Summer 2006

An Analysis of Perfusion Technology Preadmission Factors on Academic Success and American Board of Cardiovascular Perfusion Certification Achievement

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AN ANALYSIS OF PERFUSION TECHNOLOGY PREADMISSION FACTORS ON ACADEMIC SUCCESS AND AMERICAN BOARD OF CARDIOVASCULAR PERFUSION CERTIFICATION ACHIEVEMENT

by

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Submitted in partial fulfillment of

the requirements for the degree

Doctor of Education

Instructional Leadership Excellence at Duquesne

School of Education

Duquesne University

August 2006

Duquesne University
School of Education

Dissertation

Submitted in Partial Fulfillment of the Requirements
For the Degree of Education (Ed.D.)

Instructional Leadership Excellence at Duquesne

Presented by:

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April 27, 2006

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Abstract

An analysis of perfusion technology pre-admission factors on academic success and American Board of Cardiovascular Perfusion certification examination achievement

This retrospective study was designed to evaluate the contribution of grade point average (GPA) and the Wechsler Adult Intelligence Scale-Revised (WAIS-R) practical scores toward predicting perfusion academic success, career placement as a clinical perfusionist, and certification success or failure. The files of 95 students enrolled in the perfusion technology program at Carlow University-University of Pittsburgh Medical Center School of Cardiovascular Perfusion (CARLOW-UPMC) from 1995 through 2005 were reviewed to obtain admission and academic data. The independent variables used were WAIS-R practical results for the picture completion (PC), picture arrangement (PA), block design (BD), object assembly (OA) and digit symbol (DS) tests, undergraduate grade point average (UGPA), science grade point average (SGPA), and anatomy and physiology grade point average (APGPA). The dependent variables used were perfusion grade point average (PGPA), career placement status as a clinical perfusionist (CAREER), and success or failure on the American Board of Cardiovascular Perfusion (ABCP) certification examination. The research plan consisted of logistic and multiple linear regression analyses to determine which of the WAIS-R and GPA independent variables were significantly associated with the dependent variables. UGPA, SGPA, and APGPA all correlate at the 5% significance level with success achieving high PGPA. WAIS-R measures were not significant indicators of academic success. PGPA, UGPA, SGPA, and APGPA did not significantly correlate with any of the tested WAIS-R scores.

PC, BD, and OA scores correlate well with CAREER. OA and DS scores correlate at the 5% significance level with ABCP certification success.

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Dedicated to Alane, Adam, Abby and Amber

CHAPTER I

INTRODUCTION

A perfusion technologist is a skilled allied healthcare professional, trained and educated specifically as a member of a surgical team. The field of perfusion technology is regarded as a very demanding vocation. The perfusionist is responsible for the selection, set up and operation of a mechanical device commonly known as the heart-lung machine (American Society of Extra-Corporeal Circulation, 1972).

The term perfusion is derived from the French verb perfuse, meaning to pour over or through. Perfusionists employ artificial blood pumps and lungs to propel an open-heart surgery patient's blood through their body tissue, replacing the function of the heart while the cardiac surgeon operates on the heart. When a patient's blood is continuously removed and returned by pumps through plastic tubing and artificial organs the technique is called extra-corporeal circulation or outside of the body blood circulation. A perfusionist is a skilled person, qualified by academic and clinical education, who operates extra-corporeal circulation equipment during any medical situation where it is necessary to support or temporarily replace the patient's circulatory or respiratory function. The perfusionist is knowledgeable concerning the variety of equipment available to perform extra corporeal circulation functions and is responsible, in consultation with the physician, for selecting the appropriate equipment and techniques to be used. By combining different artificial components, the perfusionist constructs circuits to treat various patient populations.

The underlying mission of accredited perfusion training programs has been to ensure that perfusion candidates entering the field possess both fundamental scientific knowledge of extra corporeal bypass and the practical ability to provide patients with clinically competent care. This process prepares graduates for their future role as a member of an open-heart team. Perfusionists work closely with anesthesiologists, cardiothoracic surgeons, and registered nurses in an atmosphere of teamwork.

The American Board of Cardiovascular Perfusion (ABCP) was established in 1975 with the primary purpose of protecting the public through the establishment and maintenance of standards in the field of cardiovascular perfusion (History of the American Board, 2005). The Board has established qualifications for examination and procedures for certification in perfusion technology. “Certification in cardiovascular perfusion is evidence that a perfusionists qualification for operation of extra corporeal equipment are recognized by his or her peers” (History of the American Board, 2005, p. 19). Certification in clinical perfusion is attained by satisfactory performance on the American Board of Cardiovascular Perfusion certification examination (History of the American Board, 2005). The examination is composed of two parts; the perfusion basic science exam and the clinical applications in perfusion exam. Successful candidates that pass these examinations are credentialed as Certified Clinical Perfusionists (CCP).

The evolution of perfusion education from an informal hospital-based system to its current university-based sponsorship has occurred over a 42-year period. The relationship between having an adequate supply of individuals trained to operate heart-lung machines and the quality patient care mandates has been recognized since the early 1950’s (Clark & Magovern, 1982). The challenges facing institutions charged with the delivery of health care has affected the growth of perfusion technology curriculums. In the 41 years since the establishment of formalized perfusion education, significant changes have shaped how the fundamentals pertaining to perfusion sciences are learned (Stammers, 1999). The strength of the perfusion profession is tied to the success of perfusion education programs. The peak of perfusion education programs occurred in 1995 with thirty-five programs, and ten years later only twenty-two programs are accredited by the Committee on Accreditation of Allied Health Programs (CAAHEP). The number of new perfusionists entering the field has always been of concern because job growth for perfusionists has followed the trend in cardiovascular service delivery (Riley, 1991).

Since the early 1950's, cardiovascular market factors have been described as explosive. Employment opportunities were abundant for perfusionists in the 1970s and 1980s. The 1990s maintained a period of employment stabilization. The late 1990s to present day has been a metamorphic period for both perfusion education and cardiovascular market place demands. The current changes in perfusion education are occurring as the entire health care system is undergoing a restructuring period causing new expectations for its employees.

This metamorphosis has also been experienced by individuals preparing to become perfusionists. Contemporary students are younger than in the past and a much higher percentage are entering perfusion technology as their first health career. “This challenging student population will result in graduates with a narrower discipline focus than the multi-skilled graduates of earlier years” (Plunkett, 1997, p. 239). Perfusion educators are challenged to meet market place demands with younger candidates drawn from a smaller pool of applicants. Perfusion educators focus now on student selection. One topic that has surfaced in discussions with perfusion leadership is the need to recruit high quality candidates to enter the profession. Program directors state that it is increasingly difficult to fill all the available positions in perfusion schools and that this will lead to a perfusion shortage that may be overwhelming to centers that render cardiac services (Bishop, 2003). Applicant selection, recruitment, and retention of prospective perfusion technology candidates directly affect the longevity of the profession. Research directed at this certainty may have the greatest impact on the future recruitment of qualified perfusion candidates.

The Problem

Currently, the CAAHEP accredits 19 programs that educate candidates for the role of cardiovascular perfusionists (The commission on accreditation of, 2005). CAAHEP is an allied health education organization whose purpose is to accredit entry-level allied health education programs similar to perfusion. The basis of CAAHEP accreditation is a program's ability to meet a specific set of standards and guidelines adopted by the CAAHEP Board of Directors for the perfusion profession. These standards and guidelines were initially adopted and developed in 1980 by the Accreditation Committee on Perfusion Education (AC-PE) and the sponsoring perfusion organizations. They are the minimum standards or benchmarks of quality used in accrediting programs that prepare individuals to enter the profession. CAAHEP review boards scrutinize individual perfusion program admission guidelines to insure fair practices in candidate recruitment, selection, and retention. Critical review of pre-requisite qualifications for entry into the perfusion arena targets selection of candidates with the most potential for success in a perfusion career.

Most allied health professions require a challenging combination of cognitive knowledge, psychomotor skill and clinical decision-making. The cardiovascular perfusion curriculum not only requires obtaining a strong knowledge base in a relatively short period but also developing manual dexterity and decision making ability necessary for sound clinical competency (DeAngelis, 2003). Perfusion programs are required, because of the demands placed on allied health professions, to employ highly predictive and valid criteria to select the most qualified applicants. It is impossible to select only candidates who are ultimately successful, admissions decisions must be based on the best data available to reduce the risk of attrition and to increase the number of graduates entering the profession. The purpose of this study provides an initial investigation into the potential use of the Wechsler Adult Intelligence Scale Revised (WAIS-R) as predictive measure of academic success.

Statement of the Purpose

The purpose of this study was to develop and conduct an investigation which would establish a framework by which other accredited perfusion programs could investigate further possible correlations which may or may not exist between grade point average, cognitive ability scores of the WAIS-R and a candidate's outcome on the ABCP certification exam. It was proposed to provide background information by which these facts could be examined by other perfusion educators in future studies. Attempts to identify patterns of special cognitive ability, measured by the individual WAIS-R practical tests, which might be related to certification by the ABCP, were studied to predict overall academic and clinical success.

Information was gathered from 1995 through 2005 for first time perfusion candidates taking the ABCP certification exam part I and part II. Concurrent test scores from the WAIS-R practical test that include picture completion, picture arrangement, block design, object assembly and digit symbol were then correlated with the ABCP results to determine if relationships existed between the cognitive ability scores and certification success.

Identification of the Variables

One measure of intelligence and three measures of achievement are used in the student selection process at Carlow University-University of Pittsburgh Medical Center School of Cardiovascular Perfusion (CARLOW-UPMC). The measure of intelligence is the WAIS-R practical test. This practical test yields scores for picture completion (PC), picture arrangement (PA), block design (BD), object assembly (OA) and digit symbol (DS). The measure of academic achievement utilized was pre-admission grade point average from undergraduate studies at Carlow University. Student selection is based largely on these scores and grades, and a combination of non-academic factors such as personal essays, prior medical experience, interviews and reference letters. These non-academic factors have not been addressed in this study because they are subjective measures which may be inconsistent. Success in the program is assessed by overall program grades and success achieving certification on the ABCP examination.

Research Questions

In order to fulfill the purpose of this study, the following research questions were addressed.

1. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA information is used as an indicator of success?

2. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information is used as an indicator of success?

3. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification information is used as an indicator of success?

4. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

5. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

6. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

7. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

8. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

9. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores

are used as indicators of success?

10. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

11. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

12. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Operational Definitions of Terms

Perfusion Technology Program: Any educational program in perfusion technology, which is recognized by the Committee on Allied Health Education and Accreditation (CAHEA) of the American Medical Association.

Final Perfusion Grade Point Average: Those grades achieved by students in the perfusion technology program, which reflect academic and clinical performance. The numerical grade which is obtained by the conversion of the letter grades to numbers; A+= 4, A=4, A-=3.75, B+=3.25, B=3, B-=2.75, C+=2.25, C=2, C-=1.75, D+=1.25, D=1, D-=.75, and F=0. The converted numerical grade for each course is multiplied by the number of credit hours for that course; the multiplied grades are added and the sum is divided by the total number of credit hours earned. Repeated courses are counted as separate courses, and pass-fail grades are not included. Final perfusion grade point average refers to the grade point average obtained in the professional perfusion technology program only.

Grade Point Average Preadmission: The numerical average of all those Carlow University courses, which the applicant completes prior to admission to CARLOW-UPMC perfusion program, computed in the same manner as the final grade point average.

Wechsler Adult Intelligence Scale Revised Practical Measure: The WAIS-R is an intelligence measure composed of six verbal tests and five practical tests. Only the scores on the performance section were used which included picture completion, picture arrangement, block design, object assembly and digit symbol. The scaled score and individual scores were obtained.

Perfusion Certification Examination: Certification in clinical perfusion is attained by satisfactory performance on the ABCP certification examination. The certification examination is composed of two parts. Part one is the perfusion basic science examination. Part two is the clinical applications in perfusion examination. The examination is based on six perfusion topics that include basic science, cardiopulmonary bypass, principles of laboratory analysis, intervention, biomedical engineering and safety. Certification to practice is required by most hospitals.

Admission Requirements

Carlow University, in cooperation with UPMC Shadyside Hospital, offers a four-year program leading to a Bachelor of Science (BS) degree with certification in perfusion technology. Successful completion from an accredited perfusion program is mandatory for ABCP eligibility. The perfusion technology program requires three academic years at Carlow as a biology major, a three-week summer clinical program at UPMC Shadyside

Hospital following the second year, and 17 months of clinical training substituting for the traditional senior year.

Admission to Carlow University and UPMC Shadyside is a separate two-step process that occurs prior to freshman matriculation and then following successful completion of pre-requisites of the third year curriculum. Candidates must first satisfy all the requirements of the BS degree in biology with a few modifications specific for allied healthcare training. These include anatomy and physiology I and II, microbiology, immunology, pharmacology, and biomedical ethics. The fourth year curriculum is determined by the school of cardiovascular perfusion at UPMC Shadyside.

Candidates applying for admission to Carlow must first submit a completed application form by either applying online or submitting a formal application for admission along with a non-refundable application fee. Transcripts from high school, undergraduate and/or graduate education that include cumulative Grade Point Average (GPA), class rank, grades received, and results of achievement and assessment tests are submitted for review. Scores from the Scholastic Assessment Test (SAT) and the results of the American College Testing (ACT) are required for candidate selection. Candidates are also required to submit a recommendation from a secondary school principal, teacher or guidance counselor. A personal interview and a campus visit are optional, but strongly recommended.

Carlow University has an ongoing admission policy. As soon as the application is reviewed and evaluated, students are notified of the admission decision. The admission committee at Carlow affirms that a student’s ability, motivation and maturity cannot be measured by mathematical formulas, but rather by a careful and thoughtful review of all of the applicant's credentials.

Candidates enrolled at Carlow applying to the UPMC Shadyside Hospital School of Cardiovascular Perfusion must first submit a completed application form to the Director of Shadyside's program in or before their junior year at Carlow. Transcripts from high school, undergraduate and/or graduate edification that include cumulative GPA, class rank, transcripts, and results of achievement and assessment tests are submitted for review. Scores from the SAT and the results of the ACT are required for candidate selection. Candidates are also required to submit three letters of recommendation from professional colleagues. A personal interview and onsite completion of the WAIS-R are required. A visit to Shadyside's surgical suites is optional, but strongly recommended.

Candidates for UPMC Shadyside submit SAT scores along with undergraduate quality point average and GPA scores. The result of the WAIS-R practical portion, further qualifies the candidate's Intelligence Quotient (IQ) score. This information, along with a personal interview, serves to qualify the selection of a suitable perfusion candidate.

The selection process has been one of trial and error. Results on the national certification exams meet and regularly exceed recommended guidelines set by allied health acreditors. This ambiguous, but successful process has not been questioned or examined.

This study investigated the relationship between a perfusion candidate's cognitive abilities as judged by the WAIS-R scores and their outcomes on the ABCP certification exam. General ability or "*g*" is a form of general intelligence common to all subjects.

General abilities, involved in many perfusion performance activities, have common identifiable roots. These general ability markers statistically predict success on ABCP certification examines. The findings of this study will serve to augment candidate selection based on general ability as it relates to success on ABCP certification examination.

Analysis of the admission standards and guidelines of the University of Pittsburgh's Medical Center's School of Cardiovascular Perfusion identified correlations that may exist between a student's cognitive admission testing scores and their outcomes on the national certification examination. Successful completion of this certification examination is the tool used to indicate that an individual is competently prepared for an entry-level perfusion position.

Importance of the Study

Perfusion Program Directors continue to state that it is more and more difficult to fill all the available positions in perfusion schools and there is the fear that this will lead to a perfusion shortage that we may not be able to overcome. There has always been a need to recruit and retain high quality candidates with the vocational aptitude to become competent perfusionists.

The information gathered in this research may be utilized by both perfusion educators, as well as, those individuals associated with the development and implementation of national certification examinations or State licensure organizations. The information obtained serves as a logical baseline from which further modification and recommendation of perfusion admission and education criteria may be made.

The information obtained from this research may also be used to assist perfusion leadership in the development and administration of perfusion education, as well as, to qualify existing criteria used to admit candidates into the perfusion profession. Finally, the information gathered may enhance other relevant cognitive assessment tools appropriate for candidacy selection.

Shadyside's admission practices have changed slightly over the years. Selection tools have been retained because of tradition. No definitive investigation of perfusion technology admission processes has ever been published. Many perfusion technology programs have used criteria for student selection based solely on admissions investigations from other allied health professions, which may be both costly and invalid. This study is needed to validate the process as it is currently being practiced or to offer an alternative method or measure.

There is a need to recruit high quality candidates to enter the perfusion profession. It is more and more difficult to find high quality candidates to fill all the available positions in the perfusion programs. This study serves to augment admission selection processes for the limited number of accredited perfusion programs.

Limitations of the Study

Data collection was limited to only those students who graduated from CARLOW-UPMC school of cardiovascular perfusion. Perfusion technology is a multiple entry-level profession with candidates having pre-requisites that include graduate, doctoral or baccalaureate degrees. This investigation of only baccalaureate degree level students, affiliated with Carlow University in Pittsburgh, appears to be a constraint.

The profession continues to move in a direction of homogeneous methods of entry into perfusion technology. The majority of programs remain at the baccalaureate degree level with different admission requisites so the results of this study are limited to this population of graduates.

CHAPTER II

REVIEW OF THE LITERATURE

To more clearly understand the purpose of this study, the admission requirements and guidelines for the CARLOW-UPMC school of perfusion, and the process by which the educational prerequisites may influence the transformation of a novice to an entry level certified clinical perfusionist, it is essential to have a clear understanding of the admission process, cognitive evaluation tools used and certification process. In addition, criteria used to examine cognitive learning theory must be examined. Because this study was concerned with a specific health profession with limited academic depth, the literature search focused on general allied health professions.

This study sought to establish a justifiable method for selecting students into UPMC Shadyside's perfusion technology program and extend what is known about student selection models in other allied healthcare disciplines. Chapter Two reviews the literature related to the admissions process in medicine and health related professions. This chapter begins with discussions regarding improved admission practices and then proceeds with an overview of the common accepted cognitive variables used by various allied health programs.

Perfusion technology is a new allied health profession with weak academic record for educational investigational studies. The field of perfusion technology, started in the early 1960's, is relatively new when compared to other health occupations such as physical therapy (over 60 years old), occupational therapy (50 years old) or nursing (over 100 years old). A review of the specific perfusion literature demonstrates the historical development of perfusion education, certification, and common admission practices.

Finally, a review of the literature specific to intelligence and ability demonstrates the degree to which cognitive variables predict success in academic ventures and indicates that research is needed using valid and reliable measures of cognitive variables to predict the success of perfusion technology students.

Perfusion Education

Prior to World War II, physicians dreamed of being able to repair complex congenital heart defects. Up until this time, operating on the heart was considered impossible because of the required interruption in normal body circulation it would cause. To that end, doctors needed a way to stop a patient's circulation through the heart and lungs, but still deliver oxygen rich blood to the body's vital organs. During the 1930's innovative physicians and researchers tried to create a machine that could function as the heart and lungs while the actual heart and lungs were stopped to provide a motionless, easily visible operative field.

World War II provided the opportunity for daring physicians to explore damage to the chest cavity caused by enemy warfare and use these experiences to develop techniques necessary to fulfill the need for open-heart surgery. Once these pioneer cardiac surgeons returned to private practice they were eager to implement some of these new discoveries and inspired their colleagues to develop an artificial device to take the place of the heart and lungs. In 1953, Dr. John Gibbon used the first heart and lung machine to repair a congenital heart defect on a young woman. During the procedure, his wife Mary ran the new heart lung machine. Together they had devised this equipment, with the financial backing of IBM, were able to apply it to clinical use (Miller, 2000; Romaine-Davis, 1991).

Although the first attempts at open-heart surgery were often met with disappointing failures, the era of cardiac surgery with the use of the heart lung machine or extra corporeal circuit was established. As this new era emerged, so did the need for personnel to operate this highly technical equipment. The novelty of open-heart surgery stimulated interest from other allied health professions to fill the manpower void. However, with the increasing success of open heart surgery it became apparent that a profession dedicated to the operation of the extra corporeal circuit was needed. During the 1950's and 1960's perfusionists were often residents, laboratory personnel, or nurses. Cardiac surgeons would appoint personnel as designated perfusionists and their training often consisted of skills learned on-the-job from other perfusion personnel. Frequently, the only pre-requisite to become a perfusionist was a surgeon's endorsement.

Initially, the use of cardiopulmonary bypass was limited because of difficulty sterilizing and obtaining components of the heart lung machine. However, as it became clear that the extra-corporeal circuit was an integral part of cardiac surgery, manufacturers began increased supply productions further illustrating the need for additional perfusionists. At this time, perfusion training still occurred primarily on-the-job, but it became apparent that some form of structured perfusion education and training would be needed in the future.

The first organized hospital based perfusion education program was established at the Cleveland Clinic in 1963. The first university-based program was begun at Ohio State University in 1968. Both hospital and university based programs have been useful in establishing the current perfusion education system.

The American Society of Extracorporeal Technology (AmSECT) was formed in

1964 by a group of perfusionists meeting to discuss and share issues related to the evolving science of perfusion technology. The group identified formal perfusion education as a necessity to establish the profession's credibility. Formal perfusion education had its roots in these early working committees that AmSECT established for the purposes of credentialing individuals, accrediting training programs and establishing perfusion standards of practice (Plunkett, 1997).

Admissions Recruitment

A great deal of attention has been focused on developing and implementing effective student recruitment strategies (Health professions education directory, 2000). Student enrollment in allied health professions, if not addressed, can threaten the viability of healthcare services. Allied health programs are vulnerable during times of low enrollment and/or fiscal deficits. Administrators are then forced to evaluate the quality and effectiveness of the programs.

Research studies of candidates enrolled in allied health disciplines have focused primarily on factors necessary for academic success. An adequate supply of individuals trained in allied health professions to meet ongoing demands is an educational challenge as is the need to recruit high quality candidates to meet the needs of our changing healthcare environment. There is a need to use selective criteria that can effectively identify candidates capable of successfully completing the academic requirements, displaying appropriate clinical performance and passing certification or licensure examinations.

Over the past two years one topic that has surfaced in perfusion education discussions is the need to continue to recruit and retain high quality candidates. Perfusion educators comment that it is difficult to fill all the available positions in perfusion schools with competent candidates (Bishop, 2003). This current state of affairs has changed since the early 1980's when the perfusion school enrollment increased as perfusion employment demands increased.

Physical therapy, another allied health care field, has seen similar admission enrollment changes over the years. Competition for places in physical therapy programs in the early 1970's were confronted with many more applicants than they could accept (Gartland, 1977). The growth and recognition of physical therapy as a profession in the 1970's and 1980's continued to enlarge the applicant pool (McGinnis, 1984). This shortage of physical therapists continued through the 1990's. The selection of students into a program with limited enrollment is a difficult process when the number of applicants exceeds the number of positions available (Roehrig, 1990).

Perfusion Certification

In July 1972 the AmSECT administered the first certification examination (American Society of Extra-Corporeal Circulation, 1972). This was the culmination of five years of work by AmSECT certification and education Committee (American Society of Extra-Corporeal Circulation, 1972). During this time it was given on a grandfather basis in order to establish a knowledge database (American Society of Extra-Corporeal Circulation, 1972). Grandfather was defined as a candidate who had two years of clinical experience in cardiovascular perfusion and who had conducted 100 clinical perfusions as of July 19, 1974, with a suitable database established (History of the American Board, 2005).

In 1975, AmSECT relinquished the duties of certification and recertification to the ABCP (American Society of Extra-Corporeal Circulation, 1972). The ABCP was originally incorporated in mid 1975 (ABCP, 1975). AmSECT had adopted certain requirements for certification and recertification and had also established minimum standards for cardiovascular perfusion education programs (American Society of Extra-Corporeal Circulation, 1972). The ABCP adopted all criteria previously established by AmSECT (American Society of Extra-Corporeal Circulation, 1972). Since that time, the ABCP has made some alterations in these standards as they became appropriate (History of the American Board, 2005).

In 1993 the ABCP made the decision to change from a norm-referenced to a criterion-referenced examination and in 1996 the first criterion-referenced examination was administered. The criterion-referenced examination is based on a job or practice related analysis that provides the knowledge core for the scope of perfusion practice. Because of the increasing depth of the perfusion knowledge base, the decision was made in 1995 to change the oral examination to a written clinical applications examination to allow for the measurement of the knowledge base in the practice of clinical perfusion. The clinical applications examination was field tested in 1996 and replaced the oral examination in 1996.

Certification in clinical perfusion is attained by satisfactory performance on the ABCP certification examination. The certification examination is composed of two parts. Part I, the perfusion basic science examination, is a 220-item, multiple-choice examination designed to cover perfusion basic sciences and cardiopulmonary bypass. Part II, the clinical applications in perfusion examination, is also of a multiple-choice format where a series of clinical scenarios are presented, each with a series of questions.

The number of questions on the Part 2 examination may vary from 200 to 220, depending on the scenarios used. Both the perfusion basic science examination and the clinical applications in perfusion examination are given twice a year, in the spring and in the fall.

The applicant meeting all requirements to take the perfusion basic science examination and meeting all other criteria may sit for the clinical applications in perfusion examination at the same examination site. The examination is based on topics in the ABCP knowledge base. There are six major sections of the knowledge base; basic science, cardiopulmonary bypass (adult, pediatric, infant, neonate), principles of laboratory analysis, intervention, biomedical engineering, and safety.

Once certified by the ABCP, all perfusionists must recertify annually. Recertification is designed to ensure that CCP's, through continuing education and clinical activity, continue to meet standards and possess current and adequate knowledge in the field. Recertification contains two components: clinical activity and professional activity. A certified perfusionist is required to perform a minimum of forty (40) clinical activities annually.

In 1968, AmSECT formed the certification and education committee whose purpose was to develop an examination process that insured that all entry-level perfusionists showed competency in basic perfusion knowledge. Over a five-year period, a series of questions were solicited from practicing perfusionists, which served as the foundation for the initial examination (Toomasian & Kurusz, 2003). Certified perfusionist or CCP was designated and still remains the recognized credential awarded to an individual successfully completing the certification process and acknowledges peer-endorsed minimal entry-level knowledge of perfusion (Toomasian & Kurusz, 2003).

Although AMSECT continued to endorse perfusion education, board members felt that an independent credentialing agency should oversee perfusion certification to avoid conflict of interest issues and to endorse credibility of perfusion certification to the medical community.

In 1975, the ABCP was established as a 12-member board whose scope of practice was to insure that all practicing perfusionists could demonstrate proficiency in perfusion science. Once the ABCP began the responsibility of credentialing perfusionists and insuring that credentialed perfusionists maintain certification requirements they began to endorse formalized perfusion education programs as opposed to on-the-job training. The ABCP hypothesized that graduates from formal perfusion programs should have higher examination scores than on-the-job trained perfusionists. A retrospective study endorsed these predictions and showed that test scores from accredited school graduates were consistently higher than those from non-accredited programs (Toomasian & Kurusz, 2003). This was an important finding and led the ABCP to advocate that perfusion education be conducted only at accredited perfusion education programs. In 1976 the ABCP set a policy mandating that by 1981 all candidates applying for perfusion certification must be graduates of an accredited perfusion program.

The ABCP felt that an independent accreditation body should accredit formal perfusion education programs. In 1976 the American Medical Association (AMA) recognized cardiovascular perfusion as an allied health profession. Under the AMA's endorsement, the CAAHEP formed the Joint Review Committee for Perfusion Education (JRC-PE). The JRC-PE was comprised of 12 board members of different surgical, anesthesia and perfusion organizations. The main goal of the JRC-PE was to develop essential curriculum guidelines that perfusion education programs must comply with in order to achieve accreditation. In 1991 the JRC-PE reorganized and became the AC-PE. Also at that time the AMA withdrew support of credentialing allied health programs. CAAHEP assumed the responsibility of accrediting allied health professions. Both CAAHEP and the AC-PE continue as the current accreditation agencies for perfusion education.

University of Pittsburgh Medical Center Shadyside Hospital School of Perfusion

When open-heart surgery with cardiopulmonary bypass became a reality in the early 1950's a need was created for individuals who could operate the new life supporting machines. The history of Shadyside hospital's early perfusionist program began with an apprentice approach to training. This historical review is very typical of other early perfusion technology training endeavors. The goal was to prepare qualified perfusionists for employment at the sponsoring institution. Michael Dunaway founded Shadyside's program in perfusion technology in 1968. Dunaway started Shadyside's program at a time when open-heart surgery was in its infancy. The operation of cardiopulmonary bypass circuits was often performed by laboratory personnel, medical technologists or physicians trained by attending thoracic surgeons. Dunaway's background in medical technology and service in the military were timely prerequisites for a future role operating the heart lung machine. Dr. Ford, a well-known thoracic surgeon in the western Pennsylvania area, served as his mentor and instructor. Perfusion skills were learned on the job from observations in the laboratory environment and successive cases in the operating room.

As cardiac surgery continued to grow, there was a growing need for some type of structured perfusion education and training. Dunaway started a formal training program in April of 1968. He introduced perfusion education to the Western Pennsylvania area during a time period when educators were challenged to increase the number of individuals entering the perfusion profession. Graduates were awarded a certificate in perfusion technology at the end of their 12-month training period. Class sizes were small, numbering only one or two students, with graduates quickly assuming leadership roles at other new cardiac programs across the country. Shadyside's program was challenged to meet evolving educational demands established by AmSECT and the ABCP.

Jack McEwen, a former student of Dunaway, assumed the role of Shadyside's Program Director in 1976. The future of perfusion education was maturing and accrediting agencies established standards restricting the eligibility for certification to graduates of accredited perfusion education programs. At this time there was a shift from the apprentice approach of educational training to a more structured curriculum with required educational standards.

In 1977 McEwen was promoted to Director of Shadyside's Perfusion Services Department requiring him to appoint a new program director. Realizing the need to continue to support perfusion education, McEwen appointed Patty Gaich as the new director of the perfusion school. Gaich was instrumental in forming a partnership between Shadyside's School of Perfusion and Carlow College. Carlow College, a private women's college in Pittsburgh, was located several miles from the Shadyside campus. This close proximity helped solidify this partnership and still exists today. Gaich's goals for establishing this joint venture were to incorporate the science curriculum that the accreditation agency was requiring and to motivate young women to enter this predominately male field. Her foresight incorporating this hospital-based program to a four-year baccalaureate degree enabled Shadyside to remain in compliance with the newest accreditation requirements for perfusion training programs.

Robert Rush assumed the role of the school director in 1982 and remains the current perfusion school program director. As a result of Rush's long tenure as program director there has been continued growth in the number of perfusion education programs, an increase in the number of graduates, and a turnover in many of the institutions sponsoring perfusion programs. Fundamental changes have occurred regarding program sponsorship and student demographics over the past 40 years. These changes include a shift from hospital sponsorship to university sponsored programs and students entering the program at a younger age with less prior clinical experience.

Predictors of Success

To be successful, admissions committees need valid and reliable predictors of both academic and clinical performance. The purpose of this section is to review the literature on admission criteria into perfusion technology, physical therapy, occupational therapy, medical school, nursing and other relevant allied health programs. This review will be used to address the question of what valid and reliable predictors are available based on existing research data.

Predicting the success of applicants in perfusion technology programs continues to be a difficult task. Success in perfusion training has typically been assessed in the academic and/or clinical domains within the schools. Research regarding admission standards and practices within the perfusion community has not been well documented or formerly researched. This literature search revealed nothing on this subject. Individual perfusion schools select candidates based on criteria validated by other relevant allied health educators. To that end, a literature search aimed at allied health education revealed a number of key academic predictors of success. They include academic standings qualified by grade point average, science grade point average, standardized test scores, and achievement in certain science coursework. A literature search of various allied health professions with this cognitive information included physical therapy training, occupational therapy instruction, medical school edification, and nursing education.

Academic Achievement

The methods adopted for selecting candidates for perfusion training should be based on valid and reliable scientific data. There is much criticism concerning the adequacy of student selection. The evidence is unclear and critical appraisals of admissions research express doubt that any single pre-entry measure can alone predict academic and clinical success. The admission requirements for allied health professional programs vary considerably (Balogun, Karacoloff, & Farina, 1986). The majority of studies involving admissions criteria have investigated the relationship between various admission factors and academic performance in health professions and medical schools. Few studies have researched the relationship between admission criteria and clinical performance.

A search of the literature beginning in the mid 1960’s to early 1970’s detailed much criticism concerning the adequacy of the three leading means of student selection for that era that included: academic standing, interview performance, and references (Gartland, 1977; Gough, Hall, & Harris, 1963; Pinkston & Margolis, 1970; Wingard & Williamson, 1973). Researchers concluded at that time that the predictive validity of the results of admissions measures as a whole required scrutiny and more valid and reliable selection procedures (Gartland, 1977; Gough, Hall, & Harris, 1963; Pinkston & Margolis, 1970; Wingard & Williamson, 1973). To this day there seems to be little agreement as to which admissions data are predictive of professional competence for any allied health endeavor (Gartland, 1977; Gough, Hall, & Harris, 1963; Pinkston & Margolis, 1970; Wingard & Williamson, 1973). Admission criteria used in allied health professions validate previous scholastic achievement that includes both overall preadmission GPA and GPA based on prerequisite science courses (Agho, Mosley, & Williams, 1999; Dietrich & Crowley, 1982; Gartland, 1977; Nayer, 1992; Payton, 1997).

Criteria that have traditionally been used to predict academic success include preadmission GPA, ACT scores, Graduate Record Examination (GRE) scores, interview ratings, letters of recommendation, and Allied Health Professions Admissions Tests (AHPAT) scores. Balogun (1987) found that GPA and AHPAT scores were the most reliable preadmission predictors of academic success. The cognitive and noncognitive factors used in the selection of allied health students are presented in Table 1 (Agho et al., 1999).

Table 1

Comparison of the Rankings in Admissions Decisions among Select Allied Health Programs

1.	Overall grade point average
2.	Grade point average in foundation courses: biology, chemistry, physics, and anatomy and physiology.
3.	Letters of recommendation
4.	Performance on admission personal interview
5.	Quality of personal goal statement
6.	Volunteer work in a field setting
7.	Prior work experience
8.	Standardized test scores
9.	Student's character
10.	Increase diversity among students
11.	Student's participation in extracurricular activities
12.	Student's desire to work in an underserved community
13.	Participation in academic summer enrichment program
14.	High school grade point average

A number of studies have attempted to describe the relationship between proposed measures of success in allied health professions training programs and other variables believed to be predictive of such success (Baker, Douphrate, & Ridley, 1996; Balogun, 1987; Guthrie, 1990; Nayer, 1992; Norman & Boonyawiroj, 1997; Roehrig, 1990; Thieman, Weddle, & Moore, 2003). Most of these studies measure success in terms of GPA concluding that preadmission grades were the best predictors of success for physical therapy education (Baker, Douphrate, & Ridley, 1996; Balogun, 1987; Guthrie, 1990; Nayer, 1992; Norman & Boonyawiroj, 1997; Roehrig, 1990; Thieman, Weddle, & Moore, 2003). None of the admission criteria or graduate program grades predicted clinical performance (Watson, Barnes, & Williamson, 2000).

Given the difficulty defining non-academic characteristics, a reasonable mix of academic and non-academic variables appears to exert a significant influence in the selection process (Guthrie, 1990). Noncognitive variables may be essential components of effective clinical performance. Personal attributes that work in concert with cognitive abilities allow an individual to be an effective clinician (Hayes, Huber, Rogers, & Sanders, 1999). There is some evidence that previous academic performance predicts future academic performance (Kirchner & Holm, 1997). Scott et al. (1995) researched allied health programs finding that most programs used college GPA for admission decisions. The use of GPA to select candidates is supported by evidence that college GPA is related to grades eventually obtained during enrollment in occupational therapy training (Ford, 1979; Kirchner & Holm, 1997). Letters of reference, personal interviews and writing samples were also used by a number of surveyed` programs with little evidence to support the effectiveness of these predictors (Scott et al., 1995).

“Research has shown that a student’s undergraduate college major has no correlation with progress or ultimate achievement in medical school” (McGaghie, 1990, p. 137). After admission to medical school, students with undergraduate majors in the humanities or social sciences do just as well as the pre-med majors throughout the medical school curriculum (McGaghie, 1990). Few allied health programs use standardized examinations such as the SAT or the GRE, and there is little evidence available on the usefulness of these measures as predictors of success or effectiveness in screening applicants for admission (Scott et al., 1995).

Because of an increased demand for rehabilitation services, the demand for physical therapists has increased much faster than the supply (Balogun et al., 1986). Correspondingly, the growth and recognition of physical therapy as a profession during the late 1970's and early 1980's enlarged the applicant pool of candidates (McGinnis, 1984). Because the number of applicants outnumbered the positions available in professional programs, educators had increased responsibility to identify students least likely to succeed. The relationship between admission criteria and performance after admission continues to be a subject of considerable interest and debate within the physical therapy educational community. In a survey of physical therapy programs, Gartland (1977) reported that the most important admission factor was previous academic performance.

The admissions requirements for the professional education programs in the health sciences have always varied, but pre-professional cognitive academic measures such as GPA, science grade point average (SGPA), standardized test scores, and achievement in certain science coursework have predominated as selection criteria (Guffey, 2000). Admissions criteria found to have predictive validity with students' subsequent academic performances are GPA, SGPA, and essays (Balogun et al., 1986; Roehrig, 1990; Scott et al., 1995). The ability to reliably predict success in allied health occupations is difficult to accomplish. Completion of an education program does not ensure competence as a practicing clinician. The question of academic performance, prior to entry into perfusion technology study, as a valid and reliable predictor for academic and clinical performance following admission, has yet to be answered.

Grade Point Average

GPA has always been the cornerstone of cognitive variables considered in the admissions process (Hayes, Fiebert, Carroll, & Magill, 1997). The literature supports GPA as a predictor of success in health related fields and it is considered the major point of consideration in the applicant selection process (Balogun et al., 1986; Guffey, 2000; Payton, 1997).

Physical therapy.

Peat et al. (1982) studied admission average and academic performance of 186 graduates in a university based physical therapy program. Admission GPA was highly related to academic performance. It was the second year average that showed the strongest relationship to admission GPA, with 45% of the variation explained. The significant relationship between academic performance and GPA is a criterion for acceptance of students in health care programs of this kind. Clark (1983) investigated the selection of students for physical therapy education and how they performed in a baccalaureate entry-level program. Seventy-six graduates who completed the two-year curriculum in 1981 through 1982 were considered as subjects in this study. Pre-admission GPA, pre-admission math and science GPA, score on the Otis Mental Ability Test, and scores on the Nelson-Denny (ND) Reading Test were used as variables to predict final physical therapy GPA, clinical education grades, and scores on the state board examination. The best predictor of final GPA was a model combining the pre-admission

GPA and the reading score from the ND reading test. The best predictor of achievement on the clinical medicine portion was a combination of the pre-admission GPA and ND comprehension score. The best predictor of achievement on the physical therapy portion was a combination of the pre-admission GPA and ND vocabulary score.

McGinnis (1984) evaluated a number of admission predictors for 111 pre-physical therapy majors. Freshman GPA is a relatively strong predictor of ultimate success in gaining admission to professional schools (McGinnis, 1984). The primary implications of the results of her study are that a relationship between freshman GPA and success for the physical therapy program does exist with a statistically significant variance of 45%. This study suggests a means to identify successful applicants to physical therapy programs.

Balogun et al. (1986) undertook a retrospective study to determine the best predictors of academic achievement in a baccalaureate physical therapy program. The files of 83 students were reviewed. Analysis revealed that the best predictors of future academic achievement were GPA with a statistically significant variance of 40%.

Day (1986) studied 552 post baccalaureate graduate record examination analytical (GRE-A) scores between 1975 and 1982 to predict academic success in physical therapy education. The GRE-A score was not as useful alone as when combined with other predictor variables such as overall preadmission GPA accounting for as much as 68% of the variance in predicting final GPA.

Levine, Knecht, and Eisen (1986) studied two physical therapy cohorts in 1982 (N=25) and 1983 (N=31). Pre-professional academic and personal characteristics were used to predict academic and clinical success. Pre-professional cumulative GPA for the class of 1982 significantly correlated with cumulative GPA's in the physical therapy program (r=.50, r<.05). All other correlations were low, and correlations for the class of 1983 were lower than 1982.

Balogun (1987) did a retrospective study of 40 students evaluating the contribution of the AHPAT toward predicting academic achievement in a physical therapy education program. The results of this study revealed that GPA was a viable predictor of first year grades in the physical therapy professional curriculum. The GPA accounted for a 47.98% variance. The result of this study revealed that pre-admission GPA was the most viable predictor of first-year academic performance in the physical therapy professional program.

Byl (1988) confirmed an association between GPA and academic success. She conducted a 3-year retrospective analysis of admissions from 1984-1986 to a 15-month baccalaureate certificate program in physical therapy. “Although GPA is considered an essential aspect of the admission process in physical therapy, not all studies suggest a relationship between grades and clinical or professional performance” (Byl, 1988, p. 13). Academic GPA accounted for 56% of the variation in clinical performance. All of the students passed the professional licensing examination, ranking in the 80th and 96th percentile (1985 and 1986 respectively).

Gross (1989) studied the value of physical therapy admission criteria in predicting clinical, didactic and licensure performance. He looked at three cohorts from 1983 through 1985. His results indicated that pre-professional academic performance and standardized measures of general verbal and mathematic aptitude are moderate predictors of professional didactic performance, and are less valuable in predicting licensure performance.

Kirchner, Holm, Ekes, and Williams (1994) studied select predictors of student success in an entry-level master's in physical therapy program. Support was found for two of the five independent variables, undergraduate grade point average (UGPA), and scores on the GRE, to predict professional physical therapy education GPA and scores on the final written examination. These results were consistent with those of other studies. Pre-professional grades were a powerful predictor of professional GPA and scores on the comprehensive examination.

There is strong evidence in the literature that academic achievement has good predictive ability for future academic performance (Nayer, 1992). Nayer (1992) surveyed 13 Canadian physical therapy programs with 11 considering grades as the most important criteria for admission. Roberts (1996) identified physical therapy program admission criteria that could explain the variance associated with measures of future academic performance. The sample included forty-eight physical therapy graduates that graduated in 1995. Prerequisite GPA was related to academic achievement in physical therapy education examination scores. Prerequisite science GPA correlated with professional achievement of physical therapy students. ACT scores were the single best admission variable that explained differences in the academic performance of physical therapy students.

Payton (1997) reviewed the literature from 1983 through 1994 on admissions criteria as predictors of academic performance in physical therapy education. His meta-analysis of the literature was based on selected titles found either in Physical Therapy, the Journal of Physical Therapy Education, or Physiotherapy Canada. The 22 studies were statistically analyzed and revealed a highly significant relationship. "The physical therapy community should accept, as demonstrated, that the best single predictor of academic success, grades in physical therapy educational programs, is pre-physical therapy GPA" (Payton, 1997, p. 101). This meta-analysis indicated that physical therapy has one valid and reliable predictor of success in the academic setting of training, the pre-physical therapy GPA.

Watson et al. (2000) surveyed various allied health educational programs that included diagnostic medical imaging, health information management, nurse mid-wifery, occupational therapy, physical therapy, and physician assistant education. 462 surveys were sent out with a 63 % return rate. The most frequently required admission criteria were GPA, personal references, interviews, SGPA, and writing samples.

Dockter (2001) studied the relationship between selected physical therapy preadmission factors and academic success of 107 students enrolled in a four-year physical therapy program from 1996 through 1999. Overall core GPA ($r=.341$, $P<.01$) and first-year GPA ($r=.648$, $P<.05$) were significantly correlated to success on the National Physical Therapy licensing Examination (NPTE). The best predictor of success on the NPTE was the GPA following the first year of physical therapy education enrollment.

Thieman et al. (2003) evaluated a variety of admission criteria of 12 candidates enrolled in a master's level physical therapy program from 1998 through 2001. Admission criteria included overall and prerequisite preadmission GPA, GRE scores, and other admission information. The outcome variables included final physical therapy didactic GPA and NPTE scores. Overall physical therapy academic competence was best predicted by preadmission grades. GRE scores, age and prerequisite GPA accounted for

37% of the variability in graduate physical therapy success.

Occupational therapy.

A survey of admission criteria for occupational therapy training suggested that college grades were the second most frequently used admission method in selecting students for occupational therapy education (Johnson, Arbes, & Thompson, 1974). In most cases, cumulative GPA for the freshman and sophomore years was used.

The literature examining the relationship between occupational therapy academic course work and field work performance offers evidence that a correlation between academic grades and fieldwork performance exists (Anderson & Jantzen, 1965; Ford, 1979; Katz & Mosey, 1980; Lind, 1970; Mann & Banasiak, 1985). Early occupational therapy research was focused on clinical performance rather than academic performance. GPA was used to correlate clinical fieldwork performance.

Kirchner and Holm (1997) investigated academic and clinical performance of 75 occupational therapy students enrolled in master's degree programs from 1986 through 1992. Predictor variables included UGPA, scores on the GRE, essay scores, and reference form scores. The dependent variables were GPA on occupational therapy courses and various clinical assessment outcome scores. The model predicting academic success was significant and supported the continued use of UGPA, scores on the GRE, and essays. This research was the first to establish the effectiveness of the GRE and an essay to screen applicants for admission into occupational therapy programs. Previous occupational therapy research demonstrated the usefulness of GPA as an admission-screening device (Bridle, 1987; Posthuma & Sommerfreund, 1985).

Kirchner, Stone, and Holm (2000) investigated academic and clinical performance of 63 occupational therapy students from 1994 through 1997 enrolled in master's degree program. This study was designed to replicate and extend the findings of earlier research by Kirchner and Holm (1997). Predictor variables included UGPA, scores on the GRE, essay scores, and reference form scores. The dependent variables were GPA on occupational therapy courses and select clinical assessment outcome scores. Both UGPA and scores on the GRE were found to predict occupational therapy GPA. The GRE analytical section may be a more effective predictor for screening occupational therapy applicants. The correlation between the analytical scale and occupational therapy GPA was r = .51.

Medical school.

Hamberg, Swanson, and Dohner (1971) stated the strongest predictors of medical school success are, in the following order: overall GPA, SGPA, Medical College Admission Test (MCAT) science scores, and committee letters. Cognitive criteria appear to have a stronger influence than non-cognitive criteria. Mitchell (1990) reviewed 18 studies of traditional pre-admission predictors of academic performance in medical school. This research demonstrates the predictive value of traditional academic measures of performance for medical school. Data presented in this literature reflect the usefulness of UGPA, MCAT scores, selectivity data, and transcript data for predicting SGPA, National Board of Medical Examiners (NBME) examination scores, and academic difficulty. Mitchell (1990) review of the literature from 1980 to 1990 confirmed that academic variables are important predictors with 49% of the variance in GPA and 58% of the variance in NBME scores.

Shaw, Martz, Lancaster, and Sade (1995) investigated the influence of knowledge of medical school applicants' cognitive abilities on interviewers' ratings of non-cognitive traits. Relevant results of this study qualify GPA as a predictor of academic success. The authors recommended that MCAT and GPA data not be available to interviewers during interviews. The goal of the medical school admission interview is to assess non-cognitive traits independently from academic skills. This study, along with previous research by Sade, Stroud, Levine, and Fleming (1985) and Webb et al. (1997), suggest that academic measures such as GPA and MCAT scores identify applicants who will be successful academic students, not necessarily good physicians.

Nursing.

Payne and Duffey (1986) studied nursing admission data of 283 baccalaureate graduates to identify variables that predict academic failure on the National Counsel Licensure Examination for Registered Nurses (NCLEX-RN) nursing examination. The nursing GPA of the junior year, total SAT scores, and admission GPA were found to be significant predictors of success. By the end of the junior year, 65% of the nursing students who would fail the NCLEX-RN examination could be identified. Beeson and Kissling (2001) conducted a retrospective study identifying predictors of success for baccalaureate nursing graduates on the NCLEX-RN examination. They identified 505 subjects from 1993 through 1998. Students who passed the NCLEX-RN examination have significantly higher average GPA's, made fewer grades of C or below, and scored well on the Mosby Assess Test than students who failed. This study was consistent with other research (Wall, Miller, & Widerquist, 1993; Waterhouse, Bucher, & Beeman, 1994).

Other health related fields.

Researchers in other health related fields have attempted to identify and validate predictors of successful licensure or certification outcomes. Harrelson, Gallaspy, Knight, and Leaver-Dunn (1997) researched specific academic athletic training variables, which could predict success on the National Athletic Trainers' Association Board of Certification (NATABOC) examination. Overall academic GPA, athletic training GPA, academic minor GPA, ACT score, and the number of semesters of university enrollment explained 42% of the variance in predicting certification achievement.

Schimpfhauser and Broski (1976) investigated the relationships between three cognitive measures and first year academic success in general allied health curricula. In an attempt to increase the validity of admission selection tools, Ohio State University School of Allied Medical Professions admissions contacted the Psychological Corporations with the intent to develop a standardized admission test. The AHPAT was first administered in September 1973 to several health areas that included: circulation technology (perfusion technology), medical communications, medical dietetics, medical illustration, medical records administration, nurse anesthesiology, occupational therapy, physical therapy, radiological technology, and respiratory therapy. Their objective was to study the validity and reliability of this measure against more traditional cognitive selective tools. The cognitive factors used were: ACT scores, pre-professional GPA, and AHPAT scores. Academic success, the dependent variable, was defined by first year GPA in allied health professional preparatory programs. Pre-professional grades served as the strongest predictor variable with respect to first year allied health grades. The AHPAT subtest that appeared as a significant predictor most frequently was biology.

Beckley (2005) detailed the following:

> It is true that a number of the allied health programs used the AHPAT as a predictor of some outcomes such as success in the program and graduation. After using the AHPAT for some years, for circulatory technology admissions, it was abandoned because it was determined that the test did not add anything to the predictability that was already found in just using pre-professional program GPA, ACT scores, and SAT scores.

Agho et al. (1999) investigated the admission practices of select allied health programs. Questionnaires mailed to baccalaureate occupational therapy, physical therapy, health information management, and respiratory therapy programs revealed combinations of cognitive and non-cognitive admission variables. A higher priority is placed on overall GPA and GPA in foundation courses.

Science Grade Point Average

SGPA has been another cognitive variable used by admissions committees Guffey (2000). Guffey (2000) demonstrated SGPA exceeded GPA in predictive power with regard to professional program of study performance. GPA is an important variable in the applicant selection process because future academic performance can best be predicted by past academic behavior (Guffey, 2000; Hayes et al., 1997). Many allied health programs have used academic achievement in selected science courses as an admission variable (Hayes et al., 1997). Pre-professional courses such as chemistry, physics, anatomy and physiology, and advanced science are important indicators of an applicant’s cognitive potential. SGPA is frequently considered for occupational and physical therapy program admission criteria.

Physical therapy.

Day (1986) studied 552 post baccalaureate GRE-A scores between 1975 and 1982 used to predict academic success in physical therapy education. The GRE-A score was not as useful alone as when combined with other predictor variables such as biology GPA accounting for as much as 28% of the variance in predicting final GPA.

Levine et al. (1986) studied two physical therapy cohorts in 1982 (N=25) and 1983 (N=31). Pre-professional academic and personal characteristics were used to predict academic and clinical success. Pre-professional SGPA for the class of 1982 significantly correlated with cumulative GPA's in the physical therapy program ($r = .54$, $p < .05$). All other correlations were low, and correlations for the class of 1983 were lower than 1982.

Templeton, Burcham, and Franck (1994) analyzed 12 different pre-admission academic variables with the professional GPA achieved in a two-year physical therapy program. The purpose of the study was to determine whether any of the preadmission academic scores correlated with the professional overall GPA. This study of academic achievement of 111 students does not support the findings of previous studies, which showed pre-professional GPA as a predictor of academic success in the professional phase. However, a correlation did exist with chemistry, physics, and SGPA as significant predictors of professional academic success. These predictors accounted for 16% of the variance of the physical therapy cumulative GPA.

Baker et al. (1996) evaluated the predictive validity Revised Health Occupations Aptitude Examination (R-HOAS), along with other admission variables. Data from 68 students during their first year of study in a physical therapy programs were reviewed. Significant correlations were noted between academic performance during the first year of study in physical therapy training and cumulative pre-professional GPA, pre-professional SGPA. The use of the R-HOAE can provide valuable information that, when combined with preadmission GPA and preadmission SGPA, can be helpful in selecting physical therapy students.

Occupational therapy.

Englehart (1957) investigated the relationship between UGPA and academic performance during clinical training of occupational therapy students. Subjects for the study were 104 students who graduated from 1945 through 1951. This study concluded that over-all performance during clinical training may be predicted by low, but significant, relationships from biology coursework GPA's. Ford (1979) conducted a study of grades from 16 selected college courses and the pre-occupational therapy GPA to determine significant relationships with internship grades of 72 occupational therapy students. The neurology course GPA was statistically significant at the .0004 levels as a predictor of physical disability internship academic performance.

Medical school.

Mitchell's (1990) review of academic predictors included basic science performance, clinical performance, NBME performance, and academic difficulty. She concluded that these traditional values of performance have value in predicting medical school performance. Mitchell (1990) analyzed 18 studies that utilized multiple academic predictors of basic science performance of medical students. Multiple correlations were reported ranging from .24 to .66 with a median value of .49. Other studies have confirmed Mitchell (1990) review regarding the ability of academic preadmission criteria to predict academic medical school performance reviewed the records of 420 medical students who were enrolled during 1982 to 1986 (Collins, White, & Kennedy, 1995; Hall & Bailey, 1992; Montague & Odds, 1990). A combination of MCAT scores and SGPA were useful in predicting first year academic success in medical school.

Nursing school.

Glick, McClelland, and Yang (1986) researched the relationship of the nursing admission variables of high school rank, GPA, ACT scores, select grades in pre-nursing and nursing courses, and success in the baccalaureate-nursing program. Academic achievement was identified by success on the NCLEX-RN, clinical course grades, and cumulative nursing GPA. The sample consisted of 51 graduates with the strongest predictor of academic success being biology and pre-nursing GPA.

Yang and Noble (1990) examined the relationship between admission variables of 210 baccalaureate-nursing graduates and performance on the NCLEX-RN examination. The best predictors for clinical nursing GPA were the pre-nursing GPA, social science GPA, social service GPA, and biology GPA. The significant predictors of nursing GPA were ACT scores and pre-nursing GPA. Wall et al. (1993) identified the relationship between admission variables of baccalaureate nursing graduates and performance on the NCLEX-RN examination. Overall GPA and SGPA were identified as significant predictors of NCLEX-RN examination success. A meta-analysis by Campbell and Dickson (1996) summarized the findings of 47 studies performed between 1981 and 1990. The review detailed GPA in nursing and science courses to be the greatest cognitive predictors of student academic success.

Anatomy and Physiology Grade Point Average

Anatomy and physiology grade point average (APGPA) has been another cognitive variable used by admissions committees (Feldt & Donahue, 1989; Hayes et al., 1997; Quick, Krupa, & Whitley, 1985). APGPA is an important variable in the applicant selection process because future academic performance can best be predicted by past academic behavior (Hayes et al., 1997). Many allied health programs have used academic achievement in selected science courses as an admission variable (Hayes et al., 1997).

Physical therapy.

Hayes et al. (1997) conducted a retrospective study of 107 students from a physical therapy program between 1982 and 1987. The results of this study showed a difference between the older, non-traditional students and the younger, traditional students with the best predictors of success for the latter being gross anatomy GPA and pre-professional GPA (49% and 5% of variances, respectively). For the older students, the best predictors were gross anatomy grade and interview score (35% and 8% of variances, respectively). The non-traditional students had significantly lower freshman GPA's, there was no significant difference in physical therapy final GPA between the two groups.

Nursing.

Feldt and Donahue (1989) found in their study that the best predictors for success in baccalaureate nursing programs and scores on the NCLEX-RN were individual grades in anatomy and chemistry and the composite score of the ACT examination. Griffiths, Bevil, O'Conner, and Wieland (1995) showed that scores on an anatomy and physiology examination were predictive of the performance of nursing students in the didactic portion of their nursing education.

Quick et al. (1985) studied the effectiveness of using admission indicators at the time of admission to clinical nursing courses in a baccalaureate program to predict academic performance on the NCLEX-RN examination. The predictors of success on the NCLEX-RN were GPA at the end of the freshman year, verbal scores on the SAT, and grades in anatomy and physiology.

Intelligence and Ability

The study of complex cognition originated in ideas derived from early Greek philosophy. Hippocrates believed that disease was not a punishment sent by the Gods. He used unorthodox empirical methods to study medicine. He was particularly interested in discovering the source of the cognizing mind, which he though was a separate, distinct entity that controlled the body (Sternber & Ben-Zeev, 2001). This belief that the body and the mind or spirit and soul are qualitatively different is the view that the body is composed of physical substance, but the mind is not. He believed the mind resides in the brain. The agent of control was within the body, not in the external forces of the gods or demons (Sternber & Ben-Zeev, 2001). Plato believed the mind resides in the brain while Aristotle thought the mind was in the heart. Of the many far reaching aspects of Platonic and Aristotelian philosophies, there are three areas in which the language between these two philosophers are particularly relevant to modern psychology: “the relationship between mind and body, the use of observation versus introspection as a means for discovering truth, and the original source for our ideas” (Sternber & Ben-Zeev, 2001, p. 15). The study of cognition originated in ideas derived from this original philosophy and physiology.

There is debate still today whether abilities, personality, and intelligence are innate or are acquired through interactions with the environment (Kuncel, Hezlett, & Ones, 2004; Sattler, 1992; Sternberg, 1986). The most likely explanation is that a synthesis of both experience and innate ability contribute to the many aspects of cognition. Individuals differ from one another in their ability to understand complex ideas, to adapt to their environment, to learn from experiences and to engage in reasoning (Stern, 1914). Because of these individual differences, a person's intellectual performance can be substantial and never entirely consistent (Stern, 1914). Concepts of intelligence are attempts to clarify and organize this complex set of phenomena.

The early works of psychologists Galton, Spearman, Cattell, Thorndike, Binet and Simon conceived the idea of constructing a graded scale that defined and measured intelligence (Sternber & Ben-Zeev, 2001). Their common efforts defined the qualities of human functioning. They researched and debated early techniques for sampling an individual's intellectual abilities. These measured abilities were later scaled according to age with coefficients used today. The intelligence quotient or "IQ" was a new academic standard (Sternber & Ben-Zeev, 2001).

Researchers have obtained a level of consensus on the common elements of intelligence (Sattler, 1992). These include abstract thinking or reasoning, the capacity to acquire knowledge and the ability to solve problems. The general nature of intelligence thinking or intellectual activity is the investigation of the phenomena that constitute thinking as such. Intelligence is not simply a phenomenon, but a capacity with respect to which people differ one from another (Stern, 1914).

A century of scientific research has shown that general cognitive ability or *g*, predicts a broad spectrum of important life outcomes, behaviors and performances

(Kuncel et al., 2004). General ability measures a person's capacity to deal with ideas, to solve problems, and to assimilate new information. Predicting how well a person will do on a given task has involved testing a person's ability and skills and maybe a few personality traits.

The nature of the human intellect has fascinated scholars for centuries. The earliest work, ranging from Plato and Aristotle, formed the foundation for modern explorations of intelligence. During the Modern Foundations time period psychology began to emerge as a discipline separate from philosophy, mathematics, and biology. Individuals from these diverse fields continued to influence psychological discourse and the study of intelligence. The Great Schools time period witnessed a number of theoretical and empirical investigations of intelligence. A milestone during this time period was the development of the United States' Army Alpha and Beta testing program. This massive project gave rise to the first group intelligence tests and provided a fertile training ground for many psychologists who would become influential in the ensuing decades. New statistical techniques and modern experimental designs helped to make standardized testing of intelligence and achievement a way of life in most western countries. Although general ability "*g*" theories dominated, theories of multiple intelligences began to appear (Wechsler, 1958).

Current trends in intelligence theory and research involve the formation of more complex multiple intelligence theories and a de-emphasis on the use of standardized testing to measure intelligence. The emergence of reliable genetic and neurological research methodologies is creating a new area of study in which environmental, biological, and psychological aspects of intelligence are studied (Cooper, 1999).

Intelligence commonly implies a sort of general cognitive aptitude (Cooper, 1999). It is theorized that if an individual excels in one area they will equally excel in others. General ability or "*g*" describes the many parts of the whole. Intelligence is the sum total of the many strengths and weaknesses of "*g*". Intelligence is a measure of one's ability to learn or the capacity for abstract thinking (Thorndike, 1921). The cornerstone of the traditional approach to mental measurement has been the concept of abilities (Das, Naglieri, & Kirby, 1994). "Ability is a trait or characteristic of a person, with respect to some mental task, that has attained a stable level of performance" (Das et al., 1994, p. 8). Abilities are thought of as capacities. The degree to which a person is said to have these capacities and the characteristics of these abilities define intelligence.

The psychology of individual differences acknowledges people according to their natural gifts. General abilities "*g*" and special abilities "*s*" are inherited traits that define an individual's cognitive potential. Intelligence is the global capacity to act purposefully, to think rationally and to deal effectively with one's environment (Matarazzo, 1972).

Controversy exists regarding the concept of single versus multiple dimensions of intelligence. Historically, intelligence tests produced a single score, which indicated a general measure of intellectual functioning. The concepts of multiple intelligence suggest that there are several kinds of abilities rather than just one. Gardner's theory of multiple intelligence breaks intelligence into seven different areas: linguistic, logical mathematical, musical, spatial, kinesthetic, interpersonal, and intrapersonal (Gardner, 1983). Scores on all tests of cognitive ability were proposed to be a function of two components: a general component, g, and a specific component, *s* (Spearman, 1927). The specific component is unique to a test or limited set of tests and cannot be measured without measuring *g* (Spearman, 1927). Many models of intelligence are based on the idea that there are a number of independent specific abilities.

As previously stated, the earliest classifications of intelligence were practical attempts to define patterns of behavior for medical and legal reasons. Contributions from psychologists attempted to classify intelligence by means of quantitative measurements. Intelligence tests provided quantitative data for these early classifications. Measures of cognition, derived from one or more intelligence tests, qualify IQ. IQ is a product of the results of intelligence testing. “We still have to decide the meanings we attach to the IQ, however attained” (Wechsler, 1958, p. 39). Wechsler’s theory of intelligence supports his work designing the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1958).

The Wechsler Adult Intelligence Scale Revised

Dr. David Wechsler, a clinical psychologist, developed the Wechsler intelligence scales. Wechsler’s first test, the Wechsler-Bellevue Intelligence Scale, was published in 1939 as a measure of intellectual performance in adults. Since 1939 three scales have been developed to measure intellectual performance of children and adults.

Wechsler defined intelligence as an individual’s ability to adapt and constructively solve problems in the environment (Wechsler, 1958). He viewed intelligence in terms of intellectual performance rather than capacity. His rationale for intelligence suggests that it really does not matter how much intelligence one has in order to adapt to the environment, what matters is how well one uses intelligence (Wechsler, 1958). Wechsler views intelligence tests as performance measures of intellectual performance as a multidimensional construct of different intellectual abilities (Wechsler, 1958).

David Wechsler theorizes that intelligence tests are based on two assumptions. If intelligence involves primarily the ability to perceive logical relations and to use symbols, tests that favor verbal, arithmetical, and general abstract reasoning will highlight these strengths. If intelligence is a measure of the ability to handle practical situations, tests rich in performance and manipulative ability will highlight these strengths. Intelligence test designs measure intelligence through mental abilities. The question of intelligence and ability has yet to be answered. The most important fact about any test is its overall merit as a good measure of intelligence (Wechsler, 1958).

David Wechsler devised an IQ test with multiple focus areas to define ability. Components of this measure include a variety of IQ tests that measure different abilities. The Wechsler scales have two batteries of subtests grouped into two general areas: verbal scales and performance scales. The verbal scales measure general knowledge, language, reasoning, and memory skills. The performance scales measure spatial, sequencing, and problem-solving skills. The battery of tests consists of six verbal and five performance tests. They include an information test, a general comprehension test, a memory span test, an arithmetical reasoning test, a similarities test, a vocabulary test, a PA test, a PC test, a BD test, an OA test, and a DS test. Trained examiners using a multipart set of test materials administer the Wechsler tests. Testing requires approximately ninety minutes for both parts.

The PA test consists of a series of pictures which, when placed in the right sequence, tell a little story. The pictures are presented to the subject in a disarranged order. The candidate is asked to put them together in the right order so that they make a sensible story. The set of pictures were selected on the basis of interest of content, probable appeal to subjects, ease of scoring, and discriminating value. Items represent essentially American situations and their appreciation may be expected to be influenced by cultural background. The PA test correlates unevenly and sometimes unpredictably with other subtests of the scale, but on the whole the correlation is higher with the performance than with the verbal tests (Wechsler, 1958).

The PC tests require the subject to discover and name the missing part of an incompletely drawn picture. This measure effectively measures a subject's ability to comprehend and size-up a total situation. The subject must understand the whole, must get the idea of the story, before he or she is able to accomplish the task. The subject is called upon to assess and evaluate the total situation. The subject matter of this test nearly always involves some practical situation. The understanding of these situations has been referred to as social intelligence. Wechsler's view is that social intelligence is just general intelligence applied to social situations (Wechsler, 1958). "Individuals that do well on the picture arrangement seldom turn out to be mental defectives, even when they do badly on other tests" (Wechsler, 1958, p. 209).

The PC test measures intelligence at lower levels. Basic perceptual and conceptual abilities are scored. It is the type of test that effectively measures a subject's ability to comprehend and size up a total situation and measures ability to observe details and recognize specific features of the environment (Wechsler, 1958). The examinee must identify the missing part from a set of pictures. In a broad sense the test measures the ability of the individual to differentiate essential from non-essential details (Wechsler, 1958).

Included in the BD test are nine red and white square blocks and a spiral booklet of cards showing different color designs that can be made with the blocks. The examinee must arrange the blocks to match the design formed by the examiner or shown on the cards. Each item is scored for accuracy and speed of arrangement completion. Success with the BD is dependent upon the individual's ability to analyze the whole into its component parts. "The OA and the BD tests seem to get at some sort of creative ability" (Wechsler, 1958, p. 214). These tests are observably influenced by a person's occupation (Wechsler, 1958). The BD test is a comprehensive measure of non-verbal intelligence. It correlates well with comprehension, information and vocabulary tests (Wechsler, 1958). It is a measure of general intelligence that evaluates spatial problem solving and manipulative abilities, and part to whole organization skills. One can learn about the subject by watching how they take the test. Attitudes and emotional reactions can be observed during the examination process. Temperamental traits, persistence and impulsiveness are observed during the examination process. Low scores are attributed to poor visual motor organization. The ability to perceive forms and analyze the results is also measured. This is a very good test for picking out low-grade people (Wechsler, 1958).

The DS test or substitution test measures intellectual ability. Older neurotic and unstable people do poorly on this test. Poor concentrators are judged by this measure. Emotional reactivity to persistent effort can be observed (Wechsler, 1958). The subject is required to associate certain symbols with certain other symbols, and the speed and accuracy with which he does it serve as a measure of his intellectual ability (Wechsler, 1958). The roles that visual acuity, motor coordination and speed play in the performances of the task are in question. Individuals with specific motor disabilities affect the performance of these tasks (Wechsler, 1958).

The OA test requires putting things together into a familiar configuration. The test consists of various figure form boards cut-up asymmetrically into pieces, which the subject is required to put together. The OA measures the thinking and working habits of the subjects. If completed quickly, creative ability is highlighted, realizing the ability to work toward an unknown goal. This could be a poor test for certain types of individuals (Wechsler, 1958). “People with artistic and mechanical ability seem to do very well on this test” (Wechsler, 1958, p. 217). This measure sometimes reveals the ability to work toward an unknown goal (Wechsler, 1958). “Some subjects continue working at putting together the figure although they seem to have not the slightest notion as to what it is they are putting together” (Wechsler, 1958, p. 218). The tests are of value in revealing the capacity to persist at a task (Wechsler, 1958). “Some subjects tend to give up very quickly and are discouraged by the slightest evidence of lack of success” (Wechsler, 1958, p. 218).

Admission use with the WAIS-R

According to Lazarus (1969), intelligence test scores bear decreasing relation to academic performance as students move to higher levels of education. One reason cited by Lazarus (1969) is that differences in test-measured intelligence are less important than good work habits and motivation.

Summary of the Review of the Literature

Schools of allied health need a valid and reliable index of ability for all applicants. Cognitive tests for selecting candidates generally depend upon the results achieved on MCAT, ACT, and UGPA. Most research has studied the relationship between admissions criteria and future academic performance. Results from this literature has been somewhat mixed, although the more consistent findings include a strong relationship between a variety of prerequisite GPA and academic performance measures in the professional phase of the allied health profession. Pre-admission standardized tests, like the ACT and GRE, correlated with professional academic performance. Stronger relationships resulted when test scores were coupled with prerequisite GPA. Reported studies seem to support prior academic achievement and ability test scores as valid predictors of success in allied health endeavors.

Predicting performance on various allied health care examinations for certification or licensure has been a topic of interest among educators for a number of years. The research literature identifying predictors of academic performance involves diploma, associate degree, baccalaureate, and master's education. Because of the focus of this study, allied health literature relevant to perfusion technology was reviewed.

The results of studies involving clinical performance have been less consistent than those involving academic performance in professional programs. Few studies have examined the relationship between academic and clinical performance. Positive results have rarely been reported in predictive studies in the area of clinical performance.

All of the studies concluded that it is possible to predict the students who are at risk for failing to meet academic or certification standards. Traditional predictors, such as UGPA, grades in prerequisites or other selected courses, and entrance examinations are the variables that consistently demonstrate valid and reliable correlations. Each section of the review of the literature presents evidence that GPA variables predict performance in graduate and allied health professional programs. Other demographic variables show promise for adding to predictability, however future research involving these factors is necessary before definitive conclusions can be drawn.

CHAPTER III

METHODOLOGY

The literature review guided the development of a list of potential out-comes or dependent variables. The two categories of these are typically success in the professional program usually manifested by GPA and graduation or success on an external measure of professional competence, such as the ABCP certification examination. Several variations on GPA have served as predictor variables in many studies and have also been used as a dependent variable. Because many of these studies used GPA and select standard examination scores as independent variables, this researcher used various student GPA's and scores from the WAIS-R practical measure as independent variables.

In order to fulfill the purpose of this study, the following research questions were addressed.

1. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA information is used as an indicator of success?

2. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information is used as an indicator of success?

3. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification information is used as an indicator of success?

4. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as

indicators of success?

5. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

6. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

7. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

8. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

9. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

10. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

11. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

12. To what extent do APGPA predict success in the perfusion technology

educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Methodology

The purpose of this study was to determine which of the requirements used in the selection of students for a baccalaureate perfusion technology program significantly contributed toward predicting academic achievement at the end of the program and certification accomplishment after graduation. This study also served as an investigation which would establish a framework by which other accredited perfusion programs could investigate further possible correlations which may or may not exist between select GPA, cognitive ability scores of the WAIS-R and a candidate's academic success and accomplishment of ABCP certification. It was proposed to provide background information by which these facts could be examined by other perfusion educators in future studies. Attempts to identify patterns of special cognitive ability, measured by the individual WAIS-R practical tests, which might be related to certification by the ABCP, were studied to predict academic and certification attainment. Attempts to identify patterns of previous academic success, measured by select grade point average, were studied to predict future academic and certification attainment.

It was this investigator's hypothesis that there would exist statistical differences between those candidates passing the ABCP certification examination and those failing when examined in regards to their UGPA, SGPA, APGPA, and WAIS-R practical section scores. This investigator also believed that there would be a relationship between the candidates' outcomes on the ABCP certification examination and the candidates' WAIS-R practical scores in the following subtests: PC, PA, BD, OA, and DS.

Undergraduate academic information and WAIS-R subtest results were received in a coded form from CARLOW-UPMC school of cardiovascular perfusion. This information allowed this investigator to make explicit assumptions as to the relation and pattern of academic admission variables as it relates to success on the ABCP certification examination. This final examination has been determined as a method by which a novice perfusionist may be determined to be adequately prepared to enter the field of perfusion technology as an entry level professional.

These linkages between the students' academic admission variables and their outcome on the ABCP certification examination have been determined by performing multiple logistical regressions on parametric and non-parametric measures while controlling for multiple comparisons. The data was entered in to the SPSS 12.0 for Windows statistical package for data analysis.

Subjects

The subjects used in this investigation were 95 undergraduate perfusion candidates enrolled at Carlow University from 1995 through 2005. All candidates met the requirements for eligibility for certification through the ABCP. The perfusion program is accredited and approved by CAAHEP. Perfusion students in this study were admitted to college level courses according to college criteria of cut-off scores on the SAT in math and english and high school or relevant academic GPA. Admission to the perfusion major requires a 2.5 GPA when the student makes application to the clinical perfusion practicum. For progression in the program, students must maintain a minimum of a C in all perfusion technology courses.

The records maintained by CARLOW-UPMC school of cardiovascular perfusion were the primary source of data used in this analysis. This research study and method of data collection met the criteria for review established by the Institutional Review Board of the University of Pittsburgh Medical Center, Duquesne University, and Carlow University.

Independent Variables

The independent variables in this investigation included the mean, median of distribution, and frequency of the candidates' overall UGPA, SGPA, APGPA, and WAIS-R practical scores in the following subtests; PC, PA, BD, OA, and DS. These independent variables were selected to compare admission demographics of the sample to that of the total population of all candidates taking the certification examination, to gain information to predict the success of applicants in perfusion technology.

Dependent Variables

The dependent variables in this study included the students' academic success at CARLOW-UPMC school of Perfusion, cumulative results on the two-part ABCP certification examination, and career appointment as a clinical perfusionist. Numerical values were used for the academic success variables GPA, pass or fail were used for the certification variable and yes or no were used for the program completion variable.

Instruments

Two instruments used in this study included the WAIS-R and the ABCP certification examination.

The Wechsler Adult Intelligence Scale Revised

The WAIS-R is intended for ages 16 and to 74 and was designed to assess some aspects of intelligence. “Intelligence is not a particular ability but a multifaceted and multi-determined overall competency or global capacity which in one way or another enables a sentient individual to comprehend the world and to deal effectively with its challenges” (Mitchell, 1985, p. 1703). Intelligence is a consequence of personality as a whole and is responsive to other factors besides those included under the concept of cognitive abilities (Mitchell, 1985). Intelligence tests measure these factors. Since 1939 two generations of psychologists have used either the Wechsler-Bellevue or the WAIS to elicit information about an individual (Mitchell, 1985). The 1955 Wechsler Adult Intelligence Scale has been the supreme measure for the appraisal of adult intelligence (Mitchell, 1985). Revisions began in the mid 1976 time period with the revised edition available in 1981. The revision was slight, with 80% of the WAIS-R items remaining the same.

The WAIS-R was standardized by 1,880 Americans. Development of the WAIS-R involved 39 States and the District of Columbia. The result was a completely updated and partly revised test. No other test available at that time period, or which was likely to be published in that same time period, was as reliable, valid, or clinically useful for assessing the measurable aspects of adult intelligence (Mitchell, 1985).

Included in the 1,880 samples were 940 males and 940 females distributed in equal numbers across nine age groups. “The standardization sample represents an almost perfect replica of the United States population, based on the 1970 census, on the following variables: age, sex, race, geographic region, occupation, education, and urban rural residence” (Mitchell, 1985, p. 1704).

Validity.

The validity of the WAIS-R relies on validity data obtained from the 1955 WAIS. Validity data is missing from the WAIS-R manual. The noted lack of validity data will soon be remedied by studies on the revised battery, but the omission from the manual is a noted disappointment (Mitchell, 1985).

However evidence of criterion-related validity was found in studies that compared the Stanford-Binet Intelligence Scales with the Wechsler Adult Intelligence Scale Third Edition (r .82) and the Woodcock-Johnson III Tests of Cognitive Abilities (r .78).

Reliability.

The reliability of the WAIS-R is outstanding (Mitchell, 1985). Split-half technique or the standard error of measurement qualified an equally high reliability result. A critical weakness of the WAIS, the lack of data on its test-retest reliability was addressed in this revision. The test-retest reliability coefficients for verbal IQ, performance IQ and full scale IQ ranged from .89 to .97 (Mitchell, 1985, p. 1704). The coefficients for each of the eleven individual subtests ranged from .67 and .94 (Mitchell, 1985). An excellent reliability for the performance IQ averaged .93; with a less than ideal value of .88 for ages sixteen to seventeen was observed (Mitchell, 1985).

Subtest reliability coefficients are excellent with average values exceeding .80 for nine of the eleven subtests (Mitchell, 1985). The PA (.74) and OA (.68) fell short of expectations (Mitchell, 1985). The only cautionary note regarding reliability concerns ages sixteen and seventeen where OA dips to .52 and six of the eleven subtests are below .75 (Mitchell, 1985). The use of the WAIS-R for sixteen and seventeen year olds should generally avoid too much interpretation of single subtest scores (Mitchell, 1985). “Test-retest coefficients for the subtests confirm the excellent reliability of all tasks except OA and PA" (Mitchell, 1985, p. 1702).

Overview of the examination.

The WAIS-R retains the same eleven subtests used in the original WAIS. However, the order of the administration of the subtests has been changed. The WAIS required the examiner to first administer all of the verbal subtests followed by the five performance subtests. "To reduce examinee boredom and fatigue this sequence was changed in the WAIS-R" (Mitchell, 1985, p. 1703). Overall the WAIS-R is a slight revision of the WAIS. Changes on several items illustrate sensitivity toward women and blacks, and a reduction of obsolete concepts.

American Board of Cardiovascular Perfusion Examination

Certification in clinical perfusion is attained by satisfactory performance on the ABCP certification examination. The certification examination is composed of two parts. Part one is the perfusion basic science examination. Part two is the clinical applications in perfusion examination. The examination is based on six perfusion topics that include basic science, cardiopulmonary bypass, principles of laboratory analysis, intervention, biomedical engineering and safety. Certification to practice is required by most hospitals.

In 1993 the ABCP made the decision to change from a norm-referenced to a criterion-referenced examination and in 1996 the first criterion-referenced examination was administered (History of the American Board, 2005). The criterion-referenced examination is based on a job or practice related analysis, which is the basis for the knowledge base for the scope of perfusion practice. Because of the increasing depth of the perfusion knowledge base, the decision was made in 1995 to change the oral examination to a written clinical applications examination to allow for the measurement of the knowledge base in the practice of clinical perfusion. The clinical applications examination was field tested in 1996 and replaced the oral examination in 1996.

Knowledge base revalidation is “an integral part of the examination development process is the periodic updating and revising of the ABCP perfusion knowledge base which is derived from a task/job analysis of perfusion practices” (Bishop, 2003). The knowledge base is the document from which examination questions are written. Each year the ABCP knowledge base is revised by the Board and sent to certified perfusionists for revalidation by means of an analysis survey. Certified perfusionists with a minimum of three years experience are asked to participate in the revalidation process. On the basis of the responses from the participating perfusionists, the new knowledge basis is established.

Each year the Board updates the new knowledge base. Questions from both the perfusion basic science examination and the clinical applications in perfusion examination banks are re-assigned index numbers to confirm to the newly accepted perfusion knowledge base (Bishop, 2003). During this process, all items in the banks are scrutinized for content validity, statistical relevance and reliability, and grammatical correctness (Bishop, 2003). This process is conducted every five to seven years to ensure quality of the ABCP examination process.

Validity and reliability.

The ABCP was petitioned with a request for information regarding validity and reliability data that qualify the ABCP certification examination. After careful review by the Board at their spring conference, it was unanimously decided not to disclose any information regarding validity or reliability.

A literature search that included the mental measurements yearbook, test reviews Online, and the educational testing service database failed to provide any information about the ABCP certification examination.

Examination development.

Each year the Board reviews item statistics for items used on both forms of the previous year's examinations. Items are accepted, reworked, or discarded by the Board. Each item is evaluated for validity of content related to perfusion, for difficulty, and for relevance (Bishop, 2003).

Data Collection

This retrospective study analyzed the performance of all perfusion technology candidates who were examined between 1995 and 2005. Data was obtained from official college records, perfusion technology records and ABCP results. All identifying information was removed prior to data collection and treated as confidential. The study sample consisted of perfusion technology candidates. The raw data were coded and later stored on the Duquesne University computer system.

Limitations of this Study

Data collection was limited to only those students who graduated from CARLOW-UPMC school of cardiovascular perfusion. Perfusion technology is a multiple entry-level profession with candidates having pre-requisites that include graduate, doctoral or baccalaureate degrees. This investigation of only baccalaureate degree level students, affiliated with Carlow University in Pittsburgh, appears to be a constraint.

The profession continues to move in a direction of homogeneous methods of entry into perfusion technology. The majority of programs remain at the baccalaureate degree level with different admission requisites so the results of this study are limited to this population of graduates.

Data Analysis

A list of perfusion graduates from Carlow University dated back to 1995 was compiled for this study. The academic advisor at Carlow University delivered a list of students, recorded on a Microsoft Word document file, to Carlow's Registrar along with a formal request for a written transcript for each graduate.

After receiving this information from Carlow's registrar, the academic advisor for Carlow's perfusion program reviewed this information for both authenticity and accuracy. The academic advisor recorded other research information on the written transcript. Each transcript was coded with an identification number that replaced the graduate's name. The results of the Wechsler scores for each of the five individual measures and the overall performance score were recorded on the back of the transcript. Results of the ABCP certification examination were recorded on the back of the written transcript. Candidates that failed to complete Carlow's curriculum for perfusion technology were recorded on the back of the transcript. All identifying information was removed prior to research data collection and treated as confidential.

The academic advisor for Carlow's perfusion program reviewed all of the compiled data for both authenticity and accuracy. The academic advisor removed all identifying information from the transcript. After careful review, each uniquely coded transcript, with the respective academic standings information, was tabulated using the following Carlow University grade scale and GPA formula.

A+	4.0	Quality points
A	4.0	Quality points
A-	3.75	Quality points
B+	3.25	Quality points
B	3.0	Quality points
B-	2.75	Quality points
C+	2.25	Quality points
C	2.0	Quality points
C-	1.75	Quality points
D+	1.25	Quality points
D	1.25	Quality points
D-	.75	Quality points
F	.00	Quality points

Total Quality Points / Total Credits = GPA

Coded information from each transcript was recorded onto a Microsoft Excel spreadsheet. The completed spreadsheet was forwarded to this researcher without any student names for statistical review. Raw data from Carlow University was statistically analyzed with SPSS 12.0.

Prior to initiating inferential tests, descriptive analyses was done on all appropriate data gathered on each variable to understand the nature of the information. This descriptive analysis included establishing means, medians, modes, standard deviations, and minimums and maximums. The proportions and frequency distributions for the discrete variables were calculated on the respective pass-fail or yes-no dependent variables. Preliminary investigation to determine which independent variables have an effect on the dependent variable was hypothesized. The following independent and dependent variables were evaluated:

Independent variables:

Picture completion	scaled 1-19
Picture arrangement	scaled 1-19
Block design	scaled 1-19
Object assembly	scaled 1-19
Digit symbol	scaled 1-19

Undergraduate grade point average at Carlow

Undergraduate grade point average in science at Carlow

Undergraduate grade point average in anatomy and physiology at Carlow

Dependent variables:

American Board of Cardiovascular Perfusion: Pass (1) or Fail (0)

Grade point average at UPMC Shadyside Hospital of Perfusion

Career as a clinical perfusionist: Yes (1) or No (2)

The research plan consists of logistic and linear regression analyses. Using binary logistic models and linear regression models, four separate phases of regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R and GPA independent variable were significantly associated with the dependent variables. Significant independent variables were identified using a p value of .05 or lower.

Phase I will answer the first three research questions:

1. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA information is used as an indicator of success?

2. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information is used as an indicator of success?

3. To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification information is used as an indicator of success?

Phase I will consist of three separate regression models. One for each dependent variable with the Wechsler scores as the independent variable. In the model with PGPA as the dependent variable, a linear regression was performed to determine which of the independent variables are significant. For the dependent variables of certification and program completion, a binary logistic regression will be performed to determine which of the independent variables were significant.

Phase II will answer the second set of three research questions:

4. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

5. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

6. To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Phase II will consist of three separate regression models. One for each dependent variable with UGPA as an independent variable combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, linear regressions were performed to determine which of the independent variables were significant. For the dependent variables of certification and program completion, a binary logistic regression was performed to determine which of the independent variables were significant.

Phase III will answer the third set of three research questions:

7. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

8. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

9. To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Phase III will consist of three separate regression models. One for each dependent variable with undergraduate SGPA as the independent variable were combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, linear regression was performed to determine which of the independent variables were significant. For the dependent variables of certification and program completion, binary logistic regression was performed to determine which of the independent variables were significant.

Phase IV will answer the last set of three research questions:

10. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

11. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

12. To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Phase IV will consist of three separate regression models. One for each dependent variable with undergraduate APGPA as the independent variable was combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, linear regression were performed to determine which of the independent variables were significant. For the dependent variables of certification and program completion, binary logistic regression was performed to determine which of the independent variables were significant.

The last step of the data analysis included regression diagnostics to describe the associations in more detail. Several diagnostic tests were performed to determine which data points influence the association positively or negatively. These include influence, goodness of fit statistic, and residual statistics.

Residual and influence diagnostic tests for problems with the data to determine whether transformations to the data was necessary. Also it aided in looking at the relationships in greater detail and attempted to integrate theory with the highlighted relationships.

CHAPTER IV

RESULTS

Overview

This chapter describes the data collected, descriptive statistics, and results of the data analyzed for the study. Findings are reported for each of the twelve research questions. The purpose of this study was to examine relationships between and among selected admission criteria, selected professional program and academic performance measures, certification success or failure, and post-graduation employment status as clinical perfusionists for students that have graduated from the perfusion technology educational program at CARLOW-UPMC. The sample consisted of 95 students who graduated from the perfusion technology educational program at CARLOW-UPMC from 1995 through 2005. Data was collected from student files by this investigator. Statistical analyses were performed using SPSS 12.0 software.

The research plan consisted of logistic and linear regression analyses. Using binary logistic models and linear regression models, four separate phases of regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R and GPA independent variables were significantly associated with the dependent variables. Significant independent variables were identified using a p value of .05 or lower.

Phase I consisted of three separate regression models aimed at answering the first three research questions. One for each dependent variable with the WAIS-R scores as the independent variables. In the model with PGPA as the dependent variable, a linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP, binary logistic regressions were performed to determine which of the independent variables were significant.

Phase II consisted of three separate regression models aimed at answering the second set of three research questions (4, 5, and 6). One for each dependent variable with UGPA as the independent variable combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, a multiple linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP, a binary logistic regression was performed to determine which of the independent variables were significant.

Phase III consisted of three separate regression models to address the third set of research questions (7, 8, and 9). One for each dependent variable with SGPA as the independent variable was combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, a multiple linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP a binary logistic regression was performed to determine which of the independent variables were significant.

Phase IV consisted of three separate regression models aimed at answering the last set of three research questions (10, 11, and 12). One for each dependent variable with APGPA as the independent variable was combined with the significant subset WAIS-R scores from phase I. In the model with PGPA as the dependent variable, a multiple linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP a binary logistic regression were performed to determine which of the independent variables were significant.

The last steps of the data analysis were several regression diagnostics used to describe the associations in more detail. Several diagnostic tests were performed to determine which data points influenced the association positively or negatively. These included influence, goodness of fit statistic, and residual statistics. Residual and influence diagnostic tests highlighted the need to transform the data into logarithmic form.

Variable List of Information

The independent variables used for the research project included WAIS-R PC, PA, BD, OA, DS, UGPA, SGPA, and APGPA. The dependent variable used for this research included PGPA, CAREER and ABCP certification success or failure information (ABCP) (Table 2).

Descriptive information about this data set included gender (GENDER), age at WAIS-R examination (AGE), total WAIS-R practical score (TOTAL), and total WAIS-R intelligence quotient (IQ) measure score (Table 2).

Table 2

List of Variable Abbreviations and Names

Abbreviation	Definition
GENDER	Gender
AGE	Age Wechsler Tested
PC	Picture Completion
PA	Picture Arrangement
BD	Block Design
OA	Object Assembly
DS	Digit Symbol
TOTAL	Total Wechsler Practical Score
IQ	Wechsler Intelligence Quotient
UGPA	Undergraduate Grade Point Average
SGPA	Science Grade Point Average
APGPA	Anatomy & Physiology Grade Point Average
PGPA *	Perfusion Grade Point Average
CAREER *	Career Placement as a Clinical Perfusionist
ABCP *	American Board of Cardiovascular Perfusion Examination Results

* Denotes Dependent Variable

General Descriptive Statistics

Data from Carlow University academic transcripts and the perfusion technology educational program at the CARLOW-UPMC student files were analyzed in this study.

Data obtained from the graduates included information about their academic standings, WAIS-R IQ scores, employment status, and certification standings. A complete set of data was obtained from each student's file including values for each of the admission variables, undergraduate grade point average, professional grade point average, job placement status, and certification eligibility. Seven files were not complete because of anatomy and physiology transferred course work. There was no other missing data for any other variables.

The data pool consisted of 32 male (34%) and 63 female (66%) graduates of the perfusion technology educational program at CARLOW-UPMC. The age of the student population ranged from 19 to 42 years with a corresponding mean age of 24 years and a standard deviation of 5.5.

The total WAIS-R practical measure score for the study population ranged from a minimum of 40 to a maximum of 75 with a corresponding mean value of 57 and a standard deviation of 6.7. The total practical WAIS-R score for the females ranged from a minimum of 40 to a maximum of 75 with a corresponding mean value of 57 and a standard deviation of 6.3. The total practical WAIS-R score for the males ranged from a minimum of 42 to a maximum of 74 with a corresponding mean value of 56 and a standard deviation of 7.5.

The total WAIS-R IQ measure score for the study population ranged from a minimum of 83 to a maximum of 141 with a corresponding mean value of 109.84 and a standard deviation of 11.47. The total WAIS-R intelligence quotient measure score for the females ranged from a minimum of 83 to a maximum of 139 with a corresponding mean value of 110 and a standard deviation of 10.9. The total WAIS-R intelligence quotient measure score for the males ranged from a minimum of 89 to a maximum of 141 with a corresponding mean value of 109.88 and a standard deviation of 12.7.

Transformation of the Variables

Logarithmic transformation of the continuous variables for a better fit were computed for the WAIS-R picture completion (log_PC), picture arrangement (log_PA), block design (log_BD), object assembly (log_OA), digit symbol (log_DS), undergraduate grade point average (log_UGPA), science grade point average (log_SGPA), anatomy and physiology grade point average (log_APGPA), and perfusion grade point average (log_PGPA).

Descriptive Statistics for the Independent Variables

The independent variables used for the research included PC, PA, BD, OA, DS, UGPA, SGPA, and APGPA (Table 2). Table 3 details PC, PA, BD, OA, and DS descriptive statistics for this population of students. Median scores for PC, PA and BD were the same regardless of gender. OA and DS median scores varied according to gender. Select WAIS-R practical scores for the population according to gender are listed in the appendix (Appendix Table 1).

Table 3

Descriptive Statistics for Data Set using Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol

	N	Mean	Std. Deviation
PC	95	11.03	1.80
PA	95	10.91	2.38
BD	95	11.82	2.21
OA	95	10.27	2.58
DS	95	12.73	2.32
Valid N	95		

Table 4 and Table 5 detail UGPA, SGPA, and APGPA descriptive statistics for this study population. Select UGPA for the population according to GENDER is available for review in the appendix (Appendix Table 2 and 3). Overall UGPA and SGPA data for the female students was higher than the males, with the exception of APGPA.

Table 4

Descriptive Statistics of Undergraduate Grade Point Average, Science Grade Point Average, and Anatomy & Physiology Grade Point Average

	N	Mean	Std. Deviation
UGPA	95.00	3.38	0.35
SGPA	95.00	3.34	0.43
APGPA	88.00	3.41	0.50
Valid N	88.00		

Descriptive Statistics for the Dependent Variables

The dependent variable used for this research included: PGPA, CAREER, and ABCP (Table 2). Table 5 detail PGPA descriptive statistics for this study population. Select PGPA for the population according to GENDER are available for further review in the appendix (Appendix Table 3).

Table 5

Descriptive Statistics using Perfusion Grade Point Average

	N	Mean	Std. Deviation
PGPA	95.00	2.95	0.44
Valid N	88.00		

Table 6 outlines CAREER descriptive statistics for this sample of students. 15% of the graduates never continued on to practice clinical perfusion (see table 6). Females had a slightly higher career attrition rate of 16% compared to males with 14% (Appendix Table 4).

Table 6

Descriptive Statistics using Career Perfusionist

CAREER	Frequency	Percent
NO	14	14.7
YES	81	85.3
Total	95	100.0

Table 7 outlines the descriptive statistics for ABCP for this study population. An 8% failure rate was observed in this sample of graduates. Males had a slightly higher failure rate of 10% compared to females with 6% for this sample (Appendix Table 5).

Table 7

American Board of Cardiovascular Perfusion Examination Results

ABCP	Frequency	Percent	Valid Percent
Failed exam	6	6.3	7.6
Passed exam	73	76.8	92.4
Total	79	83.2	100.0
Missing System	16	16.8	
Total	95	100.0	

Phase I

The analysis plan for the first phase consisted of logistic and multiple linear regression analyses. Using binary logistic regression models and multiple linear regression models three regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R variables were significantly associated with the dependent variables PGPA, CAREER, and ABCP. Significant independent variables were identified using a p value of .05 or lower.

The first phase consisted of three separate regression models. One for each dependent variable with the WAIS-R scores as the independent variable. In the model with PGPA as the dependent variable, a linear regression was performed to determine which of the independent variables were significant. For the dependent variables of ABCP and CAREER, a binary logistic regression was performed to determine which of the independent variables were significant predictors.

Phase I answered to what extent do scores on the WAIS-R accurately predict success in the perfusion technology educational program at CARLOW-UPMC, when PGPA, CAREER, and ABCP achievement are used as indicators of success. Phase I consisted of three separate research questions.

In order to answer research questions one, two and three a pair-wise coefficient of correlation was used to measure the strength and direction of the relationship among the variables. This measure of correlations also served as an indication of collinearity among the independent variables. A regression model with dependent and independent variables was fitted.

Using Spearman's coefficient of correlation, the following matrix (Table 8) shows that PGPA was not significantly correlated with the WAIS-R scores on PC, PA, BD, OA, and DS (p = > .05). The correlation coefficient shows that CAREER was significantly correlated with the Wechsler scores on PC, and OA (p = < .05). The correlation coefficient shows that CAREER was not significantly correlated with the WAIS-R score BD at the 5% level (p = .051). The correlation coefficient shows that ACCP was significantly correlated with the WAIS-R scores on PC, OA, and DS (p = < .05). Other significant values were highlighted (see Table 8).

Table 8

Spearman's Coefficient of Correlation Matrix for the Study Variables in Phase I

Variable	Statistic	PC	PA	BD	OA	DS	PGPA	CAREER	ABCP
PC	*r*	1.00							
	p	.							
	N	95							
PA	*r*	0.30	1.00						
	p	0.00	.						
	N	95	95						
BD	*r*	0.36	0.17	1.00					
	p	0.00	0.11	.					
	N	95	95	95					
OA	*r*	0.27	0.17	0.36	1.00				
	p	0.01	0.10	0.00	.				
	N	95	95	95	95				
DS	*r*	0.05	-0.03	0.06	0.06	1.00			
	p	0.63	0.74	0.58	0.57	.			
	N	95	95	95	95	95			
PGPA	*r*	-0.04	0.06	0.10	0.13	0.09	1.00		
	p	0.69	0.57	0.35	0.22	0.40	.		
	N	95	95	95	95	95	95		
CAREER	*r*	0.23	0.10	0.20	0.30	0.10	0.33	1.00	
	p	**0.02**	0.31	0.051	**0.00**	0.33	**0.00**	.	
	N	95	95	95	95	95	95	95	
ABCP	*r*	0.23	0.11	0.13	0.28	0.30	0.29	1.00	1.00
	p	**0.04**	0.31	0.25	**0.01**	**0.01**	**0.01**	.	.
	N	79	79	79	79	79	79	79	79

The first research question is: To what extent do scores on the WAIS-R accurately predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA are used as indicators of success? (Tables 9-11)

The following table shows the R^2 is very low indicating that only 4% of the variability in PGPA is explained by the predictors considered in this analysis (Table 9).

Table 9

Coefficient of Determination Dependent Variable Perfusion Grade Point Average and Independent Variables (log_DS), (log_PA), (log_OA), (log_BD), and (log_PC) (N=95)

R	R^2
.19	.04

The null hypothesis that the effect of regression is zero was tested by the analysis of variance procedure. The ANOVA table (see Table 10) shows the calculated value of the F statistic is .70 which is less than the tabulated value of $F_{5,89}$ (.05) = 2.37. Therefore this analysis fails to reject this null hypothesis.

Table 10

Analysis of Variance (ANOVA) Table Dependent Variable (log_PGPA) and Independent Variables (log_DS), (log_PA), (log_OA), (log_BD), and (log_PC) (N=95)

	F	*p*
Regression	.70	.62
Residual		
Total		

The predictor variables PC, PA, BD, OA and DS are not statistically significant predictors for the dependent variable PGPA (see Table 11).

Table 11

Coefficient of Regression Model Dependent Variable (log_PGPA) (N=95)

Variable	*B*	*SE B*	β	t	*p*
Step 1					
(log_PC)	-.10	.11	-.10	-.89	.38
(log_PA)	.05	.07	.08	.75	.45
(log_BD)	.03	.10	.04	.35	.72
(log_OA)	.05	.06	.09	.82	.41
(log_DS)	.10	.08	.13	1.23	.22
Constant	.72	.32		2.22	.03

The second research question is: To what extent do scores on the WAIS-R accurately predict success in the perfusion technology educational program at the CARLOW-UPMC when CAREER information is used as indicators of success? (Tables 12-23)

The Hosmer and Lemeshow test (see Table 12) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (*p*- value = .78) (Table 12).

Table 12

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
4.82	8	.78

The classification table (see Table 13) using CAREER reveals a high predictability for those that continue on to be career perfusionists (97%). This table also shows a poor predictability (7%) for those that fail to be career perfusionists.

Table 13

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	1	13	7.1
	Yes	2	79	97.5
Overall percentage				84.2

The logistic regression analysis in Table 14 shows the OA variable is associated with the dependent variable CAREER (p = .051). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=10.82 on the odds that perfusion will be the career choice. The other WAIS-R measures are not statistically significantly related to the dependent variable CAREER (p > .05).

Table 14

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_PC)	2.91	2.20	1.747	1	.19	18.44
(log_PA)	-.05	1.43	.00	1	.97	.95
(log_BD)	2.19	1.94	1.27	1	.26	8.95
(log_OA)	2.38	1.22	3.82	1	**.05**	10.82
(log_DS)	1.12	1.43	.61	1	.43	3.07
Constant	-18.34	7.11	6.65	1	.01	.00

Since the analysis showed (see Table 14) that most of the independent variables are not statistically significantly related to the dependent variable CAREER, each of the independent variables were analyzed with the dependent variable CAREER to see whether they were significantly related individually. The following scientifically related individual variable analyses are presented (Tables 15 through 23).

The Hosmer and Lemeshow test (see Table 15) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .35) (Table 15).

Table 15

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.82	7	.35

The classification table (see Table 16) using CAREER reveals a high predictability for those that continue on to be career perfusionists (97%). This table also shows a poor predictability (7%) for those that fail to be career perfusionists.

Table 16

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	1	13	7.1
	Yes	2	79	97.5
Overall percentage				84.2

The logistic regression analysis in Table 17 shows the OA variable is significantly associated with the dependent variable CAREER (p = .01). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=17.18 on the odds that perfusion will be the career choice.

Table 17

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_OA)	2.84	1.10	6.68	1	**.01**	17.18
Constant	-4.58	2.40	3.63	1	.06	.01

The Hosmer and Lemeshow test (see Table 18) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 18). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .65) (Table 18).

Table 18

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
2.48	4	.65

The classification table (see Table 19) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 19

Classification Table

		CAREER		Percentage correct
		Yes	No	
CAREER	No	0	14	00.0
	Yes	0	81	100.00
Overall percentage				85.26

The logistic regression analysis in Table 20 shows the PC variable is significantly associated with the dependent variable CAREER (*p* = .03). The regression coefficient (B) is a positive value with a corresponding high PC score and an increased chance that perfusion will be the career choice. A one unit increase of (log_PC) has a multiplicative effect of Exp(B)=66.65 on the odds that perfusion will be the career choice.

Table 20

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_PC)	4.20	1.97	4.53	1	**.03**	66.65
Constant	-8.12	4.59	3.13	1	.08	.00

The Hosmer and Lemeshow test (see Table 21) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 21). By looking at the Hosmer and Lemeshow Chi-square Test the null hypothesis is accepted (p- value = .74) (Table 21).

Table 21

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
2.72	5	.74

The classification table (see Table 22) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 22

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	00.0
	Yes	0	81	100.00
Overall percentage				85.26

The logistic regression analysis in Table 23 shows the BD variable is significantly associated with the dependent variable CAREER (p = .04). The regression coefficient (B) is a positive value with a corresponding high BD score and an increased chance that perfusion will be the career choice. A one unit increase of (log_BD) has a multiplicative effect of Exp(B)=39.52 on the odds that perfusion will be the career choice.

Table 23

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_BD)	3.68	1.78	4.26	1	**.04**	39.52
Constant	-7.12	4.25	2.81	1	.09	.00

The third research question is: To what extent do scores on the WAIS-R accurately predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certifications are used as indicators of success? (Tables 24-32)

The Hosmer and Lemeshow test (see Table 24) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 24). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .42) (Table 24).

Table 24

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
8.18	8	.42

The classification table (see Table 25) using ABCP certification reveals a high predictability for those that achieve ABCP certification (97%). This table also shows poor predictability (33%) for those that fail to achieve ABCP certification.

Table 25

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	2	4	33.33
	Passed exam	2	71	97.26
Overall percentage				92.41

The logistic regression analysis in Table 26 shows the DS variable is significantly associated with the dependent variable ABCP (p = .04). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of Exp(B)=136.70 on the odds of ABCP certification success. The other WAIS-R measures are not statistically significantly related to the dependent variable ABCP (p > .05).

Table 26

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_PC)	2.45	3.11	.62	1	.43	11.56
(log_PA)	.35	2.39	.02	1	.88	1.41
(log_BD)	.93	2.65	.12	1	.73	2.53
(log_OA)	2.34	2.01	1.36	1	.24	10.43
(log_DS)	4.92	2.42	4.11	1	**.04**	136.70
Constant	-23.38	9.94	5.54	1	.02	.00

Since the analysis showed (see Table 26) that most of the independent variables are not statistically significantly related to the dependent variable ABCP, each of the independent variables were analyzed with the dependent variable ABCP to see whether they were significantly related individually. The following scientifically related individual variable analyses are presented (Tables 27 through 32).

The Hosmer and Lemeshow test (see Table 27) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 27). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .22) (Table 27).

Table 27

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
8.23	6	.22

The classification table (see Table 28) using ABCP certification reveals an ideal predictability for those that achieve ABCP certification (100%). This table also shows no predictability (0%) for those that fail ABCP certification.

Table 28

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	0	6	0.00
	Passed exam	0	73	100.00
Overall percentage				92.41

The logistic regression analysis in Table 29 shows the independent variable OA certification is significantly related at a 5% significance level to the dependent variable ABCP. By increasing one unit of (log_OA) there is a likelihood of 21% increase in predictability to be an ABCP certified perfusionist.

The logistic regression analysis in Table 29 shows the OA variable is significantly associated with the dependent variable ABCP (p = .048). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance of ABCP certification. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=21.31 on the odds of ABCP certification success.

Table 29

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_OA)	3.06	1.55	3.91	1	**.05**	21.31
Constant	-4.33	3.35	1.67	1	.20	.01

The Hosmer and Lemeshow test (see Table 30) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 30). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .28) (Table 30).

Table 30

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.32	5	.28

The classification table (see Table 31) using ABCP certification reveals an ideal predictability for those that achieve ABCP certification (100%). This table also shows poor predictability (33%) for those that fail ABCP certification.

Table 31

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	2	4	33.33
	Passed exam	0	73	100.00
Overall percentage				94.94

The logistic regression analysis in Table 32 shows the DS variable is significantly associated with the dependent variable ABCP (p = <.00). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of Exp(B)=601.44 on the odds of ABCP certification success.

Table 32

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_DS)	6.40	2.25	8.10	1	**.00**	601.44
Constant	-12.90	5.24	6.07	1	.01	.00

Phase II

The analysis for the second phase consists of binary logistic regression and linear regression analyses. Using binary logistic regression models and linear regression models three regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R variables and UGPA are significantly associated with the dependent variables PGPA, CAREER, and ABCP. Significant independent variables will be identified using a p value of .05 or lower.

The second phase consists of three separate regression models. One for each dependent variable with undergraduate grade point average as an independent variable combined with PC, BD, OA, and DS WAIS-R scores from the first phase. In the model with PGPA as the dependent variable, a multiple linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP, a binary logistic regression was performed to determine which of the independent variables were significant.

Phase two answered to what extent do UGPA accurately predict success in the perfusion technology educational program at CRLOW-UPMC when PGPA, CAREER, and ABCP certification achievement are used as indicators of success when the significant WAIS-R scores are identified. Phase II consists of three separate research questions.

In order to answer research questions four, five and six a pair-wise coefficient of correlation were used to measure the strength and direction of the relationship among the variables. This measure of coefficients of correlations also serves as an indication of collinearity among the independent variables. A regression model with dependent and independent variables was fitted.

Using Spearman's coefficient of correlation analyses showed in the following matrix (see Table 33) that UGPA is significantly correlated at 5% significance level with OA at .31 with a *p* value = <.001. Other significant values are highlighted (see Table 33).

Table 33

Spearman's Coefficient of Correlation Matrix for the Study Variables in Phase II

Variable	Statistic	PC	BD	OA	DS	UGPA	PGPA	CAREER	ABCP
UGPA	*r*	0.05	0.12	0.31	0.13	1.00			
	p	0.66	0.27	**0.00**	0.21	.			
	N	95	95	95	95	95			
PGPA	*r*	-0.04	0.10	0.13	0.09	0.54	1.00		
	p	0.69	0.35	0.22	0.40	**0.00**	.		
	N	95	95	95	95	95	95		
CAREER	*r*	0.23	0.20	0.30	0.10	0.03	0.33	1.00	
	p	**0.02**	0.05	**0.00**	0.33	0.77	**0.00**	.	
	N	95	95	95	95	95	95	95	
ABCP	*r*	0.23	0.13	0.28	0.30	0.20	0.29	1.00	1.00
	p	**0.04**	0.25	**0.01**	**0.01**	0.08	**0.01**	.	.
	N	79	79	79	79	79	79	79	79

In order to answer the research question four this researcher looked at the correlation between the dependent and the independent variable. A linear regression model was built with UGPA as an independent variable and PGPA as dependent variable. Select WAIS-R measures were not included in these models because significant values were not obtained in the first phase of the research proposal.

The fourth research question is: To what extent do UGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when

PGPA information and significant WAIS-R are used as indicators of success? (Tables 43-45)

The following table shows the R^2 is very high indicating a significant amount of variation explained by the predictors considered (Table 34).

Table 34

Coefficient of Determination Dependent Variable Perfusion Grade Point Average and Independent Variable Undergraduate Grade Point Average (N=95)

R	R^2
.56(a)	.31

The null hypothesis that the effect of regression is zero was tested by the analysis of variance procedure. The ANOVA table (see Table 35) shows the calculated value of F statistic is 41.64 which is greater than the tabulated value of $F_{1,93}$ (.05) = 4.00. Therefore this analysis rejects this null hypothesis.

Table 35

Analysis of Variance (ANOVA) Table Dependent Variable (log_PGPA) and Independent (log_UGPA) (N=95)

	F	*p*
Regression	41.64	.00
Residual		
Total		

The predictor variable UGPA is a statistically significant predictor for the dependent variable PGPA (see Table 36).

Table 36

Coefficient of Regression Model Dependent Variable (log_PGPA) and Independent Variable (log_UGPA) (N=95)

Variable	*B*	*SE B*	β	t	*p*
Step 1					
(log_UGPA)	.79	.12	.56	6.45	**.00**
Constant	.11	.15		.76	.45

In order to answer the research question five this researcher looked at the correlation between the dependent and the independent variable. A linear regression model was built with UGPA as an independent variable and CAREER as dependent variable. WAIS-R PC, BD, and OA were included together and individually in these models because significant values were obtained in the first phase of the research proposal.

The fifth research question is: To what extent do UGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER and significant WAIS-R scores are used as indicators of success? (Tables 46-51)

The Hosmer and Lemeshow test (see Table 37) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 37). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .49) (Table 37).

Table 37

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.44	8	.49

The classification table (see Table 19) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 38

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	0	81	100.0
Overall percentage				85.3

The logistic regression analysis in Table 39 shows the independent variable UGPA is not a statistically significant predictor for the dependent variable CAREER (p=.63).

Table 39

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_UGPA)	1.33	2.74	.23	1	.63	3.77
Constant	.15	3.32	.00	1	.96	1.16

The Hosmer and Lemeshow test (see Table 40) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 40). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .53) (Table 40).

Table 40

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.02	8	.53

The classification table (see Table 41) using CAREER reveals a high predictability for those that continue on to be career perfusionists (99%). This table also shows a poor predictability (7%) for those that fail to be career perfusionists.

Table 41

Classification Table

		CAREER		Percentage correct
		Yes	No	
CAREER	No	1	13	7.1
	Yes	1	80	98.8
Overall percentage				85.3

The logistic regression analysis in Table 42 shows the OA variable is significantly associated with the dependent variable CAREER (p = .048). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=10.48 on the odds that perfusion will be the career choice. The other WAIS-R measures are not statistically significantly related to the dependent variable CAREER (p > .05).

Table 42

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_UGPA)	-.16	2.87	.00	1	.95	.85
(log_PC)	3.06	2.16	2.01	1	.16	21.43
(log_BD)	2.52	1.92	1.72	1	.19	12.46
(log_OA)	2.35	1.19	3.92	1	**.05**	10.48
Constant	-16.53	7.38	5.02	1	.02	.00

In order to answer the research question six this researcher looked at the correlation between the dependent and the independent variables. A linear regression model was built with UGPA as an independent variable and ABCP as dependent variable. WAIS-R OA and DS were included together and individually in these models because significant values were obtained in the first phase of the research proposal. The significant WAIS-R results are presented.

The sixth research question is: To what extent do overall UGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification achievement information and significant WAIS-R scores are used as indicators of success? (Tables 52-57)

The Hosmer and Lemeshow test (see Table 43) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 43). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .61) (Table 43).

Table 43

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.29	8	.61

The classification table (see Table 44) using ABCP certification reveals an ideal predictability for those that become ABCP certified (100%). This table also shows no predictability (0%) for those that fail ABCP certification.

Table 44

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	0	6	0.00
	Passed exam	0	73	100.00
Overall percentage				92.4

The logistic regression analysis in Table 45 shows the independent variable UGPA is not a statistically significant predictor for the dependent variable ABCP (p=.08).

Table 45

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_UGPA)	7.45	4.20	3.15	1	.08	1719.65
Constant	-6.27	4.82	1.69	1	.19	.00

The Hosmer and Lemeshow test (see Table 46) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 46). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .75) (Table 46).

Table 46

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
5.09	8	.75

The classification table (see Table 47) using ABCP certification reveals a high predictability for those that become ABCP certified (97%). This table also shows a poor predictability (33%) for those that fail ABCP certification.

Table 47

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	2	4	33.3
	Passed exam	2	71	97.3
Overall percentage				92.4

The logistic regression analysis in Table 48 shows the DS variable is significantly associated with the dependent variable ABCP (p = .01). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of Exp(B)=343.55 on the odds of ABCP certification success. The other WAIS-R measures are not statistically significantly related to the dependent variable ABCP (p > .05).

Table 48

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_UGPA)	6.84	4.95	1.908	1	.17	931.63
(log_OA)	2.36	1.91	1.517	1	.22	10.55
(log_DS)	5.84	2.33	6.256	1	**.01**	343.55
Constant	-24.79	9.14	7.361	1	.01	.00

Phase III

The research plan for the third phase consists of logistic and linear regression analyses. Using binary logistic regression models and linear regression models three regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R variables and SGPA were significantly associated with the dependent variables PGPA, CAREER, and ABCP. Significant independent variables were identified using a p value of .05 or lower.

The third phase consists of three separate regression models. One for each dependent variable with SGPA as an independent variable combined with PC, BD, OA, and DS WAIS-R scores from the first phase. In the model with PGPA as the dependent variable, a linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP, a logistic regression was performed to determine which of the independent variables were significant.

Phase three answered to what extent do SGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA, CAREER, and ABCP certification are used as indicators of success when the significant WAIS-R scores are identified. Phase III consists of three separate research questions.

In order to answer research questions seven, eight and nine a pair-wise coefficient of correlation was used to measure the strength and direction of the relationship among the variables. This measure of coefficients of correlations also serves as an indication of collinearity among the independent variables. A regression model with dependent and independent variables was fitted.

Using Spearman’s coefficient of correlation, the following matrix (Table 49) shows that SGPA is significantly correlated at 5% significance level with OA at .28 with a p value = .01. Other significant values are highlighted (Table 49).

Table 49

Spearman's Coefficient of Correlation Matrix for the Study Variables in Phase III

Variable	Statistic	PC	BD	OA	DS	SGPA	PGPA	CAREER	ABCP
SGPA	*r*	0.00	0.09	0.28	0.09	1.00			
	p	0.97	0.40	**0.01**	0.41	.			
	N	95	95	95	95	95			
PGPA	*r*	-0.04	0.10	0.13	0.09	0.47	1.00		
	p	0.69	0.35	0.22	0.40	**0.00**	.		
	N	95	95	95	95	95	95		
CAREER	*r*	0.23	0.20	0.30	0.10	-0.03	0.33	1.00	
	p	**0.02**	0.051	**0.00**	0.33	0.74	**0.00**	.	
	N	95	95	95	95	95	95	95	
ABCP	*r*	0.23	0.13	0.28	0.30	0.18	0.29	1.00	1.00
	p	**0.04**	0.25	**0.01**	**0.01**	0.12	**0.01**	.	.
	N	79	79	79	79	79	79	79	79

In order to answer the research question seven this researcher looked at the correlation between the dependent and the independent variables. A linear regression model was built with SGPA as an independent variable and PGPA as dependent variable. Select WAIS-R measures were not included in these models because significant *p* values were not obtained in the first phase of the research proposal.

The seventh research question is: To what extent do SGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success? (Tables 50-52)

The following table shows the R^2 is relatively high indicating a significant amount of variation explained by the predictors considered (Table 50).

Table 50

Coefficient of Determination Dependent Variable Perfusion Grade Point Average and Independent Variable Science Grade Point Average (N=95)

R	R^2
.47	.22

The null hypothesis that the effect of regression is zero was tested by the analysis of variance procedure. The ANOVA table (see Table 51) shows the calculated value of the F statistic is 27.0 which is greater than the tabulated value of $F_{1,93}$ (.05) = 4.00. Therefore this analysis rejects this null hypothesis.

Table 51

Analysis of Variance (ANOVA) Table Dependent Variable (log_PGPA) and Independent (log_SGPA) (N=95)

	F	*p*
Regression	27.0	0.00
Residual		
Total		

The predictor variable SGPA is a statistically significant predictor for the dependent variable PGPA (Table 52).

Table 52

Coefficient of Regression Model Dependent Variable (log_PGPA) and Independent Variable (log_SGPA) (N=95)

Variable	*B*	*SE B*	β	t	*p*
Step 1					
(log_SGPA)	.54	.10	.47	5.20	.00
Constant	.42	.13		3.38	.00

In order to answer the research question eight this researcher looked at the correlation between the dependent and the independent variable. A logistic regression model was built with SGPA as an independent variable and CAREER as dependent variables. WAIS-R PC, BD, and OA were included together and individually in these models because significant values were obtained in the first phase of the research proposal.

The eighth research question is: To what extent do overall UGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when perfusion CAREER and significant WAIS-R scores are used as indicators of success? (Tables 53-67)

The Hosmer and Lemeshow test (see Table 53) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 53). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .21) (Table 53).

Table 53

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
9.68	7	.21

The classification table (see Table 54) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 54

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	0	81	100.0
Overall percentage				85.3

The logistic regression analysis in Table 55 shows the independent variable SGPA is not a statistically significant predictor for the dependent variable CAREER (p=.83).

Table 55

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	-.47	2.24	.04	1	.83	.62
Constant	2.32	2.72	.73	1	.39	10.18

The Hosmer and Lemeshow test (see Table 56) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 56). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .22) (Table 56).

Table 56

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
10.66	8	.22

The classification table (see Table 41) using CAREER reveals a high predictability for those that continue on to be career perfusionists (99%). This table also shows a poor predictability (7%) for those that fail to be career perfusionists.

Table 57

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	1	13	7.1
	Yes	1	80	98.8
Overall percentage				85.3

The logistic regression analysis in Table 58 shows the OA variable is significantly associated with the dependent variable CAREER (p = .04). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=11.51 on the odds that perfusion will be the career choice. The other WAIS-R measures are not statistically significantly related to the dependent variable CAREER (p > .05).

Table 58

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	-1.38	2.36	.34	1	.56	.25
(log_PC)	2.96	2.17	1.86	1	.17	19.34
(log_BD)	2.49	1.95	1.64	1	.20	12.13
(log_OA)	2.44	1.19	4.24	1	**.04**	11.51
Constant	-14.99	7.22	4.32	1	.04	.00

In order to complete research question eight this researcher looked at the correlation between the dependent and the independent variable in separate models. A linear regression model was built with SGPA as an independent variable and CAREER as dependent variable. Wechsler PC, BD, and OA were included individually in these models because significant values were obtained in the first phase of the research proposal. The significant WAIS-R results are presented (Table 59-67).

The Hosmer and Lemeshow test (see Table 59) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 59). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .61) (Table 59).

Table 59

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.30	8	.61

The classification table (see Table 60) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 60

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	0	81	100.0
Overall percentage				85.3

The logistic regression analysis in Table 61 shows the PC variable is significantly associated with the dependent variable CAREER (p = .03). The regression coefficient (B) is a positive value with a corresponding high PC score and an increased chance that perfusion will be the career choice. A one unit increase of (log_PC) has a multiplicative effect of Exp(B)=66.27 on the odds that perfusion will be the career choice.

Table 61

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	-.47	2.26	.04	1	.84	.63
(log_PC)	4.19	1.97	4.52	1	**.03**	66.27
Constant	-7.55	5.35	1.99	1	.16	.00

The Hosmer and Lemeshow test (see Table 62) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 62). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .15) (Table 62).

Table 62

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
12.09	8	.15

The classification table (see Table 63) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 63

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	0	81	100.0
Overall percentage				85.3

The logistic regression analysis in Table 64 shows the BD variable is significantly associated with the dependent variable CAREER (p = .04). The regression coefficient (B) is a positive value with a corresponding high BD score and an increased chance that perfusion will be the career choice. A one unit increase of (log_BD) has a multiplicative effect of Exp(B)=42.02 on the odds that perfusion will be the career choice.

Table 64

Coefficient's of the Logistic Regression Model for the Dependent Variable Career as a Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	-.91	2.25	.16	1	.69	.40
(log_BD)	3.74	1.79	4.38	1	**.04**	42.02
Constant	-6.17	4.84	1.63	1	.20	.00

The Hosmer and Lemeshow test (see Table 65) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 65). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .48) (Table 65).

Table 65

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.52	8	.48

The classification table (see Table 66) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (99%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 66

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	1	80	98.8
Overall percentage				84.2

The logistic regression analysis in Table 67 shows the OA variable is significantly associated with the dependent variable CAREER (*p* = .01). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=19.34 on the odds that perfusion will be the career choice.

Table 67

Coefficient's of the Logistic Regression Model for the Dependent Variable as Career Perfusionist (N=95)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	-1.67	2.34	.51	1	.48	.19
(log_OA)	2.96	1.11	7.14	1	**.01**	19.34
Constant	-2.85	3.39	.71	1	.40	.06

In order to answer the research question nine this researcher looked at the correlation between the dependent and the independent variable. A linear regression model was built with SGPA as an independent variable and ABCP as dependent variables. WAIS-R OA and DS were included together and individually in these models because significant values were obtained in the first phase of the research proposal. The significant WAIS-R results are presented.

The ninth research question is: To what extent do SGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when

ABCP certification and significant WAIS-R scores are used as indicators of success? (Tables 77-82)

The Hosmer and Lemeshow test (see Table 68) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 43). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .64) Table 68).

Table 68

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.07	8	.64

The classification table (see Table 69) using ABCP certification reveals an ideal predictability for those that become ABCP certified (100%). This table also shows no predictability (0%) for those that fail ABCP certification.

Table 69

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	0	6	0.00
	Passed exam	0	73	100.0
Overall percentage				92.4

The logistic regression analysis in Table 70 shows the independent variable SGPA is not a statistically significant predictor for the dependent variable ABCP (*p*=.08).

Table 70

Coefficient of Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	6.12	3.53	3.01	1	.08	455.52
Constant	-4.53	3.93	1.33	1	.25	.01

The Hosmer and Lemeshow test (see Table 71) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit

(Table 71). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .77) (Table 71).

Table 71

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
4.88	8	.77

The classification table (see Table 72) using ABCP certification reveals a high predictability for those that continue on to become ABCP certified (97%). This table also shows a poor predictability (33%) for those that fail ABCP certification.

Table 72

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	2	4	33.3
	Passed exam	2	71	97.3
Overall percentage				92.4

The logistic regression analysis in Table 73 shows the DS variable is significantly associated with the dependent variable ABCP (p = .01). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of

Exp(B)=252.99 on the odds of ABCP certification success. The other WAIS-R measure was not statistically significantly related to the dependent variable ABCP ($p > .05$).

Table 73

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_SGPA)	4.43	3.79	1.36	1	.24	83.59
(log_OA)	2.37	1.85	1.63	1	.20	10.66
(log_DS)	5.53	2.24	6.09	1	**.01**	252.99
Constant	-21.16	7.61	7.73	1	.00	.00

Phase IV

The analysis plan for the fourth phase consisted of binary logistic regression and linear regression analyses. Using binary logistic regression models and linear regression models three regression models were used for each of the independent variables and dependent variables to determine which of the WAIS-R variables and APGPA are significantly associated with the dependent variables PGPA, CAREER, and ABCP. Significant independent variables were identified using a p value of .05 or lower.

The fourth phase consists of three separate regression models. One for each dependent variable with APGPA as an independent variable combined with PC, BD, OA, and DS WAIS-R scores from the first phase. In the model with PGPA as the dependent variable, a linear regression was performed to determine which of the independent variables were significant. For the dependent variables of CAREER and ABCP, a logistic regression was performed to determine which of the independent variables were significant predictors.

Phase four answered to what extent do overall APGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA, CAREER, and ABCP certification are used as indicators of success when the significant WAIS-R scores are identified. Phase II consists of three separate research questions.

In order to answer research questions ten, eleven and twelve a pair-wise coefficient of correlation was used to measure the strength and direction of the relationship among the variables. This measure of correlations also serves as an indication of linearity among the independent variables. A regression model with dependent and independent variables was fitted.

Using Spearman’s coefficient of correlation the following matrix (Table 74) shows that APGPA is not significantly correlated at 5% significance level with the WAIS-R scores on PC, BD, OA, and DS. However, APGPA is significantly correlated at 5% significance level with PGPA (Table 74). Other significant values are highlighted (Table 74).

Table 74

Spearman's Coefficient of Correlation Matrix for the Study Variables in Phase IV

Variable	Statistic	PC	BD	OA	DS	APGPA	PGPA	CAREER	ABCP
APGPA	*r*	-0.11	0.05	0.19	-0.05	1.00			
	p	0.32	0.64	0.08	0.63	.			
	N	88	88	88	88	88			
PGPA	*r*	-0.04	0.10	0.13	0.09	0.40	1.00		
	p	0.69	0.35	0.22	0.40	**0.00**	.		
	N	95	95	95	95	88	95		
CAREER	*r*	0.23	0.20	0.30	0.10	-0.12	0.33	1.00	
	p	**0.02**	0.051	**0.00**	0.33	0.27	**0.00**	.	
	N	95	95	95	95	88	95	95	
ABCP	*r*	0.23	0.13	0.28	0.30	-0.02	0.29	1.00	1.00
	p	**0.04**	0.25	**0.01**	**0.01**	0.87	**0.01**	.	.
	N	79	79	79	79	73	79	79	79

In order to answer the research question ten this researcher looked at the correlation between the dependent and the independent variable. A linear regression model was built with APGPA as an independent variable and PGPA as dependent variable. Select WAIS-R measures were not included in these models because significant values were not obtained in the first phase of the research proposal.

The tenth research question is: To what extent do overall APGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success? (Tables 75-77)

The following table shows the R^2 is high indicating a significant amount of variation explained by the predictors considered (Table 75).

Table 75

Coefficient of Determination Coefficient of Determination Dependent Variable Perfusion Grade Point Average and Independent Variable Anatomy & Physiology Grade Point Average (N=88)

R	R^2
.31	.10

The null hypothesis that the effect of regression is zero was tested by the analysis of variance procedure. The ANOVA table (see Table 76) shows the calculated value of F statistic is 9.37 which is greater than the tabulated value of $F_{1,86}$ (.05) = 2.37. Therefore this analysis rejects this null hypothesis.

Table 76

Analysis of Variance (ANOVA) Table Dependent Variable (log_PGPA) and Independent (log_APGPA) (N=88)

	F	*p*
Regression	9.37	0.00
Residual		
Total		

The predictor variable APGPA is a statistically significant predictor for the dependent variable PGPA (see Table 52).

Table 77

Coefficient of Regression Model Coefficient of Regression Model Dependent Variable (log_PGPA) and Independent Variable (log_APGPA) (N=88)

Variable	*B*	*SE B*	β	t	*p*
Step 1					
(log_APGPA)	.30	.10	.31	3.06	.00
Constant	.70	.12		5.86	.00

In order to answer research question 11 this researcher looked at the correlation between the dependent and the independent variables. A linear regression model was built with APGPA as an independent variable and CAREER as a dependent variable. WAIS-R PC, BD, and OA were included together and individually in these models because significant values were obtained in the first phase of the research proposal.

The eleventh research question is: To what extent do overall APGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER and significant WAIS-R scores are used as indicators of success? (Tables 78-92)

The Hosmer and Lemeshow test (see Table 78) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table

78). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .29) (Table 78).

Table 78

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.37	6	.29

The classification table (see Table 79) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 79

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	0.00
	Yes	0	74	100.0
Overall percentage				84.1

The logistic regression analysis in Table 80 shows the independent variable APGPA is not a statistically significant predictor for the dependent variable CAREER.

Table 80

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=88)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-2.44	2.16	1.28	1	.26	.09
Constant	4.67	2.71	2.96	1	.08	107.07

The Hosmer and Lemeshow test (see Table 81) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 81). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .16) (Table 81).

Table 81

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
11.71	8	.16

The classification table (see Table 41) using CAREER reveals a high predictability for those that continue on to be career perfusionists (99%). This table also shows a poor predictability (21%) for those that fail to be career perfusionists.

Table 82

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	3	11	21.4
	Yes	1	73	98.6
Overall percentage				86.4

The logistic regression analysis in Table 83 shows the OA variable is significantly associated with the dependent variable CAREER (p = .04). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=12.42 on the odds that perfusion will be the career choice. The other WAIS-R measures are not statistically significantly related to the dependent variable CAREER (p > .05).

Table 83

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=88)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-3.42	2.36	2.10	1	.15	.03
(log_PC)	2.65	2.20	1.46	1	.23	14.22
(log_BD)	2.64	1.99	1.76	1	.18	14.06
(log_OA)	2.52	1.22	4.26	1	**.04**	12.42
Constant	-12.33	7.06	3.05	1	.08	.00

In order to complete research question eleven this researcher looked at the correlation between the dependent and the independent variables in separate models. A logistic regression model was built with APGPA as an independent variable and CAREER as dependent variable. WAIS-R PC, BD, and OA DS were included individually in these models because significant *p* values were obtained in the first phase of the research proposal. The significant WAIS-R results are presented (Table 84-92).

The Hosmer and Lemeshow test (see Table 84) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 84). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .22) (Table 84).

Table 84

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
10.67	8	.22

The classification table (see Table 85) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (100%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 85

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	00.0
	Yes	0	74	100.0
Overall percentage				84.1

The logistic regression analysis in Table 86 shows the PC variable is significantly associated with the dependent variable CAREER (*p* = .04). The regression coefficient (B) is a positive value with a corresponding high PC score and an increased chance that perfusion will be the career choice. A one unit increase of (log_PC) has a multiplicative effect of Exp(B)=53.69 on the odds that perfusion will be the career choice.

Table 86

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=88)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-2.32	2.27	1.04	1	.31	.10
(log_PC)	3.98	1.96	4.12	1	**.04**	53.69
Constant	-4.83	5.37	.81	1	.37	.01

The Hosmer and Lemeshow test (see Table 87) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 87). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .62) (Table 87).

Table 87

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.26	8	.62

The classification table (see Table 88) using CAREER reveals an ideal predictability for those that continue on to be career perfusionists (97%). This table also shows no predictability (0%) for those that fail to be career perfusionists.

Table 88

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	0	14	00.0
	Yes	2	72	97.3
Overall percentage				81.8

The logistic regression analysis in Table 89 shows the BD variable is significantly associated with the dependent variable CAREER (p = .03). The regression coefficient (B) is a positive value with a corresponding high BD score and an increased chance that perfusion will be the career choice. A one unit increase of (log_BD) has a multiplicative effect of Exp(B)=55.11 on the odds that perfusion will be the career choice.

Table 89

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=88)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-2.85	2.22	1.65	1	.20	.06
(log_BD)	4.01	1.82	4.83	1	**.03**	55.11
Constant	-4.50	4.82	.87	1	.35	.01

The Hosmer and Lemeshow test (see Table 90) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 90). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .37) (Table 90).

Table 90

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
8.72	8	.37

The classification table (see Table 91) using CAREER reveals a high predictability for those that continue on to become a career perfusionist (97%). This table also shows a poor predictability (7%) for those that fail to be a career perfusionist.

Table 91

Classification Table

		CAREER		
		Yes	No	Percentage correct
CAREER	No	1	13	7.1
	Yes	2	72	97.3
Overall percentage				83

The logistic regression analysis in Table 92 shows the OA variable is significantly associated with the dependent variable CAREER (p = .01). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance that perfusion will be the career choice. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=1.43 on the odds that perfusion will be the career choice.

Table 92

Coefficient's of the Logistic Regression Model for the Dependent Variable Career Perfusionist (N=88)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-3.62	2.27	2.55	1	.11	.03
(log_OA)	.36	.13	7.05	1	**.01**	1.43
Constant	2.71	2.84	.91	1	.34	14.97

In order to answer the research question twelve this researcher looked at the correlation between the dependent and the independent variables. A logistic regression model was built with APGPA as an independent variable and ABCP as dependent variable. WAIS-R OA and DS were included together and individually in these models because significant values were obtained in the first phase of the research proposal. The significant WAIS-R results are presented.

The twelfth research question is: To what extent do overall APGPA accurately predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success? (Tables 93-104)

The Hosmer and Lemeshow test (see Table 93) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 93). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .53) (Table 93).

Table 93

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
6.06	7	.53

The classification table (see Table 69) using ABCP reveals an ideal predictability for those that become ABCP certified (100%). This table also shows no predictability (0%) for those that fail ABCP certification.

Table 94

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	0	6	0.00
	Passed exam	0	67	100.0
Overall percentage				91.8

The predictor variable APGPA is not a statistically significant predictor for the dependent variable ABCP (see Table 95).

Table 95

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-.86	2.87	.09	1	.76	.42
Constant	3.46	3.54	.95	1	.33	31.78

The Hosmer and Lemeshow test (see Table 96) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table

96). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .85) (Table 96).

Table 96

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
4.09	8	.85

The classification table (see Table 97) using ABCP reveals a high predictability for those that continue on to become ABCP certified (98%). This table also shows a poor predictability (17%) for those that fail ABCP certification.

Table 97

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	1	5	16.7
	Passed exam	1	66	98.5
Overall percentage				91.8

The logistic regression analysis in Table 98 shows the DS variable is significantly associated with the dependent variable ABCP (p = .01). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of Exp(B)=584.56 on the odds of ABCP certification success. The other WAIS-R measures are not statistically significantly related to the dependent variable ABCP ($p > .05$). OA and DS are analyzed individually in the following tables (see Tables 98-104).

Table 98

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-3.15	3.51	.80	1	.37	.04
(log_OA)	2.48	1.85	1.79	1	.18	11.90
(log_DS)	6.37	2.58	6.11	1	**.01**	584.56
Constant	-14.59	6.81	4.58	1	.03	.00

The Hosmer and Lemeshow test (see Table 99) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 99). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .46) (Table 99).

Table 99

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.77	8	.46

The classification table (see Table 100) using ABCP reveals an ideal predictability for those that become ABCP certified (100%). This table also shows no predictability (0%) for those that fail ABCP certification.

Table 100

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	0	6	0.00
	Passed exam	0	67	100.0
Overall percentage				91.8

The logistic regression analysis in Table 101 shows the independent variable OA is significantly related at a 5% significance level to the dependent variable ABCP. By increasing one unit of (log_OA) there is a likelihood of 21% increase in predictability to be an ABCP certified perfusionist.

The logistic regression analysis in Table 101 shows the OA variable is significantly associated with the dependent variable ABCP (p = .048). The regression coefficient (B) is a positive value with a corresponding high OA score and an increased chance of ABCP certification. A one unit increase of (log_OA) has a multiplicative effect of Exp(B)=21.05 on the odds of ABCP certification success.

Table 101

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-1.82	2.97	.38	1	.54	.16
(log_OA)	3.05	1.54	3.91	1	**.05**	21.05
Constant	-2.17	4.55	.23	1	.63	.11

The Hosmer and Lemeshow test (see Table 102) is evaluating whether the data is significantly different from the predicted values obtained from the predictors used in the regression model. The null hypothesis states that there is no difference between the observed data and the predicted data. The null hypothesis is the model is a good fit (Table 102). By looking at the Hosmer and Lemeshow Chi-square test the null hypothesis is accepted (p- value = .52) (Table 102).

Table 102

Hosmer and Lemeshow Test

Chi-square	*df*	*p*
7.14	8	.52

The classification table (see Table 103) using ABCP reveals a high predictability for those that continue on to become ABCP certified (100%). This table also shows a poor predictability (33%) for those that fail ABCP certification.

Table 103

Classification Table

		ABCP results		
		Failed Exam	Passed exam	Percentage correct
ABCP results	Failed exam	2	4	33.3
	Passed exam	0	67	100.0
Overall percentage				94.5

The logistic regression analysis in Table 104 shows the DS variable is significantly associated with the dependent variable ABCP (p = .01). The regression coefficient (B) is a positive value with a corresponding high DS score and an increased chance of ABCP certification. A one unit increase of (log_DS) has a multiplicative effect of Exp(B)=1129.36 on the odds of ABCP certification success.

Table 104

Coefficient's of the Logistic Regression Model for the Dependent Variable American Board of Cardiovascular Perfusion (N=79)

Variable	*B*	*SE*	Wald	*df*	*p*	Exp(B)
(log_APGPA)	-2.91	3.65	.63	1	.43	.05
(log_DS)	7.03	2.55	7.60	1	**.01**	1129.36
Constant	-10.90	6.00	3.29	1	.07	.00

Conclusion

UGPA, SGPA, and APGPA all correlate well with success achieving equally high PGPA. These predictor variables are statistically significant predictors for the dependent variable PGPA all at the 5% significance level (Table 105).

WAIS-R measures were not significant indicators of academic success or failure. PGPA, UGPA, SGPA, and APGPA did not significantly correlate with any of the tested WAIS-R practical measure scores (Table 105).

PC, BD, OA scores correlate well with CAREER. These predictor variables are statistically significant predictors for the dependent variable CAREER all at the 5% significance level (Table 105).

OA and DS scores correlate well with ABCP certification success. These predictor variables are statistically significant predictors for the dependent variable ABCP success all at the 5% significance level (Table 105).

Table 105

Coefficient of Regression Conclusion Matrix for the Dependent and Independent Study Variables all at the 5% significance level

Variable	Question	PC	BD	OA	DS	UGPA	SGPA	APGPA
PGPA	4					**<.001**		
	7						**<.001**	
	10							**<.001**
CAREER	2	**.03**	**.04**	**.01**				
	5			**.05**				
	8			**.04**				
	8	**.03**	**.04**	**.01**				
	11			**.04**				
	11	**.04**	**.03**	**.01**				
ABCP	3				**.04**			
	3			**.05**	**<.001**			
	6				**.01**			
	9				**.01**			
	12				**.01**			
	12			**.05**	**.01**			

CHAPTER V

DISCUSSION

Introduction

In chapter four, the results of data analysis relative to each of the research questions created for this study was provided. In this chapter the data analysis will be interpreted and suggestions for a practical use of the results of this study will be suggested. The format used to present the results of this study will be similar to the format used in chapter four. Each research question will be presented and a discussion of the results of the data analysis related to that question will be presented. From this discussion a conclusion will be drawn and one or more recommendations will be made relative to the specific research question. The final section of this chapter will be combined into an overall set of conclusions intended to represent recommendations from the study as a whole.

Overview

Perfusion technology programs must be accountable to the students and public they serve. Graduates of these programs must be able to fulfill their roles as clinicians and be fiscally responsible health care providers in the ever-changing health care arena. Outcome assessments and accreditation are two methods through which perfusion technology programs evaluate educational effectiveness and accountability. One step in assuring appropriate educational outcomes and maintenance of accreditation standards is through the evaluation of admissions process and the criteria used for selection of students for professional programs (History of the American Board, 2005).

Most allied health professions require a challenging combination of cognitive knowledge, psychomotor skill, and clinical decision-making. The cardiovascular perfusion curriculum not only requires obtaining a strong knowledge base in a relatively short period but also developing manual dexterity and decision making ability necessary for sound clinical competency (DeAngelis, 2003). Perfusion programs are required, because of the demands placed on allied health professions, to employ highly predictive and valid criteria to select the most qualified applicants. Admissions decisions must be based on the best data available to reduce the risk of attrition and to increase the number of graduates entering the profession. This study provides an initial investigation into the potential use of the WAIS-R as predictive measure of academic success.

The purpose of this study was to develop and conduct an investigation to establish a framework by which other accredited perfusion programs could investigate further possible correlations which may or may not exist between GPA, cognitive ability scores of the WAIS-R, and a candidate's outcome on the ABCP certification exam. Unique patterns of cognitive ability, measured by these dependent variables, may offer admissions committees information used for candidate selection.

Information from 1995 through 2005 for first time perfusion candidates taking the ABCP certification exam part I and part II was used for this retrospective study. Concurrent test scores from the WAIS-R practical test that include PC, PA, BD, OA and DS were then correlated with the ABCP results to determine if relationships existed between the cognitive ability scores and certification success (Appendix Table 6).

Identification of the Variables

One measure of intelligence and three measures of achievement are used in the student selection process at CARLOW-UPMC. The measure of intelligence is the WAIS-

R practical test. This practical test yields scores for PC, PA, BD, OA, and DS. The measure of academic achievement utilized was pre-admission GPA from undergraduate studies at Carlow University. Student selection is based largely on these scores and grades, and a combination of non-academic factors such as personal essays, prior medical experience, interviews and reference letters. These non-academic factors have not been addressed in this study because they are subjective measures and may be inconsistent. Success in the program is assessed by overall program grades and success achieving certification on the ABCP examination.

The first three research questions in phase I concentrate on scores on the WAIS-R and the ability to accurately predict success in perfusion technology at CARLOW-UPMC when PGPA, CAREER, and ABCP achievement are used as indicators of success. The second set of three research questions in phase II concentrate on UGPA and the ability to accurately predict success in perfusion technology at CARLOW-UPMC when PGPA, CAREER, and ABCP achievement are used as indicators of success. Significant WAIS-R scores that were identified in the first phase were included in the regression models. The third set of three research questions in phase III concentrates on SGPA and the ability to accurately predict success in perfusion technology at CARLOW-UPMC when PGPA, CAREER, and ABCP achievement are used as indicators of success. Significant WAIS-R scores that were identified in the first phase were included in the regression models. The last set of three research questions in phase IV concentrate on APGPA and the ability to accurately predict success in perfusion technology at CARLOW-UPMC when PGPA, CAREER, and ABCP achievement are used as indicators of success. Significant WAIS-R scores that were identified in the first phase were included in the regression models.

Research Question One

To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA information is used as an indicator of success?

Discussion

This study showed no correlation between the performance portion of the Wechsler and PGPA. None of the independent WAIS-R variables are statistically significant predictors for the dependent variable PGPA. The predictor variables PC, PA, BD, OA and DS are not statistically significant predictors for the dependent variable PGPA. The WAIS-R IQ is based on both verbal and performance scores. This study used scores from the WAIS-R practical portion. PGPA is evidence of both clinical and didactic ability.

Conclusions

Based on the results of this study, WAIS-R practical scores are not significant predictors of perfusion academic success. A literature search aimed at WAIS-R practical scores used to predict academic achievement did not reveal any research findings associated with GPA for any allied health profession.

This population of perfusion graduates completed all of the didactic and clinical requirements established by CARLOW-UPMC. The overall PGPA for this population is a reflection of clinical and didactic academic accomplishments. Future research using the practical portion of the WAIS-R aimed only at the clinical accomplishments may yield significant findings. Research using the verbal portion of the WAIS-R directed at the didactic accomplishments may predict academic success. Attempts to identify patterns of special cognitive and clinical ability that might be related to PGPA and select WAIS-R scores, may serve as predictor variables in making admission decisions.

Research Question Two

To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information is used as an indicator of success?

Discussion

This study showed significant predictive value using select performance scores on the WAIS-R to envisage professional employment as a clinical perfusionist. The WAIS-R PC, BD, and OA independent variables are statistically significant predictors for the dependent variable CAREER (PC p=.03, BD p=.04, and OA p=.01). Research questions 5, 8, and 11continued to use PC, BD, and OA with the respective models to investigate other significant relationships. The WAIS-R PC, BD, and OA independent variables continued to be statistically significant predictors for the dependent variable CAREER (PC p=.03 and p=.04, BD p=.04 and p=.03, and OA p=.048, p=.04 p=.01 p=.04, and p=.01) (see Table 105).

The attrition rate for perfusionists at CARLOW-UPMC for this population of graduates is 14.7%. Admission decisions aimed at reducing the loss of students before graduation is a goal of admissions committees. The results of this study suggest that the focus should also include graduates that fail to practice perfusion as a career.

A perfusionist is a allied health professional trained as a member of an open-heart, surgical team responsible for the selection, setup, and operation of a mechanical device commonly referred to as the heart-lung machine. During open-heart surgery, when the patient’s heart is immobilized and cannot function in a normal fashion while the operation is being performed, the patient’s blood is diverted and circulated outside the body through the heart-lung machine and returned again to the patient. This machine assumes the function of both and heart and lungs (American Society of Extra-Corporeal Circulation, 1972). Perfusionists often function in a supportive role for other medical specialties in operating mechanical devices to assist in the conservation of blood and blood products during surgery, and provide extended, long-term support of a patient’s circulation outside of the operating room environment (American Society of Extra-Corporeal Circulation, 1972).

Students must possess a cognitive base that targets problem-solving and critical thinking skills. Psychomotor development involves reflex movements, perceptual abilities, physical proficiency, and skilled movement. Candidates should have intelligence, dexterity and mechanical aptitude and be able to concentrate for long periods of time. Perfusionists often work for long periods under very stressful situations with the ability to react to emergent situations at any time (Quinnipiac University Perfusion Program, 2006).

Well-practiced psychomotor skills like manual dexterity and coordination are necessary for perfusion technology proficiency. Didactic attributes include mathematics, chemistry, physics, pharmacology, and physiology (Medical University of South Carolina, 2006).

“Professionals involved in the field of cardiovascular perfusion are required to possess an aptitude in the sciences, critical thinking skills, problem solving ability, mechanical comprehension, meticulous attention to detail, good physical health, stamina, and sensitive concern for the ill” (Barry University School of Perfusion, 2006). Candidates that choose this career find that it demands significant responsibility for patient safety (Barry University School of Perfusion, 2006).

“Cardiopulmonary bypass (CPB) is such a formidable intrusion into the mechanisms of homeostasis that monitoring of a few key parameters is necessary for maintenance of viable conditions” (Galletti & Brecher, 1962, p. 251). With any complex system like CPB, it is vulnerable to accidents. Gaba, Maxwell, and Deanda (1987) described characteristics that predispose a medical device to accidents. This theory can be applied to CPB.

“Distractions and interruptions extraneous to patient management during CPB can lead to errors. In this regard, the perfusionist would be well advised to adopt a curious and suspicious attitude any time CPB is being used (Gravlee, Davis, Kurusz, & Utley, 2000, p. 556)”. This point of view is practiced by airplane pilots to anticipate and avoid problems (Collins, 1986).

Gaba et al. (1987, p. 251) describes “complexity of interactions and tightness of coupling as two key elements that make a system at risk”. Complex interactions can be divided into those having intrinsic complexity, proliferation complexity, and uncertainty complexity (Gaba et al., 1987).

“Intrinsic complexity is a property of highly technical systems that require extraordinary effort and close coordination among various components in order to function properly” (Mora, Guyton, Finlayson, & Rigatti, 1995, p. 299). Proliferation complexity is a property of a system that requires multiple simple components that interface in a complex fashion (Mora et al., 1995). Uncertainty complexity occurs when a process, although relatively straightforward, is not well understood and contains a degree of unpredictability (Mora et al., 1995).

It is easy to apply this type of analysis to CPB. Multiple complex interactions must be carefully integrated for successful extracorporeal circulation. The perfusionists various responsibilities and activities during bypass contribute to the proliferative complexity of CPB.

Gaba et al. (1987) analysis implies that a system becomes complex and prone to mishap due to the interfacing of multiple, interdependent components. In today's technological world, this interfacing requires human involvement and quick reaction to different possible outcomes, resulting in the potential for human error. This theory is supported by studies that looked at anesthetic accidents to evaluate their causes and develop possible preventative measures (Cooper, Newbower, & Long, 1978; Gaba et al., 1987).

During CPB the perfusionist monitors all aspects of the perfusion circuit. This monitoring should be done on a continual orderly scanning basis. "The attention of the perfusionist should not become fixed on any one aspect of the perfusion for longer than two or three seconds. Nothing should be allowed to break this train of scanning observation" (Reed, Kurusz, & Lawrence, 1988, p. 128). "It is useful to establish a pattern of continuous scanning if cardiopulmonary bypass functions and monitors and the activities of other personnel in the operating room" (Gravlee et al., 2000, p. 556).

Intelligence is thought to have three components: abstract thinking and reasoning, problem solving ability, and a capacity to acquire knowledge (Snyderman & Rothman, 1987). Intelligence tests that generate a single score indicate a measure of general intellectual functioning. Tests like the WAIS-R provide two scores, one for verbal and one for practical performance. The WAIS-R views intelligence as multidimensional suggesting degrees of strengths and weaknesses of intellectual functioning. For this study the WAIS-R practical scores were used to evaluate the practical performance of the candidate. These scores were used to measure the ability of perfusion graduates to predict career placement as clinical perfusionist.

Many organizations have found that using ability tests is a cost effective means for selecting employees (Cooper, 1999). There are a number of tests available to identify the most appropriate employee or candidate "who might most benefit from the training course" (Cooper, 1999, p. 123). These tests may measure a wide range of abilities. Some serve to closely approximate a candidate's level of precise ability (Cooper, 1999). Kanfer, Ackerman, and Goff (1995) suggest that tests of intellectual abilities are the single most predictive element in employee selection and certainly more valid than the use of personal interviews predicting training and career success.

The subject using the PC has to discover and name the missing part of 21 incomplete pictures. The underlying principle suggests an ability to comprehend familiar objects and to determine the absence of essential rather than non-essential or irrelevant details. The test measures perception, insight, awareness, acuity, and observation abilities. It also measures conceptual, abstract, intangible, elusive, vague, and subtle abilities. Candidates that focus attention to the environment, demonstrate obsessive interest to details, or exhibit compulsive perfectionism behavior score well on the test. Low scores can be attributed to poor attention and concentration due to anxiety.

The candidate using the BD is challenged with seven two-dimensional designs to be reproduced with multicolored blocks within a time limit. The red and white sides of the blocks are utilized, with the blue and yellow sides serving as distracters. This test measures basic perception, insight, logic and reasoning, awareness, acuity, and observation abilities. Visual motor coordination and special visualization ability are highlighted. The work habits of the candidate are expressed as the candidate is challenged to solve the BD. Speed and accuracy in sizing up a problem with trial and error methods aimed at solving the design highlight synthesizing cognition to perceive the pattern. Individuals with artistic or creative abilities do well on this test.

The OA test consists of four jigsaw picture puzzles of common items to be assembled within a time limit. This test measures the thinking and working habits of the candidate as they work toward an unknown goal. The capacity to persist at a task along with the ability to synthesize concrete visional forms yields a high score. This measure gets to the creative ability of the student. The candidate is challenged to see special whole-part relationships in order to complete the task. Mechanical and artistic ability aid in higher scores.

Conclusion

Based on the results of this study, there is a predictive value using select performance scores on the WAIS-R to predict professional employment as a clinical perfusionist. The PC, BD, and OA independent variables are statistically significant predictors for the dependent variable CAREER.

Because of the complexity of CPB, candidates that continue on to be career perfusionists must possess a minimum number of the characteristics detailed by perfusion educators. The complexity of CPB circuitry requires a unique balance of cognitive and psychomotor ability supported with an affective personal drive. This study suggests that there is a relationship between individual characteristics necessary for perfusion success, described by perfusion educators, and abilities measured by select WAIS-R practical subtests. This study established a framework by which other accredited perfusion programs might investigate correlations that may or may not exist between cognitive ability scores of the WAIS-R and a candidate's success as a clinical perfusionist.

The attributes necessary for career success as a perfusionist are subjective in nature and are best judged by peers within the perfusion community. Because there are a limited number of perfusion technology programs in America, development of a survey that focuses on characteristics necessary for perfusion academic and clinical success may identify key attributes necessary for career success. This information, along with WAIS-R information, might identify candidates most suited for careers in perfusion technology

Research Question Three

To what extent do scores on the WAIS-R predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification information is used as an indicator of success?

Discussion

This study showed significant predictive value using select performance scores on the WAIS-R to predict future success passing the ABCP certification examination. The WAIS-R OA and DS independent variables are statistically significant predictors for the dependent variable ABCP (OA p=.048, DS p<.001). Research questions 6, 9, and 12 continued to use OA and DS with the respective models to investigate other significant relationships. The WAIS-R OA and DS independent variables continued to be statistically significant predictors for the dependent variable ABCP (OA p=.048, and DS p=.01, p=.01, p=.01, and p=.01) (see Table 105).

Wechsler defined intelligence as an individual's ability to adapt and constructively solve problems in the environment (Wechsler, 1958). He viewed intelligence in terms of intellectual performance rather than capacity. His rationale for intelligence suggests that it really does not matter how much intelligence one has in order to adapt to the environment, what matters is how well one uses intelligence (Wechsler, 1958). Wechsler views intelligence tests as performance measures of intellectual performance used to explain different intellectual abilities (Wechsler, 1958).

David Wechsler theorizes that intelligence tests are based on two assumptions. If intelligence involves primarily the ability to perceive logical relations and to use symbols, tests that favor verbal, arithmetical, and general abstract reasoning will highlight these strengths. If intelligence is a measure of the ability to handle practical situations, tests rich in performance and manipulative ability will highlight these strengths. Intelligence test designs measure intelligence through mental abilities. The question of intelligence and ability has yet to be answered. The most important fact about any test is its overall merit as a good measure of intelligence (Wechsler, 1958).

David Wechsler devised an IQ test with multiple focus areas to define ability. Components of this measure include a variety of IQ tests that measure different abilities. The Wechsler scales have two batteries of subtests grouped into two general areas: verbal scales and performance scales. The verbal scales measure general knowledge, language, reasoning, and memory skills. The performance scales measure spatial, sequencing, and problem-solving skills.

Certification in clinical perfusion is attained by satisfactory performance on the ABCP certification examination. The certification examination is composed of two parts. Part I, the Perfusion Basic Science Examination, is a 220-item, multiple-choice examination designed to cover perfusion basic sciences and cardiopulmonary bypass. Part II, the Clinical Applications in Perfusion Examination, is also of a multiple-choice format where a series of clinical scenarios are presented, each with a series of questions (History of the American Board, 2005).

The examination is based on topics in the ABCP knowledge base. There are six major sections of the knowledge base; basic science, cardiopulmonary bypass (adult, pediatric, infant, neonate), principles of laboratory analysis, intervention, biomedical engineering, and safety. Test development for questions on the ABCP examination require that each test question be fully referenced with two up to date academic resources within past ten years (History of the American Board, 2005). All questions must be supported by at least two references from textbooks or peer reviewed journals in order to be eligible for consideration. The candidate that commits to memory various perfusion references has the greatest potential for passing the certification examination.

The OA test consists of four jigsaw picture puzzles of common items to be assembled within a time limit. This test measures the thinking and working habits of the candidate as they work toward an unknown goal. The capacity to persist at a task along with the ability to synthesize concrete visional forms yields a high score. This measure gets to the creative ability of the student. The candidate is challenged to see special whole-part relationships in order to complete the task. Mechanical and artistic ability yield higher scores on this measure.

The DS test challenges the subject to associate certain symbols with certain other symbols and then to recreate these combinations within a time limit. The candidate's speed and accuracy memorizing serves as a measure of intellectual ability. The candidate is challenged to learn highly specific types of new tasks, with visual-motor dexterity, to yield high scores.

Conclusions

Based on the results of this study, there is a predictive value using select performance scores on the WAIS-R to predict certification success or failure. The OA and DS independent variables are statistically significant predictors for the dependent variable ABCP. There is common relationship with CAREER placement as a practicing perfusionist and overall certification success. Future research directed at this statistical relationship may specify abilities common to perfusionists that have success practicing in the field.

The complexity of CPB conduct requires a unique balance of cognitive and psychomotor aptitude supported with an affective personal drive. This study suggests that there is a relationship between individual characteristics necessary for perfusion success, described by perfusion educators, and abilities measured by select WAIS-R practical subtests. This study established a framework by which other accredited perfusion programs might investigate correlations that may or may not exist between cognitive ability scores of the WAIS-R and a candidate's success passing the ABCP certification exams.

This project examined the overall success or failure of the whole certification process. WAIS-R scores used to examine the success of failure for each of the exams may further clarify the clinical and cognitive component required for perfusion success. The practical portion of the WAIS-R was used to examine certification attainment. Future research using the WAIS-R verbal portion aimed at the cognitive portion of the certification exam, along with the WAIS-R practical portion directed at the second part clinical exam, may harmonize the cognitive and clinical skills with the most appropriate mental ability measure.

Research Question Four

To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

Discussion

This study showed significant predictive value using UGPA to predict future academic success at CARLOW-UPMC perfusion school. The independent variable UGPA is a statistically significant predictor for the dependent variable PGPA ($p<.001$).

GPA has always been the cornerstone of cognitive variables considered in the admissions process (Hayes, Fiebert, Carroll, & Magill, 1997). The literature supports GPA as a predictor of success in health related fields and it is considered the major point of consideration in the applicant selection process (Balogun et al., 1986; Guffey, 2000; Payton, 1997).

With regard to perfusion technology admissions policies, a literature search aimed at perfusion technology admission practices did not reveal any research findings associated with GPA. This study offers the first significant findings where GPA may serve as the focal point for admissions decisions in perfusion technology. Cognitive measures have typically served as a significant determinant for admissions decisions in many health related professions (Balogun et al., 1986; Guffey, 2000; Payton, 1997). The results of this study with regard to the predictive value of GPA actually fall in line with other allied health professions. Pre-professional grades served as the strongest predictor variable with respect to first year allied health grades.

Cognitive tests for selecting candidates generally depend upon the results achieved on MCAT, ACT, and undergraduate GPA. Most research has studied the relationship between admission criteria and future academic performance. The more consistent findings include a strong relationship between a variety of prerequisite GPA and academic performance measures in the professional phase of the allied health profession. Pre-admission standardized tests, like the ACT and GRE, correlated with professional academic performance. Stronger relationships resulted when test scores were coupled with prerequisite GPA. Reported studies seem to support prior academic achievement and ability test scores as valid predictors of success in allied health endeavors.

Traditional predictors, such as UGPA, grades in prerequisites or other selected courses, and entrance examination scores are the variables that consistently demonstrate valid and reliable correlations (Balogun, 1988;. Day, 1986; Dietrich & Crowley, 1982; Gross, 1989; Guthrie, 1990; Hayes, Fiebert, Carroll, & Magill, 1997; Johnson, Arbes, & Thompson, 1974; Roehrig, 1990; Schimpfhauser & Broski, 1976; Watson, Barnes, & Williamson, 2000) Other demographic variables show promise for adding to predictability, however future research involving these factors is necessary before definitive conclusions can be drawn.

Conclusions

Based on the results of this study, UGPA alone is a strong predictor of future PGPA. Admission decisions that are founded solely on academic / cognitive variables like UGPA as a primary predictor of success may reject other important admission factors that add to the total worth of the candidate. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction of academic and clinical success.

Future research that challenges this study should involve a diverse sample of students involved in a large number of perfusion schools. UGPA alone should not serve as a sole predictor in making admissions decisions. Research aimed at clarifying admissions variables that highlight both academic clinical success should be the overall goal of any future perfusion research.

Research Question Five

To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

Discussion

The results of this study do not support UGPA as a useful predictor for who will choose perfusion technology as a final career path. The independent variable UGPA is not a statistically significant predictor for the dependent variable CAREER. The poor performance of UGPA as a predictor of CAREER may be surprising. Perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge with a focus on natural sciences is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with career choice in perfusion technology or any other allied health profession

This population of students from CARLOW-UPMC all graduated from the program. Candidates enrolled in the program that failed to complete the academic and/or clinical training were not included in this study.

Conclusions

Based on the results of this study, UGPA alone is not a predictor of future career success as a perfusionist. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction of career success.

Research should be conducted that identifies students that may not complete perfusion training or never choose to practice as perfusionists. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research.

Research Question Six

To what extent do UGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Discussion

The results of this study do not support UGPA as a useful predictor of scores on the ABCP certification exam. The independent variable UGPA is not a statistically significant predictor for the dependent variable ABCP. The poor performance of UGPA as a predictor of ABCP may be unexpected. The perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge with a focus on natural sciences is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with ABCP certification or any other allied health profession licensure or certification process.

Certification and/or licensure are a requirement for most practicing perfusionists and hospitals (Joint Commission on Accreditation of Healthcare Organizations, 2006). The JCAHO requires all accredited hospitals using the CPB staff these procedures with ABCP certified perfusionists or certified eligible candidates (Joint Commission on Accreditation of Healthcare Organizations, 2006). Advancements by States to license perfusionists establish minimum training and education guidelines founded by the ABCP certification standards.

Conclusions

Based on the results of this study, UGPA alone is not a predictor of future success or failure on the ABCP examination. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction ABCP testing.

Research Question Seven

To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

Discussion

GPA has always been the cornerstone of cognitive variables considered in the admissions process (Hayes, Fiebert, Carroll, & Magill, 1997). The literature supports

GPA as a predictor of success in health related fields and it is considered the major point of consideration in the applicant selection process (Balogun et al., 1986; Guffey, 2000; Payton, 1997).

With regard to perfusion technology admission policies, a literature search aimed at perfusion technology admission practices did not reveal any research findings associated with SGPA. This study offers the first significant findings where SGPA might serve as the focal point for admissions decisions in perfusion technology. The independent variable SGPA is a statistically significant predictor for the dependent variable PGPA ($p<.001$). Cognitive measures have typically served as a significant determinant for admissions decisions in many health related professions (Balogun et al., 1986; Guffey, 2000; Payton, 1997). The results of this study with regard to the predictive value of SGPA actually fall in line with other allied health professions. It is important to note that the undergraduate curriculum at Carlow University is science based. It should be no surprise that SGPA and UGPA correlate well with PGPA.

Guffey (2000) demonstrated SGPA exceeded GPA in predictive power with regard to physical therapy education performance criteria. GPA is an important variable in the applicant selection process because future academic performance can best be predicted by past academic behavior (Guffey, 2000; Hayes et al., 1997). Many allied health programs have used academic achievement in selected science courses as an admission variable (Hayes et al., 1997). Pre-professional courses such as chemistry, physics, anatomy and physiology, and advanced science are important indicators of an applicant's cognitive potential.

Conclusions

Based on the results of this study, SGPA alone is a strong predictor of future PGPA. Admission decisions that are founded solely on academic or cognitive variables like SGPA as a primary predictor of success may reject other important admission factors that add to the total worth of the candidate. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction of academic and clinical success.

Future research that challenges this study should involve a diverse sample of students involved in a large number of perfusion schools. SGPA alone should not serve as a sole predictor in making admissions decisions. Research aimed at clarifying admissions variables that highlight both academic clinical success should be the overall goal of any future perfusion research.

Research Question Eight

To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

Discussion

The independent variable SGPA is not a statistically significant predictor for the dependent variable CAREER. The poor performance of SGPA as a predictor of CAREER may be surprising. Perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge, with a focus on natural sciences, is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with career choice in perfusion technology or any other allied health profession. The results of this study do not support SGPA as a useful predictor for who will choose perfusion technology as a final career path.

This population of students from CARLOW-UPMC all graduated from the program. Candidates enrolled in the program that failed to complete the academic and/or clinical training were not included in this study.

Conclusions

Based on the results of this study, SGPA alone is not a predictor of future career success as a perfusionist. Admission decisions that are founded solely on academic / cognitive variable like SGPA are not appropriate for decisions that may or may not predict career attrition. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction career success.

Research should be conducted that identifies students that may not complete perfusion training or never choose to practice as perfusionists. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research.

Research Question Nine

To what extent do SGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Discussion

The independent variable SGPA is not a statistically significant predictor for the dependent variable ABCP. The WAIS-R DS independent variable is a statistically significant predictor for the dependent variable ABCP (p=.01).

The results of this study do not support SGPA as a useful predictor of scores on the ABCP certification exam. The independent variable SGPA is not a statistically significant predictor for the dependent variable ABCP. The poor performance of SGPA as a predictor of ABCP may be unexpected because of the results using UGPA. Perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge with a focus on natural sciences is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with ABCP certification or any other allied health profession licensure or certification process.

Certification and/or licensure are a requirement for most practicing perfusionists and hospitals (Joint Commission on Accreditation of Healthcare Organizations, 2006). The JCAHO requires all accredited hospitals using the CPB staff these procedures with ABCP certified perfusionists or certified eligible candidates (Joint Commission on Accreditation of Healthcare Organizations, 2006). Advancements by States to license perfusionists establish minimum training and education guidelines founded by the ABCP certification standards.

Conclusions

Based on the results of this study UGPA alone is not a predictor of future success or failure on the ABCP examination. Admission decisions that are founded solely on academic / cognitive variables like UGPA are not appropriate for decisions that may or may not predict ABCP success or failure. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction ABCP testing.

Research should be conducted that identifies students that may not pass the ABCP examination. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research. Accreditation agencies require that hospitals employee certified or certified eligible perfusionists in their open-heart programs. Perfusion educators must graduate academically and clinically sound candidates that have the greatest potential, not only to complete the training, but also pass the certification and/or licensure requirements.

Research Question Ten

To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when PGPA and significant WAIS-R scores are used as indicators of success?

Discussion

With regard to perfusion technology admission policies, a literature search aimed at perfusion technology admission practices did not reveal any research findings associated with APGPA. This study offers the first significant findings where APGPA might serve as the focal point for admissions decisions in perfusion technology. The independent variable APGPA is a statistically significant predictor for the dependent variable PGPA ($p<.001$). Cognitive measures have typically served as a significant determinant for admissions decisions in many health related professions (Balogun et al., 1986; Guffey, 2000; Payton, 1997). The results of this study with regard to the predictive value of APGPA actually fall in line with other allied health professions. It is important to note that the undergraduate curriculum at Carlow University is science based.

UGPA and SGPA are closely related to each other because of the common number of shared classes. To this point, GPA academic standings have consisted of a number of courses offered over a three-year period of study. Anatomy and physiology is a two-semester class presented over a short period of time. This six credit hour class highlights a significant academic finding regarding future PGPA achievement.

GPA has always been the cornerstone of cognitive variables considered in the admissions process (Hayes, Fiebert, Carroll, & Magill, 1997). The literature supports GPA as a predictor of success in health related fields and it is considered the major point of consideration in the applicant selection process (Balogun et al., 1986; Guffey, 2000; Payton, 1997).

APGPA has been another cognitive variable used by admissions committees (Feldt & Donahue, 1989; Hayes et al., 1997; Quick, Krupa, & Whitley, 1985). APGPA is an important variable in the applicant selection process because future academic performance can best be predicted by past academic behavior (Hayes et al., 1997). Many allied health programs have used academic achievement in selected science courses as an admission variable (Hayes et al., 1997).

Conclusions

Based on the results of this study, APGPA alone is a strong predictor of future PGPA. Admission decisions that are founded solely on academic or cognitive variables like APGPA as a primary predictor of success may reject other important admission factors that add to the total worth of the candidate. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction of academic and clinical success.

Future research that challenges this study should involve a diverse sample of students involved in a large number of perfusion schools. SGPA alone should not serve as a sole predictor in making admissions decisions. Research aimed at clarifying admissions variables that highlight both academic clinical success should be the overall goal of any future perfusion research.

Research Question Eleven

To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when CAREER information and significant WAIS-R scores are used as indicators of success?

Discussion

The results of this study do not support APGPA as a useful predictor for who will choose perfusion technology as a final career path. The independent variable APGPA is not a statistically significant predictor for the dependent variable CAREER. The poor performance of APGPA as a predictor of CAREER may be surprising. Perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge with a focus on natural sciences is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with career choice in perfusion technology or any other allied health profession.

This population of students from CARLOW-UPMC all graduated from the program. Candidates enrolled in the program that failed to complete the academic and/or clinical training were not included in this study.

Conclusions

Based on the results of this study, APGPA alone is not a predictor of future career success as a perfusionist. Admission decisions that are founded solely on academic / cognitive variables like APGPA are not appropriate for decisions that may or may not predict career attrition. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction career success.

Research should be conducted that identifies students that may not complete perfusion training or never choose to practice as perfusionists. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research.

Research Question Twelve

To what extent do APGPA predict success in the perfusion technology educational program at CARLOW-UPMC when ABCP certification and significant WAIS-R scores are used as indicators of success?

Discussion

The results of this study do not support APGPA as a useful predictor for who will choose perfusion technology as a final career path. The independent variable APGPA is not a statistically significant predictor for the dependent variable ABCP. The poor performance of SGPA as a predictor of ABCP certification may be surprising. Perfusion technology curriculum is based in the natural sciences. It could be theorized that general academic knowledge with a focus on natural sciences is a foundation for any allied health profession. Unfortunately the literature review did not reveal any research linking academic success or failure with ABCP certification.

This population of students from CARLOW-UPMC all graduated from the program. Candidates enrolled in the program that failed to complete the academic and/or clinical training were not included in this study.

Conclusions

Based on the results of this study, APGPA alone is not a predictor of future ABCP success or failure. Admission decisions that are founded solely on academic / cognitive variable like APGPA are not appropriate for decisions that may or may not predict certification success or failure. Perfusion education lacks research that focuses on admission practices and variables applicable to the prediction career success.

Research should be conducted that identifies students that may not complete perfusion training or never choose to practice as perfusionists. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research.

Summative Limitations, Conclusions and Recommendations

Data collection was limited to only those students who graduated from CARLOW-UPMC school of cardiovascular perfusion. This investigation of only baccalaureate degree level students, affiliated with Carlow University in Pittsburgh, may be considered a constraint.

The ABCP was petitioned with a request for information regarding validity and reliability data that qualify the ABCP certification examination. After careful review by the Board at their spring 2005 conference, it was unanimously decided not to disclose any information regarding validity or reliability. A literature search that included the mental measurements yearbook, test reviews Online, and the educational testing service database failed to provide any information about the ABCP certification examination. The absence of validity and reliability testing regarding the ABCP certification examinations was a limitation of this study.

Since there is a lack of symmetry of distribution with the dependent variables CAREER and ABCP, it is indicated to have a larger sample size. The dependent variables CAREER and ABCP have small effect sizes for the population researched. The sample size for this population was a limitation of this study.

Studies have been conducted to assess the ability of various admission variables to predict academic and clinical performance of medical and allied health students. The results of these studies have been somewhat mixed. Few studies have been conducted to investigate the ability of admission criteria or professional academic achievement to predict future clinical performance. Another focus of research in various allied health professions is the predication of licensure examination scores of their graduates.

This study was conducted to identify perfusion technology admission criteria that could explain the variance associated with measures of future performance in academic aspects of the professional program, on the certification examination, and on career choice after graduation. Specifically, the purpose of this study was to determine admission criteria that could explain variance associated with perfusion academic achievement, employment placement after graduation, and certification attainment.

The results of this study support the predictive potential of select cognitive variables with regard to perfusion grades, career choice, and certification success. The population used for this research was not a true sample of the overall perfusion population. However, this was a population of CARLOW-UPMC candidates that fairly represents this particular program.

Based on the results of this study, GPA predicts future GPA. Students that do well academically at Carlow University statistically have the potential to do well at CARLOW-UPMC perfusion training. Select scores on the practical WAIS-R provide statistically significant information about a candidate's ultimate career choice as a perfusionist and outcome on the ABCP certification exams. This research provides a foundation for future research regarding admission variables used to select candidates that may or may not enter the perfusion profession. The following conclusions are presented.

1. Standardized tests like the WAIS-R offer a few advantages for the selection of students. The first is that the users have access to reference norms showing how often each score on the measure compared to other similar groups or individuals. The second advantage is the test should have clear evidence that they can predict performance in a variety of settings. For example this research shows a significant relationship between performances on select WAIS-R practical scores and perfusion abilities. Future research aimed at establishing a link between ideal perfusion ability and abilities measured by the WAIS-R may identify ideal candidates for perfusion technology.

2. It must be stressed that it is not always sensible to use ability tests as the sole selection identifier. It may be that some of the skills required cannot be measured or identified by this specific test. Other batteries of tests are available that measure wide ranges of psychological variables that may or may not lead to ideal candidates. This spectrum of tests adds time and expense to candidate selection. If the consequences of

choosing the wrong individual are not important, then the cheaper form of evaluation may be indicated. However, if perfusion educators are committed to identifying the most suited candidates for the limited number of positions, it may be appropriate to utilize other tests.

3. General ability is not the only variable that affects performance. Motivation also plays a large part and future job knowledge may well overtake cognitive ability as the best predictor of performance after an individual has been performing as a career perfusionist. A carefully chosen ability test can provide a useful and inexpensive means of predicting how well an applicant is likely to perform on the ABCP examination or as a career perfusionist. The value motivation plays regarding performance cannot be measured in most cognitive ability tests (Cooper, 1999).

4. SGPA should be further evaluated as having any value more than UGPA in regard to making admissions decisions. SGPA is a component of UGPA. Research supports both UGPA and SGPA as a predictor of outcome in other academic ventures. UGPA has a stronger academic history of research qualifying the value it has predicting future GPA.

5. APGPA should be further evaluated as having any value more than UGPA or SGPA in regard to making admissions decisions. APGPA is a component of UGPA. Research supports UGPA, SGPA and APGPA as a predictor of outcome in other academic ventures. UGPA has a stronger academic history of research qualifying the value it has predicting future GPA.

6. This population of students did not include those that withdrew from Carlow University or CARLOW-UPMC perfusion training. Review of their WAIS-R scores and GPA information may further qualify some of the finding of this research.

Future Research

There are a small number of perfusion technology programs within the United States. A sample of perfusion candidates and graduates from a variety of perfusion programs across the country would appropriately represent the perfusion population. The population of students used for this research involved one perfusion program over a ten-year period. This population focused only on graduates from CARLOW-UPMC. Future research should also focus on the national pool of candidates that fail to complete the training, ultimately never entering the perfusion profession.

The attributes necessary for career success as a perfusionist are subjective in nature and are best judged by peers within the perfusion community. Because there are a limited number of perfusion technology programs in America, development of a survey that focuses on characteristics necessary for perfusion academic and clinical success may identify key attributes necessary for career success. Future research that identifies characteristics essential for clinical competency and academic success would be of great value to the perfusion community.

Research should also be conducted that identifies students that may not pass the ABCP examination. Perfusion organizations committed to identifying the very best candidates available or because of financial constraints require accurate admission variables may sponsor such research. Accreditation agencies require that hospital employees be certified or certified eligible perfusionists in their open-heart programs. Perfusion educators must graduate academically and clinically sound candidates that have the greatest potential, not only to complete the training, but pass the certification and/or licensure requirements. Future research should focus on identifying the most suited candidates for the limited number of perfusion positions.

The literature review for this project revealed an overall deficiency in perfusion education research. Perfusion is a relatively young allied health profession. Any future research effort aimed at promoting clinical or academic practice would only serve to strengthen perfusions position within the medical community.

Conclusion

The profession continues to move in a direction of homogeneous methods of entry into perfusion technology training. The majority of programs remain at the baccalaureate degree level with different admission prerequisites so the results of this study are limited to this population of graduates.

The purpose of this study was to develop and conduct an investigation which would establish a framework by which other accredited perfusion programs could investigate further possible correlations which may or may not exist between GPA, cognitive ability scores of the WAIS-R and a candidate's outcome on the ABCP certification exam. Perfusion technology programs must be accountable to the students and public they serve. Graduates of these programs must be able to fulfill their roles as clinicians and be fiscally responsible health care providers in the ever-changing health care arena. Perfusion admissions committees should consider the inclusion of alternate forms of cognitive variables, like the WAIS-R, if the intension of admissions decisions is to identify persons with the greatest potential for perfusion academic success, passing scores on the ABCP certification exam, and ultimate placement as a career clinical perfusionist.

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APPENDIX TABLE A

Descriptive Statistics for Gender using Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol

Appendix Table A

Descriptive Statistics for Gender using Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol

Gender		PC	PA	BD	OA	DS
Male	Mean	11.31	11.19	11.97	10.56	11.22
	Std. Deviation	1.77	2.73	2.61	2.42	1.77
Female	Mean	10.89	10.76	11.75	10.13	13.49
	Std. Deviation	1.81	2.20	1.99	2.66	2.20

APPENDIX TABLE B

Descriptive Statistics for Gender using Undergraduate Grade Point Average, Science Grade Point Average, and Anatomy & Physiology Grade Point Average

Appendix Table B

Descriptive Statistics for Gender using Undergraduate Grade Point Average, Science Grade Point Average, and Anatomy & Physiology Grade Point Average

Gender		UGPA	SGPA	APGPA
Male	Mean	3.33	3.29	3.44
	Std. Deviation	0.30	0.37	0.46
Female	Mean	3.41	3.36	3.39
	Std. Deviation	0.38	0.46	0.53

APPENDIX TABLE C

Descriptive Statistics for Gender using Perfusion Grade Point Average

Appendix Table C

Descriptive Statistics for Gender using Perfusion Grade Point Average

Gender		PGPA
Male	Mean	2.89
	Std. Deviation	0.45
Female	Mean	2.98
	Std. Deviation	0.44

APPENDIX TABLE D

Descriptive Statistics for Gender and Career Perfusionist using Cross Tabulation

Appendix Table D

Descriptive Statistics for Gender and Career Perfusionist using Cross Tabulation

			Gender		
			Male	Female	Total
Career Perfusionist	NO	Count	5	9	14
		% within Career Perfusionist	35.7%	64.3%	100.0%
		% within Gender	15.6%	14.3%	14.7%
	YES	Count	27	54	81
		% within Career Perfusionist	33.3%	66.7%	100.0%
		% within Gender	84.4%	85.7%	85.3%
Total		Count	32	63	95
		% within Career Perfusionist	33.7%	66.3%	100.0%
		% within Gender	100.0%	100.0%	100.0%

APPENDIX TABLE E

American Board of Cardiovascular Perfusion Results and Gender using Cross Tabulation

Appendix Table E

American Board of Cardiovascular Perfusion Results and Gender using Cross Tabulation

			Gender		
			Male	Female	Total
ABCP Results	Failed Exam	Count	3	3	6
		% within ABCP results	50.0%	50.0%	100.0%
		% within Gender	10.0%	6.1%	7.6%
	Passed Exam	Count	27	46	73
		% within ABCP results	37.0%	63.0%	100.0%
		% within Gender	90.0%	93.9%	92.4%
Total		Count	30	49	79
		% within ABCP results	38.0%	62.0%	100.0%
		% within Gender	100.0%	100.0%	100.0%

APPENDIX TABLE F

List of Variable Abbreviations and Names

Appendix Table 6

List of Variable Abbreviations and Names

Abbreviation	Definition
GENDER	Gender
AGE	Age Wechsler Tested
PC	Picture Completion
PA	Picture Arrangement
BD	Block Design
OA	Object Assembly
DS	Digit Symbol
TOTAL	Total Wechsler Practical Score
IQ	Wechsler Intelligence Quotient
UGPA	Undergraduate Grade Point Average
SGPA	Science Grade Point Average
APGPA	Anatomy & Physiology Grade Point Average
PGPA *	Perfusion Grade Point Average
CAREER *	Career Placement as a Clinical Perfusionist
ABCP *	American Board of Cardiovascular Perfusion Examination Results

* Denotes Dependent Variable