
_____ 2-year college
_____ vocational-technical school
_____ hospital
_____ other (please specify) _____

19. Are changes being considered in articulation agreement(s) with degree-granting institutions?

_____ No
_____ Yes. If yes, what might be the change?
_____ Added articulation agreement(s)
_____ Ended articulation agreement(s)

20. Are there changes being considered in consortium arrangements for the respiratory care program?

_____ No
_____ Yes. If yes, what might be the change?
_____ Started new consortium(s)
_____ Ended consortium(s)

21. Is there a change being considered in the academic outcome?

_____ No
_____ Yes. If yes, what might be the new outcome?
_____ certificate/diploma
_____ 2-year degree (i.e., AA, AS, or AAS)
_____ 4-year degree (i.e., BA, BS)
_____ graduate degree (i.e., MA, MS)

22. Is a change being considered in the academic length of the accredited respiratory therapy educational program?

_____ No
_____ Yes. If yes, what might be the new length?
_____ semester hours scheduled over _____ semesters OR
_____ quarter hours scheduled over _____ quarters OR

_____ clock hours scheduled over _____ months

23. Is a change being considered in required postsecondary academic prerequisites for your respiratory therapy educational program?

_____ No _____ Yes. If yes, what might be the change?
_____ Add prerequisites
_____ Drop prerequisites

24. Is a change being considered in the major components of the respiratory care curriculum? (CHECK ALL THAT APPLY; CHECK ONLY THOSE BEING CONSIDERED, BUT NOT APPROVED)

| ADDING | DELETING | |
|---|---|---|
| _____ | _____ | entry level RT content |
| _____ | _____ | advanced level RT content |
| _____ | _____ | entry level PFT content |
| _____ | _____ | advanced level PFT content |
| _____ | _____ | perinatal/pediatric content |
| _____ | _____ | subacute/SNF respiratory care |
| _____ | _____ | cardiopulmonary rehabilitation |
| _____ | _____ | home respiratory care content |
| _____ | _____ | multiskilled content |
| _____ | _____ | patient assessment skills |
| _____ | _____ | computer skills |
| _____ | _____ | ethics, legalities, economics |
| _____ | _____ | English, communication skills |
| _____ | _____ | mathematics |
| _____ | _____ | research, statistics |
| _____ | _____ | educational methods |
| _____ | _____ | management, administration |

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# THE UNIQUENESS OF THE CLINICAL SIMULATION EXAMINATION

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**Abstract**

The written clinical simulation prototype exam was developed when the American Association for Respiratory Therapy received a federal grant. The respiratory care profession has kept this unique form of testing although no other nursing or allied health professional credentialing agency utilizes such testing or requires two separate and different examination processes for one credential. Simulations have been postulated to measure "something different: problem-solving ability not tapped by multiple choice questions" (Swanson, Norcini & Grosso, 1987, p. 236). Since the written examination for the advanced therapist will now test 73% of its items at the analysis level, it is questionable whether additional simulation-based testing is necessary to demonstrate problem-solving ability. In order for the credentialing system to reflect current practices in an efficient and cost-effective manner, the profession should consider the necessity of the Clinical Simulation Examination.

## The Uniqueness of the Clinical Simulation Examination

Changes are afoot with the entry level credential designation. Effective July 1999, the Certified Respiratory Therapy Technician (CRTT) will be designated Certified Respiratory Therapist, or CRT (Smith, 1998). Those who pass the entry level exam or currently hold the CRTT credential will receive the CRT designation. This is in concert with the implementation of a new matrix for both the entry level and advanced respiratory therapist examinations. The promulgation of the CRT credential now means that two levels of therapist credentialing will co-exist: the CRT and Registered Respiratory Therapist (RRT). Given these changes, consideration of the purpose and effectiveness for the Clinical Simulation Examination (CSE) may be explored.

The written clinical simulation prototype exam was developed when the American Association for Respiratory Therapy received a federal grant (American Association for Respiratory Therapy/Health Services Resources Administration, 1978; Nettles, 1981). The National Board for Respiratory Therapy (NBRT) participated in this project to develop a branching logic type examination called the Clinical Simulation Examination, or CSE. Candidates are asked to make decisions about patient care situations and then, based on their selections, are directed to any number of various portions of the problem. Latent image or invisible ink is used in the process to conceal the directives in the problem until the candidate has made a decision, thus revealing information (Bryant, 1989).

In 1979, 3,167 candidates sat for the first 10-problem CSE. This was 6.5 times the number of candidates that could be examined in any 3-day period of the oral examination (Bryant, 1989). The major impetus for this change was that the testing organization could not accommodate the large pool of candidates waiting for the oral examination.

In the ensuing 10 years, the number of registered therapists grew from 6,228 to 33,960 (Bryant, 1989). The CSE, with its ability to test an unlimited number of candidates, provided the mechanism for the growth in the number of credentialed RRTs (Smith, 1989). The purpose of this article is to evaluate the continuing appropriateness of the CSE.

The Clinical Simulation Examination was the replacement test for the NBRT oral examination. The CSE was first offered in June 1979 (Bryant, 1989; Smith, 1989; Whitacre, 1989). The latent image patient management problems were considered a viable option and testing alternative. Considered cutting-edge testing in 1974, latent image patient management problems were utilized by internal medicine specialties and administered by the National Board of Medical Examiners (Bryant, 1989). The respiratory care profession has kept this unique form of testing, although no other nursing or allied health professional credentialing agency utilizes such testing or requires two separate and different examination processes for one credential in their certification applications (American Health Information Management Association, 1997; American Registry of Radiologic Technologists, 1997; American Society of Clinical Pathologists Board of Registry, 1997; Dietetic Registration, 1997; Federation of State Boards of Physical Therapy Professional Examination Service, 1997; National Certification Agency for Medical Laboratory Personnel, Inc., 1997; National Council of State Boards of

Nursing, Inc., 1997).

Simulations create paper and pencil environments of lifelike situations in the real world. Simulations are perceived to have greater relevance than textbooks but are still not as significant as the real world. Simulations are developed to allow students to perform an exercise that imitates reality without environmental distractions and noise (McGuire, Solomon, & Bashook, 1976).

Written simulations can provide a broad sampling of performance. This is due in part to the standardization of the simulation's tasks, representative of a larger matrix of performance-based criteria (McGuire et al., 1976). Simulations also have the advantage of pre-selecting and developing specific, detailed criteria for judging student performance. This is of benefit when teachers or evaluators must rely on real-life scenarios to score human performance. Simulations allow for improved inter-rater reliability over reality because each problem is controlled. According to McGuire et al., one benefit to students is that choosing an alternate solution to a problem has no real or tragic outcome in a teaching and learning situation.

Simulations have several limitations and disadvantages. Simulations are valuable tools and important adjuncts if they are utilized along with other educational teaching or assessment tools. However, a simulation is not necessarily the most appropriate measure for performance, nor is it always the only or best substitute for real-life experience. McGuire et al. (1976) found that "personal and professional practices are most firmly entrenched by repeated reinforcement, in diverse settings, over a long time span; they are most reliably assayed by careful and repeated observation under similar conditions. Between these two extremes, simulation may be effectively utilized" (p. 5).

Written simulations have seven general characteristics that if followed allow the exercise to simulate decision making (see Table 1). If written simulations are designed to meet these steps, then a performance-based measure can be created. The simulation can be introduced with a short film or brief verbal description (McGuire et al., 1976).

Table 1
*Characteristics of Written Simulations*

| | |
|---|---|
| Introduction | Real world versus predigested summary of cues for problem |
| Sequential decisions | Interdependent and representative of stages of decision making |
| Obtain information | Decisions result in realistic information as basis for subsequent decisions |
| No retraction | Unable to change an answer |
| Various approaches | Able to take an individual approach to problem |
| Alternative paths | Feedback for alternative paths |
| Lifelike | Situation should evolve in response to decisions and actions |

The student or examinee must determine what approach to take and what further data is necessary. Following the introduction, the student or examinee is supplied with choices consisting of inquiries or actions. These decisions are noted as the student or examinee develops a latent image on treated answer sheets with a special pen. Next an instruction informs the student or examinee to advance to a delineated section of the problem.

At this point the individual is presented with multiple inquiries or actions. Each choice is latently developed and the next set of choices is presented. Individual exercises have multiple sections arranged in random fashion in order to minimize cues for solution (Traband & George, 1994). Often the student or examinee may be given choices whereby additional steps can be taken to rectify an earlier complication. On the other hand, Traband and George found that some individuals may be directed to skip several sections of the problem because they chose the correct approach.

A simulation for respiratory care testing has several parts introduced by an opening scene that sets the stage. Next is a series of sections that evolve as the exercise progresses (Traband & George, 1994). There may be two parts to each section: option or bridge (McGuire et al., 1976). In an option segment, a listing of actions or inquiries is available. The bridge segment may list alternative selections permitting alternative branches through the problem or may consist of a single direction to the next appropriate section. All of the sections contain items that are paired with responses. Each response is only revealed when selected with the latent image pen.

When constructing a written simulation, the behaviors to be measured must first be identified. This will determine the content of the problem. Next a blueprint will help create the opening scene, determine the kinds of inquiries and actions to be formulated, build the option segments, and define bridging between the sections (McGuire et al., 1976). Finally the simulation must be reviewed and edited. This means it must be critiqued by content experts, tested by students or examinees, and then reviewed by the author.

The CSE is a unique form of credentialing in that it is not utilized by any other health profession. Moreover, Canadian RRTs do not take a CSE. This type of testing was popular up to the mid 1980s. Because of the complexity of the exam construction and administration, questions related to its viability and continued effectiveness for credentialing have been examined.

## Issues of Validity and Reliability Related to Credentialing

The gold standard for professional testing developed by the Educational Research Association, American Psychological Association, and National Council on Measurement in Education outlines *Standards for Educational and Psychological Testing.* This document identified 25 different standards regarding test validity and furthermore noted that validity is the most important consideration for test evaluation (Mehrens, 1995).

Given that test results are the basis for professional licensure or employability, content-related or criterion-related evidence of validity are important considerations to a legal challenge of the test. As outlined by Stoker and Impara (1995), the basic question remains whether the test was designed and developed to identify candidates who possess the knowledge and skills sufficient for a credential. When applying this basic tenet to the

Table 2
*Content Comparison of Written Registered Respiratory Therapist Examination (WRRT) and Clinical Simulation Examination (CSE) Matrices*

| 1992 WRRT | 1996 CSE |
|---|---|
| Clinical data | Select, review, obtain, and interpret data |
| Review patient record; recommend diagnostic procedures | Review existing data in patient record, or collect additional clinical data |
| Collect and evaluate additional clinical information | Recommend procedures and/or perform and interpret procedures to obtain additional data |
| Perform diagnostic procedures, interpret results, and assist in care plan | Analyze available data to determine pathophysiological state |
| Equipment | |
| Select, obtain, and ensure cleanliness | Select, assemble, and check equipment for proper function/operation and maintain cleanliness |
| Assemble, check for proper function, identify and/or correct malfunctions and perform quality control | |
| | Initiate, conduct, evaluate, modify, |
| Therapeutic procedures | or recommend therapeutic procedures |
| Evaluate, monitor, and record patient's response | Initiate/conduct/modify therapeutic procedures within the prescription |
| Maintain airway, remove secretions, and ensure ventilation and tissue oxygenation | Monitor and evaluate the patient's response to therapy |
| Modify therapy/make recommendations based on patient's response | Recommend modifications in the respiratory care plan based on patient's response/status |
| Perform emergency procedures | Initiate, conduct, modify, or recommend emergency procedures |
| Assist physician and conduct pulmonary rehabilitation/home care | Initiate, conduct, modify, or recommend pulmonary rehabilitation and home care procedures |
| | Assist physician performing special procedures |

RRT credential, it must be pointed out that advanced knowledge and skills (not entry level) are tested for the RRT credential (Traband & George, 1994). However, the issue remains that for CSE, the examination must sample the major tasks and content identified in a nationwide job analysis.

McGuire et al. (1976) specifically defined criteria related to validity of simulations as "the extent to which the content, skills, or abilities involved . . . constitute a representative sample of the total content, skills, and abilities about which inferences are to be made" (p. 214).

A comparison of the 1992 written registered respiratory therapist (WRRT) examination matrix with that of the CSE, as noted in Table 2, demonstrated few differences in content or hierarchy for problem-solving ability (Hess, Traband, George, &

Plummer, 1992; Johnson, 1992; National Board for Respiratory Care [NBRC], 1996a). Along this same line, review of all job analyses demonstrated that the CSE matrix was updated in 1996 and was formatted to an outline similar to that of the written examination. The 1997 RRT job analysis survey requested each respondent to rate the importance of tasks as "performed by the advanced respiratory care practitioner" (NBRC, 1996b, p. 1). No separate CSE job analysis exists. Because of this lack of specific or unique identified content for the CSE and its essential similarity to the advanced practitioner examination matrix, CSE content remains duplicative to the advanced level written (RRT) and the CRT matrices (Smith, 1998).

As indicated, the NBRC has asserted that all tasks on the CRT (entry level) and RRT (advanced level written) matrices produce CSE content (Smith, 1998). Since the content is the same, one must question why a second test is necessary to credential competency. The CSE, as asserted by the NBRC, will measure problem-solving ability (Traband & George, 1994).

Nonetheless, criterion-related validity standards for the CSE need to be demonstrated (Stoker & Impara, 1995). But such documentation is not readily available. Additionally, the NBRC noted that a multiple-choice exam asks the candidate to choose among visible options, which is not very clinically realistic (Traband & George, 1994). Traband and George further found that "the CSE was not designed as an exit examination for therapist programs; it was developed to credential competent advanced practitioners" (p. 1).

However, recent scholarly evidence regarding written simulations exists. Shelledy, Valley, Murphy, and Carpenter (1997) conducted a study involving the CSE. They evaluated various computer-assisted instruction, process instruction, and content instruction, with score results on the information-gathering and decision-making sections on clinical simulations. They noted moderate correlation between measured critical thinking ability and students' pre- and post-test scores for CSE information-gathering sections, but no significant relationship with pre-test decision making and a weak but significant relationship with post-test decision making.

Moreover, there was no significant relationship between critical thinking ability and the changes in pre- and post-test scores. Shelledy et al.'s (1997) study demonstrated that the improvement noted in the scores was not related to problem-solving or critical thinking ability.

Simulations have been interpreted to measure "something different: problem-solving ability not tapped by multiple choice questions" (Swanson, Norcini, & Grosso, 1987, p. 236). Simulations replaced multiple-choice questions (MCQ) in an effort to measure problem-solving ability, but issues related to reliability have been longstanding (De Kler, 1997). Because many studies initially generated low correlations (0.2 to 0.5) between scores on simulations and MCQs, Swanson et al.'s interpretation centered around the idea that CSEs measured something other than content.

Additional research provided evidence that the low correlation is due to problems in simulation reliability (Swanson et al., 1987). In fact, this is the reason the National Board for Medical Examiners and Internal Medicine eliminated latent image simulations for testing physician competency. Specifically, Norcini, Swanson, Grosso, and Webster (1984, 1985) conducted studies on the internal medicine certifying exams of 1980-1982. Both

MCQs and clinical simulations were given with MCQ reliability at .92 (coefficient alpha) and CSE averaging .73 (intercase reliability). Norcini et al. (1985) realized that a statistical adjustment (Spearman Brown correction for attentuation) was necessary when viewing the correlation between the two tests and demonstrated correlations of 0.92, 0.86, and 0.97, which provided strong evidence that indeed the two tests were measuring the same traits rather than something different.

Swanson et al. (1987), in their analysis of major psychometric studies of CSEs, concluded "there is little evidence that simulations provide unique measurement information not available through traditional MCQ formats in far less testing time. Hence, it is unclear if simulations have any real advantages beyond greater face validity" (p. 239). This can be applied to either latent-image or computer-generated simulations.

Clinical simulation tests have shown low reliability (De Kler, 1997; Norcini et al., 1984, 1985; Swanson et al., 1987). Reliability demonstrates the reproducability of a test. In other words, will repeated measures of the same individual generate similar results (Dunne, 1981)?

Additionally, reliability is a highly technical statistic as well as a precondition for validity (Popham, 1994). For CSEs, each simulation may contain hundreds of differently weighted and highly interdependent items (Hess et al., 1992; McGuire et al., 1976; Traband & George, 1994). Because of this uniqueness, scoring issues and measures of reliability must be carefully evaluated.

## Summary

The purpose of the Clinical Simulation Examination is to test the candidate's ability to perform in a simulated work setting. However, the fact that the CSE tests an individual for realistic performance does not make the test composition and domain sampling uncomplicated or unambiguous. The NBRC has stated, "The very nature of the CSE dictates that the detailed content outline for this examination includes all of the tasks performed by entry and advanced respiratory therapists" (Smith, 1998, p. 6). Given this context, the CSE will retest CRT and written RRT content. Since the 1999 written examination for the advanced therapist will now test 73% of its items at the analysis level, it is questionable whether additional simulation-based testing is necessary to demonstrate problem-solving ability.

Testing may be simplified. Elimination of the CSE should be considered. The CSE re-tests all the CRT and written RRT material. Given the complexity rating of the advanced therapist MCQ matrix, it is not necessary to demonstrate problem-solving ability again through the CSE. Clinical simulations have been proven to demonstrate low reliability and thus have been eliminated by the medical boards (Swanson et al., 1987).

With rapid fluctuations in the health care system, the complexity of practice continues to expand and increase. In order for the credentialing system to reflect current practices in an efficient and cost-effective manner, the profession should evaluate the necessity of the CSE. Over time, the credentialing process for respiratory therapists has evolved, yet it remains grounded by tradition.

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