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Perceptions and attitudes of college science students regarding carrers in clinical laobratory science

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PERCEPTIONS AND ATTITUDES OF COLLEGE SCIENCE STUDENTS REGARDING CAREERS IN CLINICAL LABORATORY SCIENCE

by

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A Thesis

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THESIS APPROVAL

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Fulfillment of the Requirements

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in the fields of Biology and Health Education

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AN ABSTRACT OF THE THESIS OF

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TITLE: Perceptions and attitudes of college science students regarding careers in clinical laboratory science

MAJOR PROFESSORS: Dr. Mark Kittleson
Dr. William Muhlach

Histology as a career offers many challenging and diverse job opportunities but few qualified applicants pursue this vocation. The purpose of this research was to collect data to identify factors impacting this problem. The study investigated the awareness, attitudes and perceptions of community college and university science students towards laboratory health science and histology as a career option. The goal was to develop strategies to identify and recruit potential individuals who are qualified for the histology profession. The researcher surveyed 15 undergraduate science classes from two community colleges and one university in the Midwest. The community colleges and university surveyed offer academic course work necessary for a student to pursue a career in histology. The survey was designed to collect data regarding the student's attitudes toward career preparedness, job opportunities, anticipated salary, and laboratory science employment. Results of this study support the hypothesis that undergraduate students pursuing science degrees are potential candidates for careers in histology but they are unaware of the profession. The study also provides a preliminary needs-assessment to support the development of programs that offer histology training for undergraduate and graduate students pursuing college science degrees.

DEDICATION

To those who have left this earth, but not before leaving a wealth of knowledge and an essence of inspiration that still fills our hallways of science. These scientists truly were, Larger-than-Life.

To Dr. Varadaraj Chandrashekar who was never too busy to talk science to students and went out of his way to inquire into the "goings on" in the histology laboratory. Many times he said "you are already teaching but taking no credit". "Finish the degree not for them, but for yourself".

To Dr. William Dyer, the thinker. I can still envision him standing in the lab, thumb under chin, finger over lips, "Hmm….". "Research is good, but often frustrating and fruitless". "Education makes you feel good because there you can make a difference".

To Dr. Lonnie Russell, who introduced me to electron microscopy, gave me the opportunity to co-author my first paper in a peer-reviewed journal and who scolded me for not pursuing a masters degree in science after graduation. "The longer you put it off, the harder it will be". "Just how tough are you"? With all due respect sir, I can finally answer, "Tough enough".

To Dr. Alan Woolf, who opened my eyes to the intriguing world of wildlife pathology. I grew fond of his "guess what this is" under the microscope game. I quickly learned NEVER leave home without your coveralls and boots, and that my mentor had no fear of knives, guns, animal bites, bugs, leeches, disease, chemicals, bad weather or authority. He faced death the same way he faced life, head-on, no holds barred. Granted, his time was cut short, but from what I could tell, it was quite a ride. I'm grateful I got to tag along on a few adventures.

To Dr. Jan Martan, who, if he knew I was tearing up just at the thought of him would say, rather loudly, “My God lady, what is your problem”. He inspired me, and countless others, to pursue a career in histology. Many of the “old-timers” he instructed are no longer around, but the stories of Dr. Martan, remain. You told me, “You will not be judged by what you accomplish, but rather by what you inspire others to accomplish.” I hope to follow in your footsteps, knowing I’ll never fill your shoes. “Ni-yah, my mentor, my friend, Ni-yah.”

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PREFACE

The United States healthcare system desperately needs more laboratory professionals to meet the growing needs of the population. The field of histology has been unsuccessful in recruiting enough qualified individuals to meet the increasing demands of the United States healthcare system.

Students pursuing associate and bachelor degrees in science are not aware of this career option involved in patient care that is both challenging and rewarding.

The purpose of this study is to contribute to a better understanding of college students' attitudes and perceptions towards careers in laboratory science such as histology.

The implications are important not only to define a qualified population of candidates for careers in histology but also to evaluate career expectations and options of college science students.

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Background

Histologists are a dying breed. Like an endangered species, their numbers are declining to a critical point from which the profession may not be able to recover. Histologists are a tight-knit group, drawn together by the unique demands of the profession. Histology technicians and technologists prepare human or animal tissue samples for microscopic examination on glass slides. The information gained from examination of tissue on the slides is used to diagnose disease or further medical research. Histologists work behind the scenes with few people understanding the weight and complexity of their jobs. For the most part, they are dedicated to improving the health and well being of not only our own species, but countless other species that inhabit our planet.

The minimum requirements for eligibility and certification for histology set by the American Society for Clinical Pathology (ASCP) are completion of an accredited histology program or one year's experience in a histology laboratory and an associate's degree in science for a histology technician and/or a bachelor's degree in science for histology technologists.[1] Some community colleges and four-year universities offer the academic course work required for a student to pursue a career in histology, but few schools promote the profession. Most students attending college with an interest in science are unaware of histology as a career choice and the important role it plays in research and medicine.[2] Many students who are not planning on becoming a doctor or nurse, express an interest in being involved in some form of healthcare, yet they are

uninformed or misdirected about the clinical health careers available and the technical skills required to work in those professions.

Purpose of the Study

The purpose of this study was to ascertain a better understanding of college students' attitudes towards careers in laboratory science. More specifically, the study investigated the awareness, attitudes and perceptions of community college and university science students towards laboratory health science and histology as a career option. The implications are important not only to define a qualified population of candidates for careers in histology but also to evaluate career expectations of college science students.

Statement of the Problem

The field of histology has been unsuccessful in recruiting enough qualified individuals to meet the increasing demands of the United States healthcare system. Students pursuing associate and bachelor degrees in science are not aware of this career option involved in patient care that is both challenging and rewarding.

Need for the Study

The United States healthcare system needs more laboratory professionals to meet the growing needs of the population. The only reasonable and controllable variable for the laboratory staffing shortage is increased recruitment of qualified candidates. Research is needed to investigate college graduates in science as potential candidates for employment as histologists in the healthcare industry.

Research Questions

1. Does a significant correlation exit between how students perceive their college experience has prepared them for a career in science and how they rate their job opportunities after graduation?

2. Does a relationship exist between 2-year community colleges students and 4-year college students in their likelihood to consider a career in laboratory health science?

3. Does a relationship exist between perceived working conditions in a laboratory and consideration of a career in laboratory health science?

4. What proportion of 2-year college science students compared to 4-year college science students has the minimum educational requirements for certification as histology technicians and technologists?

5. To what extent are students' considerations of a career in histology related to their awareness of the profession?

6. What relationship exists between students' anticipated post-graduation salary, and the average starting salaries for new hires in science and entry-level salaries histologists?

Limitations

1. This was a sample of convenience. There is a sampling bias because not everyone within the given population had an equal chance of being selected for the study.
2. The sample represents only students surveyed. This study may be limited in relevance beyond this type of population or similar populations.

3. The proportion of women and men in the study were not equivalent due to sampling.
4. Instrument bias. The students may have misinterpreted portions of survey and/or misunderstood some of the questions.
5. Self-reporting bias. The respondents' answers may have been skewed in order to meet his or her perception of the researcher's objectives.
6. Reliability. The instrument had low reliability due to survey covering different content areas.

Delimitations

1. Large sample size was used to decrease type II error.
2. Three different geographic sites were surveyed in an attempt to increase external validity.
3. Sources for this study include books, journal articles, electronic articles, government reports, professional magazines, and agency reports.
4. Reference materials not from peer-reviewed journals have been included because they provide credibility to the study and support current literature.

Assumptions

1. The study participants were assumed to be accurate and non-biased in responding to questions on the survey.
2. It is assumed the instrument was a valid measure of students' knowledge and perceptions of careers in laboratory sciences.

3. It is assumed that resources provided to the study were significant and provides accurate information in accordance with accepted standards.

Definition of Terms

1. *American Health Association* (AHA)—"is an organization that promotes the quality provision of health care by hospitals and health care networks through such efforts as promoting effective public policy and providing information related to health care". [3]
2. *American Society of Clinical Pathologists* (ASCP)—a professional organization based in Chicago,that includes pathologists and laboratory professionals. "The purpose is to advance the profession through education". The ASCP has a Board of Registry that certifies workshops, continuing education and clinical laboratory professions.[4]
3. *Bureau of Labor Statistics* (BLS)—"a government agency that functions as a fact-finding group for the U.S. government in the field of labor economics". "The BLS is an independent national statistical agency that produces and disseminates essential statistics that reflect the state of the US economy"[5]
4. *Clinical Laboratory Improvement Act 1988* (CLIA 88)—"the Clinical Laboratory Improvement Amendments (CLIA '88) defines the level of qualification required to perform tests of various complexity."[6]
6. *Diagnosis Related Groups* (DRG)—"is a system developed by Medicare to classify hospital cases into one of approximately 500 groups, expected to use similar hospital resource use as part of the prospective payment plan."[7]

7. *Health Research System Analysis* (HRSA)—"The survey of institutions that contribute to research on health topics, developed under the World Health" Organization's Health Research System Analyses (HRSA) initiative is to describe and analyze national health research systems. This survey intends to collect detailed information from a broad range and nationally representative sample of institutions that conduct or contribute to health research.[8]
8. *Licensure*—"professional and occupational regulation granted by States that is referred to as right-to-practice. These laws define who can practice based on their guidelines."[9]
9. *National Accrediting Agency for Clinical Laboratory Sciences* (NAACLS)—"international agency for accreditation and approval of educational programs in the clinical laboratory sciences and related health professions through the involvement of expert volunteers". "NAACLS accredits programs in MT/CLS, CLT/MLT, HT, and HTL throughout the country."[10]

CHAPTER 2

REVIEW OF LITERATURE

Introduction

A black hole is defined as a place or thing into which objects disappear and are never seen again.[11] It is as if laboratory technologists and technicians have become a black hole. They are one of the largest groups of health care workers, yet their numbers are declining at an alarming rate.[12] The clinical laboratory performs a variety of diagnostic tests on blood and tissue samples. These workers may specialize in specific branches of laboratory science, such as cytology (the study of cells and cell abnormalities), medical technology (the study of blood and serums), phlebotomists, who collect blood samples for testing or blood donations for blood banks, histology (the study of tissue structure and organization), microbiology (the study of bacteria) and immunology (the study of antibodies). [13] Of these specialties, there are approximately 15,000 histology technicians and technologists in the clinical field and another 10,000 in research and veterinary sciences.[14] Beginning in 2004, high school education plus experience was eliminated as a route for certification for histology technicians. New guidelines now for histology technicians require an associate degree that is usually completed at a community college, vocational school or the Armed Forces Institute of Pathology.[1] A histology technologist's education typically consists of a 4-year baccalaureate science degree program at a university. Certification for both the histology technician and technologist requires the applicant to complete one year of training in a laboratory setting. [1]

Justification for the Study

There are numerous articles addressing the present and future impact of the shortage of clinical laboratory workers, particularly histologists, on the quality of healthcare in the

United Sates. [2,12,14] This paper provides a review of the many contributing factors affecting the supply, utilization, and demand for clinical laboratory histologists. This study will evaluate past and current trends in education and the impact these disciplines have on the workforce supply. Finally, the researcher will investigate the factors contributing to underutilization of college science graduates as candidates for jobs in clinical histology laboratories.

Certification of Laboratory Professions

The American Society of Clinical Pathologists Board of Registry (ASCP) is the certifying agency for clinical laboratory technicians and technologists. This professional organization offers voluntary certification of professionals in laboratory medicine. Because receiving certification through the ASCP Board of Registry is a single event, the number certified each year is a reliable indicator of the number of persons entering the field.[1] There are a few other certifying agencies, but most laboratory professionals will aspire to an ASCP certification. This certification is the most widely recognized in the clinical arena. The healthcare industry is the largest employer of histologists. Their most desirable employees are certified or eligible technicians, meaning they have completed either an accredited program or an associates or bachelors degree in science.[1] Fifty-eight percent of HTs are certified and 30% are noncertified. 38% of HTLs are certified.[15]This year, for the first time, ASCP will attend the National Science Teachers of America symposium. Their mission is to promote careers in laboratory medicine to 2-year and 4-year institutions.[16]

Vacancy Rates and Staffing

Projecting future employment patterns for health related laboratory jobs requires an understanding of forces that likely will influence supply, demand, and utilization as well

as sufficient data to estimate their potential impact.[17] The Bureau of Labor Statistics (BLS) and the Department of Health and Human Services' Health Resources and Services Administration (HRSA) are just two examples of groups providing data regarding job shortages in the healthcare industry. Hospitals and clinics employ 60% of the medical laboratory workers with an additional 14% being employed in medical laboratories such as physicians' offices and contract labs.[18] In the U.S. there were record-breaking shortages of laboratory personnel in 2000.[19] HRSA's 2000 laboratory survey reported 74% of both hospital and non-hospital facilities reporting insufficient staffing.[20] For 2000-2001, the American Health Association (AHA) reported that vacancy rates for hospital laboratory technologists were at all time highs with 20% for histology positions vacant.[21] By 2005 ASCP's report indicated that the vacancy rate for histologists had dropped from 20% to 14% with the average time to fill a histology position being 6 months.[22] In 2007, 44% of hospitals were reporting inadequate staffing of laboratory personnel.[14] Vacancy rates can be deceiving when used to portray staffing shortages.[17] Trimming budgets can artificially reduce vacancy rates by removing the unfilled position. The use of per diem and contract workers and overtime compensation conceal the demand for more workers instead of filling the position.[9] Recent HRSA surveys indicate hospitals are experiencing increasing difficulty in recruiting laboratory technologists compared to previous years.[17] Research indicates that even though vacancy rates for laboratory workers have fluctuated over the years, laboratories have managed to provide adequate services.[23] There does however seem to be a persistent trend in the direction of increased staffing shortages and decreased ability to provide quality services that could result in a negative impact on patient care.[24] As workloads increase, delays in test results

occur more often potentially increasing error that could effect patient care.[25] The Swine flu pandemic has had little impact in the US, but a recent outbreak of flu in the Midwest is raising awareness of how inadequate our strained healthcare system would be in response to an infectious disease epidemic.[26] Most people are unaware of this patient-safety issue. In 2005, laboratory managers reported higher turnover and increased difficulty in filling histology positions with an average vacancy rate of 2.2 months.[22] Comprehensive data on laboratory workers suggest that the numbers of new entrants to the field of histology have declined in recent years.[15]

Cutbacks in Healthcare

It is suggested that staffing difficulties in many allied health fields began in 1983 with Medicare's reimbursement system of Diagnosis Related Groups (DRG's).[27] This system determines how much Medicare pays the hospital, using the assumption that patients within the same category are similar clinically and are expected to use the same level of hospital resources. This system caused clinical laboratories to down size staff to match projected payments for services.[28] All clinical laboratory testing is regulated through the Clinical Laboratory Improvement Amendments (CLIA). CLIA's is a quality assurance programs with goals to ensure quality laboratory testing through good laboratory practices.[29] In 1988, CLIA issued stringent standards that caused cut backs in laboratory personnel by enforcing task performance evaluations and requiring technologists to have at least an associates degree if they perform highly complex tests.[30] In other words, the hospital was told how many technicians it could employ based on the number of specimens it handled each year.[31] Most likely these rulings were not the exclusive reason for laboratory worker shortages, but the hospital's attempt to cut costs by trimming laboratory staff did have a negative impact on the labor force.[32,33]

Population Dynamics and Attrition

Compounding this staffing shortage is a growing concern that as demands of an aging population increase, the supply of healthcare workers will not be sufficient to meet their needs.[34] Older age groups tend to use a greater volume of health care services.[35] In the future, it is predicted there will be a dramatic increase for health care services once the baby boomers reach age 60 and beyond.[36] The population aged 65 and older will double from 2000 to 2030.[18] Moreover, the population aged 85 and older is the fastest growing age group in the United States.[36] The growing number of elderly persons will have a major effect on the demand for health care in the future. As the general population ages, so does the workforce. The U.S. Bureau of Labor Statistics (BLS) projects that by 2014, an additional 81,000 technologists and technicians will be needed to replace retirees while 68,000 will be needed to fill new positions.[18] Population changes associated with the aging generation have increased demand for laboratory personnel and, at the same time, limited supply of workers available due to retirement.[21] The average age of laboratory workers is 49 years old and 32% of histologists have worked in the laboratory an average of 20 yrs.[14]

Demographic changes will exert pressure on supply and demand of laboratorians.[37] From 2000 to 2030, the total working-aged population, people aged 18 to 64, is expected to grow by only 16 percent.[18] In 2000, the ratio of the working-aged population to the population over age 85, declined from 39.5 workers for each person 85 and older to 22.[13] These workforce trends among laboratory personnel have an affect on both current and future supply and demand for histologist and other allied health fields. The aging of the population and changes in the make up of the workforce have the potential for disparity between the future supply and demand for health care workers.[38]

Recently the issue of state licensure of histologists is being re-evaluated due to staffing problems. Eleven states, including Florida and California, require this additional licensing of laboratory technologists.[39] One of the benefits of licensing laboratory professions is that it allows comparison of education level, types of job settings and actual number of technicians working in the state.[40] Without licensure it is difficult to determine the current size of any specific group of trained healthcare professionals. Opponents of state licensure for histologists argue that the continuing education requirements mandated by state licensure put an unreasonable financial and staffing burden on departments that are already stretched to their limit.[40]

Training Programs

The healthcare industry and professional associations are reporting a trend of increasing vacancy rates in the laboratory professions along with declining trend of numbers of new recruits to the field.[41] With the total number of training facilities at an all time low, graduates of laboratory programs and the number of graduates taking certification exams has also declined.[34] The National Accrediting Agency for Clinical Laboratory Sciences (NAACLS) accredits programs in MT/CLS, CLT/MLT, HT, and HTL, throughout the country.[9] A decade ago 50% of the training programs were hospital based and less than 20% were university based.[42] A third of the histology training programs in the United States have closed in the past ten years, resulting in less qualified applicants for more jobs.[34] A large portion of clinical laboratory training is hands-on learning through performing laboratory tasks under a certified medical professional.[43] The classes are relatively small with training being intensive and costly.[44]The decline in student enrollment cannot be attributed solely to a loss of capacity in the education system because the numbers of enrollees in current programs has not increased.[45] Lack of

awareness and/or interest in the profession along with the time and energy required for instruction may have contributed to the closing of some histology programs.[41] One factor that may explain declining interest in laboratory occupations is that other business fields can offer higher salaries to technology-minded workers.[34] Representatives from professional and industrial organizations refer to the information technology and medical equipment manufacturing fields as aggressive competitors. These fields are luring away some of the most experienced technicians with their competitive salaries and generous vacation benefits.[46] Competition also comes from within the profession. Some hospitals are experiencing "predatory activity" between medical centers. New lab hires are lured away to other hospitals offering $5,000 sign-on bonuses.[47] While trends in the utilization of laboratory services are speculative, demand for histologists is expected to rise as the United States population ages.[36] In an attempt to cut budgets, hospitals have trimmed staff to skeleton crews and eliminated on-the job training programs.[21] Training students is a huge time commitment. For a program to be effective, mentors must conduct themselves as educators to meet needs of students. [44]As workloads increase, it is tempting to treat students as part-time employees and expect their work performance and productivity to equal that of the full-time staff.[48] It is hopeful that the recent advent of "distance learning" will increase the laboratory work force.[2] Alternative online instruction operates through established college science programs that network with clinical settings that provide the required laboratory experience.[2] ASCP is continually exploring avenues that will increase the laboratory workforce.[45] Recently, stimulus money, in the form of "Community-based Job training Grants" has become available for training schools or programs that are at risk of closure.[45] This money is designated for

healthcare professions training and ASCP is willing to help agencies qualify for the funds.

Earnings for Laboratory Workers

Employment and earnings data for laboratory technicians, including histologists, are not clearly representative of the current balance of supply and demand in these professions.[45] The rate of earnings growth for laboratory workers has historically lagged behind that of the overall salary increases for the healthcare workforce.[36] For statistical analysis, laboratory personnel are included with nurses and therapists who traditionally have higher salaries.[48] Earnings for all healthcare professionals grew by 10.1 percent from 2000 to 2003, while median weekly earnings for laboratory workers increased by only 4.9 percent.[36] While the laboratory workforce overall has experienced only modest recent earnings growth, the ASCP reported significant increases in wages for histology technologists and technicians.[36] According to the ASCP 2007 wage and salary report, the national average salary for histology technician was $20.24 per hour or $42,099. Histology technologists earn an average of was $23.46 per hour or $48,797 and supervisors earn an average of $28.00 per hour or $58,240.[14]

Technological Advances

Improvements in some areas may raise productivity of the existing workforce requiring less staff, whereas advances in other technologies can increase the volume and complexity of laboratory work, resulting in an increased demand for more highly trained personal.[2] Histology has become more technically advanced as emerging molecular pathology procedures increase the knowledge and expertise needed to perform these techniques.[49] For example, tests for diagnostic cancer markers like prostate specific antigen are contributing to the increased workload for histologists.[2] Technological

advances that facilitate increased automation may enhance productivity, but some believe utilization of technological advances, especially in regards to automation, could threaten the necessity for skilled laboratory personnel.[23] It is difficult to evaluate the impact of the rapidly advancing scientific technology, but so far, it has not decreased the demand for histologists and may in part be responsible for some shortages.[36] Vacancy rates for certified technicians and hourly wage rates appeared to increase with the number of billable tests performed.[13]A perfect example is the advent of the automatic immunohistochemical stainer. Immunohistochemical staining is a labor-intensive manual procedure that does not provide affordable benefits for routine diagnostic testing and only a small fraction of clinical facilities previously used these tests. Development and availability of the automatic immunostainers revolutionized diagnostic immunology and now it is standard for facilities to use these tests, creating a huge demand for competent histologists to run the machines.[50] Machines run more tests per hour than if done by hand, but monitoring the machine's progress, quality assurance of results and maintenance of the equipment still require time and expertise of a qualified technician. But other advances, such as new, more sophisticated tests and procedures, like microwave tissue processing, *in-situ* hybridization and polymerase chain reactions (PCR) will increase demand for certified HTLs who have more advanced and/or specialized skills and qualifications.[51]

Geographic location has an impact on salary and availability of trained staff with rural areas being particularly strained.[52] Less populated areas are forced to analyze how to use productivity-enhancing technology as well as staff with differing skill mixes and qualifications to supply the demand for workers.[53] For example, substitution of lower-

skilled workers for some routine laboratory tasks may increase a higher skilled technologist's productivity.[54]While the duties of laboratory technologists and technicians may overlap, and some cross training is taking place, there is little evidence that substitution of one type of worker for the other will solve any staffing problems.[54]

Histology, like many other laboratory science professions, has been traditionally a female dominated occupation.[55] In the United States, men make up only 21% of the laboratory science workforce with women contributing to 79% of the workforce.[13, 56] According to the National Society for Histotechnology (NSH) 2006 employment survey, men accounted for approximately 8% of certified histology technicians and 12% of histology supervisors.[57] Histology, and other laboratory work is often viewed as a service-type position of low prestige.[56] This stereotype undermines the professional image of histology and is likely to discourage many qualified male candidates from considering jobs in this area.[57] However, over the past several years, there has been an increase in the number of men looking for employment in fields traditionally dominated by women.[58]

Histology, like Health Education, is an obscure profession. Histology technicians perform their duties behind the closed doors of the surgery department and the morgue.[59] If 95% of the general public is unaware of this profession, it is of little or no surprise that students are not setting career goals to become histologists. The great majority of high school students are unaware careers in laboratory medicine.[59] This issue of anonymity is not new to the laboratory industry, but attempts to expose the profession and attract people to the career have been unsuccessful.[60] In an effort to increase awareness of clinical laboratory science, ASCP has teamed up with Abbott Laboratories and Channel

One to produce programs for high school students about careers in laboratory medicine.[61] In an effort to heighten awareness to the field NSH professionals have declared March 10, 2010 Histology Day.[62]

Education vs. Vocation

Historically, community colleges and four-year universities had different and distinct missions. Community colleges traditionally have focused on trade skills for blue-collar jobs. Conventional vocational education programs usually offered through community colleges prepare student for specific entry-level jobs, but not for more advanced jobs or lifelong careers.[63] Universities are the institutions of higher learning with fewer apparent direct links to employment.[64] While most science majors have many science course electives, their degrees offer limited real-life science experiences resulting in erroneous perceptions of the science job market.[65] This course of study supports those students applying to graduate school or a medical professional school. The typical college graduate with a degree in science has developed academically, but has gained little knowledge or experience related to an occupational trade in their field.[66] The Bureau of Labor Statistics estimates that one in three college graduates will not find college-level employment.[64] For most occupations, there are a variety of majors considered for employment. Qualifications for occupations for college educated workers often include previous experience, internships, or coursework that shows specific job skills.[64] Colleges are graduating adequate numbers of students with science backgrounds, but many students do not have realistic career goals and few, if any, have any marketable skills.[60] On the other hand, health care providers and professional organizations are reporting difficulty recruiting sufficient numbers of laboratory technicians and technologists.[14]

In the past, the career pathways at community colleges were rigid and limited. Students enrolled in a program like auto mechanics or practical nursing with standard curriculums without any electives.[67] Now, one of every four community college students already has a bachelor's degree or more. In some ways, the community college is "the new" retraining school for second careers.[68]

Post-secondary educational facilities are frontiers for educational reform.[69] Educators are allowed and even encouraged to experiment with learning theories and strategies. Many colleges now embrace contextual and problem-based learning that was unheard of in mainstream education several years ago. Teaching skills in workplace environments and learning within the scope of potential life experiences is reforming education.[70] Focusing on gaining a broad understanding of the workplace and learning skills that are marketable is an effective career development tool.[71] Many colleges are looking to provide more learning resources to meet the educational needs and occupational ambitions of a more job orientated population.[72]

Summary

The shortage of laboratory healthcare professionals in the U.S. is a complex issue. Many factors play a role in defining this dilemma. Previous cut backs in laboratory personnel because of quality control and billing issues have affected the present workforce population. As the aging population increases, demands for healthcare resources will increase adding to staffing shortages in the clinical laboratories. Attrition of laboratory healthcare workers will also increase vacancies as an estimated 13% of clinical laboratory workers retire in the next 5 years. The decline in training programs and competition for higher salaries has had a negative impact on the laboratory workforce. Understaffing in the laboratories increases workloads and stress for

employees making the job less appealing to new hires. Technological advances demand more complex testing and expertise performed by certified technicians. Vacancy rates are high and highly skilled certified technicians will be sought out for these positions. Anonymity has contributed to a crisis in the health care field. Professional organizations are making serious attempts to make laboratory professions more visible. At the same time, many college science students are graduating with little marketable skills and no knowledge of career opportunities in laboratory health sciences.

CHAPTER 3

METHODOLOGY

Introduction

The purpose of the study was to identify factors that contribute to undergraduate college student's aptitude toward pursuing careers in science and to compare responses for those students attending two-year and four-year colleges. The study used both qualitative and descriptive data collected from three sites. Collecting information about the factors that influence career choices in science will assist academic counselors and vocational recruiters in matching qualified candidates with ideal careers. It is hoped that the analysis of these data will lead to a better understanding of students' awareness and perception of laboratory careers in the health field with emphasis on the profession of histotechnology. The findings are important in that they will provide a tool for addressing both the occupational needs of students pursuing science degrees and addressing the staffing shortage in the field of histotechnology.

Research Design

A survey questionnaire was used as the data collection instrument. All participants in a study were asked the exact same questions and provided with the same set of predetermined answers. Structured questioning approach allows for easier data analysis of the responses.[73]Descriptive, behavioral and preferential data were collected from the instrument.[74,75]

Sample

Students were selected as a sample of convenience to complete a voluntary self-administered survey. The subject selection consisted of undergraduate/graduate students

pursuing science degrees at three Midwestern colleges in Southern Illinois. The three survey sites were non-random and were selected by the researcher because they allowed for intact groups of subjects and represented different settings, organization, and missions. Collaboration with the science instructors at the community colleges evolved from contacts with SIUC's Women in Science & Engineering organization. The survey sites were all geographically located in Southern Illinois consisting of two community colleges, John A. Logan College (JALC) and Southeasten Illinois College (SIC) and Southern Illinois University (SIUC), a four-year institution. JALC has an enrollment of 7,300 students, with the average student age of 27. JALC offers 8 allied health degrees, A.A. and averages 19-science transfer students/year to SIUC. SIC has an enrollment of 5,000 with the average student age of 30. They average 4 science transfer students to SIUC/year. SIC offers 9 allied health degrees, A.A. SIUC has an enrollment of 21,000 students. The average student age is 24. SIUC offers 5 allied health degrees requiring a bachelor's degree.

The population is defined as students with life-science majors at the institutions surveyed. At SIUC this included the departments of Biology, Microbiology, Physiology, and Zoology. Total average population/semester is (N=1300). Total sample size for the three surveyed sites, (N=306). The surveyed sample from SIUC represented approximately 23.5% of the SIUC science student population. The external validity in this study is good because the study subgroup, (number of respondents completing the survey), is relatively large compared with the population (college science students at each surveyed site). The study subgroup characteristics, i.e. geographical location, race,

gender, are not representative of the general college population. Data were collected in Spring and Fall semester of 2008 from 15 science classes.

Table 1

Classes surveyed

Survey Site	Classes surveyed
SIUC	Biology 208
	Physiology 310—Principles of Physiology
	Physiology 410—Mammalian Physiology
JALC	Chemistry 141—General Chemistry
	Chemistry 151—Chemical Principles
	Chemistry 152—Chemical Principles/ Qualitative
	Chemistry 201—Organic Chemistry
SIC	Biology 261—Human Anatomy/Physiology I
	Biology 262—Human Anatomy/Physiology II

Instrument Development

The researcher chose to use a self-reported survey consisting of 20 closed ended questions and three demographic questions. Internal validity refers to precision of the questionnaire as a data collection instrument. To assure validity of the instrument prior to submission to SIUC Human Subjects Committee (HSC), the researcher reviewed the literature as well as submitting it for review by an expert panel, Mark Kittleson Ph.D. SIU Department of Health and Recreation and Freida Carson Ph.D. Chairman, National Society of Histotechnology Education Committee. The survey and the approval letters to conduct the research at each institution were submitted to the SIUC Human Subjects Committee for approval.

Instrument Development: Pilot Test

The approved survey (Appendix B) was administered as a pilot test on April 17, 2008, using a sample of eight undergraduate and graduate students in the department of Physiology. A cover letter was attached to the survey, notifying participants that the survey was voluntary, anonymous, and confidential. Instructions were verbally explained before distribution of the survey. The students were allowed 20 minutes to complete the survey. All surveys were completed within 12 minutes. It took an average time of 8 minutes to complete the survey. Completed surveys were gathered for data analysis. Respondents who participated in the pilot test found one question confusing. Based on this information, the researcher omitted this question. Arrangements were made to administer the survey in the same manner at the three designated locations by contacting the instructors of the science classes at SIUC, SIC, and JALC. Written permission was obtained, and submitted to the HSC for approval.

A cover letter was included with the survey to introduce the researcher, state the purpose of the study and state that participation was both voluntary and anonymous. The instrument consisted of 23 closed-ended questions including knowledge, attitude, and behavior questions.[76] Table 2 lists the question categories of the survey. See Appendix B for survey item details.

Table 2

Survey Item Categories by number

	Demographic	Knowledge	Attitude	Behavior
Item #	21,22,23	8,9,10,11	2,3,5,6,7, 12, 13,16, 17,18 19	1,4,14,15 20

The knowledge statements were in multiple choice and true/false format. Four attitude questions consisted of multiple-choice items and one question used a rating scale of 1–3, 1=most important, 2= less important and 3= least important. To assess students' perception, five attitude questions used a 5 -point Likert-type scale ranging from "strongly agree"[1] to "strongly disagree" [5].[77] Behavior questions were set-up as true/false and multiple-choice format. Demographic questions were used to record gender, academic institution (2 or 4 year college), and year in school and completed science courses. These surveys were destroyed upon approval of my thesis committee and completion of the study.

Data Collection and Analysis

The researcher distributed surveys to students during a science lecture or lab class, on a day that would allow for completion of the survey during the scheduled class period. Students were allowed to read the cover letter that included a brief introduction to the research and purpose, and a statement of the anonymous and voluntary nature of their participation and their right to withdraw at any point without any recourse. After completing the survey, students were thanked and asked if they had any questions or concerns about their participation in this research project.

To insure confidentiality, surveys were collected into an envelope by the class instructor and returned to the researcher after class was dismissed. A total of 319 subjects returned completed surveys. The response rate for the study was 98%. The high response rate can be attributed to the questionnaire being distributed by the class instructor with allowance of class time to complete the survey. Participants' responses were checked for missing items. Surveys were separated by institution and numerically coded. A number

was assigned for each response choice for all the closed-ended questions in the survey. A key was created and stored in a spreadsheet that explained the coding system.[78] The data were manually entered into a Microsoft Excel spreadsheet for statistical analysis using Microsoft Excel Data Tool pack.[79]The accuracy of the data were checked by examining every tenth survey with the matching entry on the Excel spreadsheet. Analyses were intended to explore relationships among the constructs measured in the proposed study. Table 3 represents a summary of descriptive statistics used in this study. See Appendix B for description of survey items.

Table 3

Summary of descriptive statistical analysis

Survey Item #	Research index	Statistical analysis
8a-f, 9, 10, 11	Knowledge	Kuder-Richardson, Mean, Standard deviation, Variance, Confidence Intervals
2,3,5,6,7,13, 12,16, 17,18,19	Attitude	Cronbach alpha, Mean, Standard deviation, Variance, Confidence intervals
1,4, 14,15, 20	Behavior	Frequencies, Percentages
21,22,23	Demographic	Frequencies, Percentages

Internal consistency reliability is measure of correlation among test items. It is the preferred standard that the items of an instrument all be related to each other. Internal reliability is measured using Cronbach's coefficient alpha or Kuder-Richardson formula. Table 4 shows the Cronbach's Alpha for the attitude questions that used the Likert-type scale of the survey. Internal liability for the multiple choice or T/F knowledge questions was measured with Kuder-Richardson (KR) formula 20. True/false questions lower the

reliability of the instrument and should have been removed from the study. Kuder-Richardson formula was used for 4 dichotomous (1=correct, 0=incorrect) items (8,9,10,11), equaling 12 measurable components. Cronbach alpha was used for 6 attitude survey items (2,3,5,6,7,13). Acceptable reliability for basic research is 0.60. The scores indicate little cohesiveness among the items therefore low reliability of the instrument. Increasing the number of knowledge items and eliminating T/F questions may have increased the reliability. Also the elimination of questions that are less correlated (outliers) and re-computing alpha would have achieved a more acceptable level of reliability, but the reconfigured reliability index would be biased.[80] It is assumed when testing for internal consistency reliability, the test items are unidimensional. If the instrument covers different content areas the reliability of the instrument will be low. Estimating the reliability of each content area instead of the total instrument could provide a better representation of reliability of the instrument.[75]

Table 4

Instrument reliability

Cronbach alpha [CA]	Attitude Items n=6	0.43
Kuder-Richardson [KR]	Knowledge n= 12	0.38

Nonparametric statistics allow analysis on nominal and ordinal level scales. Chi-square test is commonly used to analyze this type of survey data. Chi-square compares observed frequencies against expected frequencies that occur by chance. The greater the distance between the expected and observed frequencies, the stronger the relationship. Chi-square analysis evaluates the relationship between dependent and independent

variables.[81]The null hypothesis is always that no significant relationship exists between two variables. The level of significance, alpha represents the probability of rejecting the null hypothesis, if it is true. A critical value is selected that is appropriate for the test. Chi-square test analysis is valid for this study because the variables are measured in raw frequencies and the sample size is greater than 50.[82]Type II errors (relationship between two variables falsely appears statistically significant) tend to increase when using Chi-square with smaller sample sizes. Contingency coefficient is used to compensate for the influence of sample size on Chi-square.[81]

Parametric statistics are used to analyze ordinal, interval, and ratio data. Correlation is measured by the Pearson product moment correlation. It is a measure of strength of linear relationship between two sets of data. (r) Is used to represent the value. The strength and direction of the relationship is measured by the (r) value ranging from +1 to -1. If the value of (r) is close to +1 this indicates a strong positive relationship between the variables. If the value of (r) is close to -1 this indicates a negative relationship between the variables. The closer the measured number is to 1 or -1, the stronger the relationship.[75]

Summary

Students were selected as a sample of convenience from 3 colleges in the Midwest. Samples included SIUC, a 4-yr college and JALC and SIC, both 2-year colleges. Students enrolled in science classes were selected to voluntarily participate in the survey. The survey was submitted and approved by SIUC Human Subject committee for approval prior to being administered. The instrument was a self-reporting survey consisting of 23 questions that included demographics, knowledge, attitude and behavior questions. The

questions included multiple choice, T /F, and Liker-type questions. A Pilot test was used to gauge the reliability of the instrument. The instrument was analyzed for reliability using Kuder-Richardson-20 for knowledge item and Combat alpha for attitude and behavior items. Statistical analysis of data were done using Microsoft Excel tool pack for descriptive statistics, percentages, frequencies, Chi-square and Pearson's correlation.[79]

CHAPTER 4

RESULTS

Introduction

The purpose of this study was to contribute a better understanding of factors that influence college science student's attitude toward careers in laboratory science with a focus on histotechnology. The researcher explored the attitudes and perceptions of students regarding careers in laboratory sciences and histotechnology. Data were collected from a sample of convenience from college students pursuing science degrees at three Midwestern colleges. Analysis of respondents' data and relationship to the study's research questions are presented below.

Data Analysis

326 questionnaires were distributed during the 2008 Spring and Fall semester to college science students during a scheduled class time. 319 surveys were collected. 7 students chose not to participate in the study. Participants' responses were checked for missing items. 306 surveys were used during the data analysis. 13 surveys were excluded from the study because of missing data. These surveys were unusable due to participant failure to meet the requirements of completing all of the demographic section of the survey and answering at least 18 out of 20 questions.113 usable surveys were collected from SIUC, 109 from JALC and 84 from SIC. A cover letter consisting of a paragraph at the beginning of the questionnaire was included with each survey. Participants returned surveys to a collection envelope to assure anonymity.

Demographics

Demographic characteristics collected included gender, institution of attendance, year in college and completed science course work. Tables 5, 6 and Figure 1 represent demographic information collected in this study.

Table 5 summarizes gender characteristics of respondent in this study. There were N=196 female respondents making up 64% of the participants in the study and N=110 males representing 36%. Approximately twice as many female respondents as males completed the questionnaire.

Table 5

Demographic characteristics from all schools

Gender	Frequency	Percentage	National %
Women	196	64	57
Men	110	36	43
Total	306	100	100

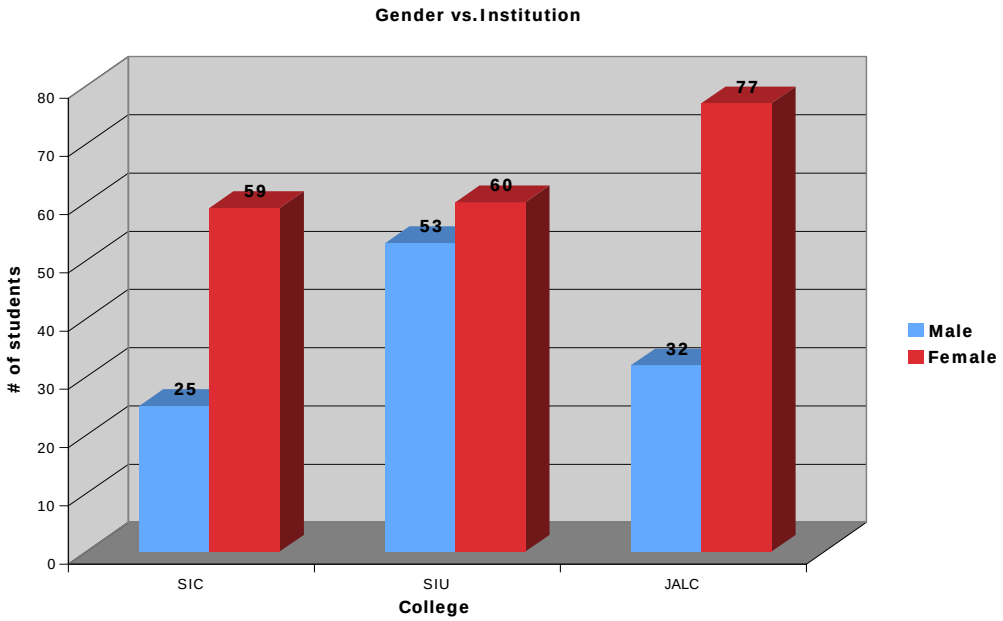


Figure 1. Gender/Institution

Figure 1 illustrates the ratio of males to females at each of the institutions surveyed. Both of the community colleges (SIC, JALC) had almost identical gender demographics. Males comprised a little over 29% at both SIC (n=25) and JALC (n=32). SIC females were roughly at 70% (n=59), while 70% (n=77) of JALC respondents were females. SIU was more evenly balanced with males representing 46% (n=53), and females consisting of 53% (n=60).

Table 6

Demographic Characteristics from Individual Institutions*

	SIUC		JALC		SIC	
Characteristic	n	%	n	%	n	%
Class						
Freshman	3	2	23	21	26	30
Sophomore	8	7	71	65	57	68
Junior	29	26	5	4.6	0	0
Senior	47	42	6	5.5	0	0
Post-Baccalaureate	26	23	4	3.5	1	1

*Percentages not equal to 100 due to rounding

Table 6 illustrates that of the students surveyed; SIUC had a higher percentage of juniors and seniors (upper classmen) making up 68% (n=76) of the sample. As expected, the majority of students surveyed at the community colleges was under classmen (freshmen and sophomores) with JALC reporting 83% (n=94) and SIC 98% (n=83). JALC had 3.5% (n=4) students who earned a bachelor degree participating in the study and SIC college had only 1% (n=1) post-baccalaureate student. SIUC reported a significant number of post-baccalaureate students, 23% (n=26) completing the survey. Upper level science courses (400 level) are used for both undergraduate and graduate course requirements. It is common to have a mixture of undergraduates and graduate students in these courses.

Descriptive statistics of the comparative groups including summed totals, means, percentages, standard deviation, and confidence intervals of 95% were compiled. A

summary of results is recorded in Table 7,8. Both 2-year colleges' group means for the 4 knowledge questions, consisting of 12 measurable items, were comparable with JALC at 7.31 and SIC at 7.31. Both JALC and SIC surveyed students averaged 7 correct answers out of 12. The calculated confidence interval will estimate with a 95% probability, the range of population means for the surveyed sample for the knowledge portion of the questionnaire. The group mean for SIUC was 8.13. This indicates the group averaged one more correct answer than the other two surveyed samples. Little difference occurred between the 95% confidence intervals, upper and lower limits for JALC, [10.35, 4.27] and SIC [10.50,4.43], meaning that there is a 95% probability that the means for the knowledge questions fell within these intervals. The confidence intervals for SIUC group means were higher with an upper limit of 11.06 and lower limit of 5.21.

Table 7

Summary of descriptive statistics for knowledge questions

Survey Item #s 8,9,10,11	Group Mean	STDEV	Variance	95% CI Upper	95% CI Lower
SIUC	8.13	1.98	3.9	11.06	5.21
JALC	7.31	1.71	2.9	10.35	4.27
SIC	7.46	1.79	3.2	10.50	4.43

The confidence interval for the difference between the means for the six attitude questions is illustrated in Table 8. The test means for SIUC and SIC was (22.30, 22.32) and the confidence intervals were [22.5,22.1]. JALC test mean of 21.75 was a little lower than the other surveyed populations and the confidence intervals were also lower [21.9,21.5].

Table 8

Summary of descriptive statistics for attitude questions

Survey Item #s 2,3,5,6,7, 13	Test Mean	STDEV	VAR	CI
SIUC	22.30	1.07	9.8	(0.2)=[22.5, 22.1]
JALC	21.75	2.58	6.7	(0.18)=[21.9, 21.5]
SIC	22.32	2.72	7.4	(0.21)=[22.5, 22.1]

External validity refers to the ability to generalize conclusions from a studied sample. It addresses the question "how representative is the surveyed sample"? External validity compares data derived from one or more subgroups of a population to data collected from an entire population. External validity is considered strong when the findings of the subgroup and population are the same. Increasing sample size and likeness to population increases external validity.[64] The large sample size helped to increase the external validity of this study.

Research Question 1

Does a significant correlation exist between how students perceive their college experience has prepared them for a career in science and how they rate their job opportunities in science after graduation?

The three surveyed samples were comparable in the perception of how well they felt their college experience prepared them for a career in science. The calculated Chi-square test of 1.479 was not significant at $p>0.05$ for differences between the three populations. Many factors play into how students perceive their academic experience will relate to their job finding capability. A student who is exposed to vocational skills and feels an

aptitude for performing these tasks is more likely to be interested in a career in this field.[82] In Table 9, frequencies, percentages, and Pearson correlations (r) for these two variables are shown.

Table 9

College preparation for science job vs. job opportunities in science

	College prepared for science career		Rate job opportunities		
	n	%	n	%	(r)
SIUC	90	80	86	76	0.495
JALC	83	76	72	66	0.191
SIC	74	82	60	71	0.847
	Chi-square test X^2=1479 Not significant		Chi-square test X^2 =12.714 Significant p<0.05		

The majority of respondents from SIUC, 80% (n=90) specified that their college experience prepared them for a career in science and 76% (n=86) rated their job opportunities in science as good to excellent. The correlation coefficient of r=0.495 indicates a moderate positive linear relationship between these two variables. This relationship indicates that as the students' attitude regarding how well their school prepared them for a science career increase, their ratings for job opportunities in science tended to increase also. A similar proportion of respondents at SIC college 82% (n=74) indicated their college experience had prepared them for a career in science and 71% (n=60) reported their job opportunities in science as good to excellent. The correlation coefficient of r=0.847 for SIC indicates a strong positive linear relationship between how the students felt their college prepared them for a science career and how positive they

felt about their job opportunities in science. A slightly lower percentage of respondents, 76% (n=83) at JALC agreed that college prepared them for a career in science with a somewhat lower rating of 66% (n=72) for job opportunities in science after graduation. The correlation coefficient for JALC was only 0.191 indicating little or no linear relationship between these two variables.

The calculated Chi-square test of 12.714, df=2, was statistically significant at $p<0.05$ for difference among the three colleges on how they rate their job opportunities in science after graduation. This means that at the 5% level of significance, a difference exist among the three surveyed samples' ratings on their job opportunities in science after graduation. The contingency coefficient was calculated at 0.011. The closer the contingency coefficient is to 1.0 the stronger the relationship.[81] The contingency coefficient indicates a very weak relationship. No data presented here indicated cause and effect.

Research Question 2

Does a relationship exist between 2-year community colleges students and 4-year college students in their likelihood to consider a career in laboratory health science?

A priori Chi-square test was used to determine the effects of demographic characteristics on this study variable. The null hypothesis was that gender has no relationship between the survey groups and their consideration of a career in laboratory health science. The Chi-square value, X^2 for SIUC and JALC was $X^2 = 2.584$, df (2), $p>2.706$. Since $2.584< 2.706$, I do not reject the null hypothesis. When computing Chi-square for JALC and SIC, $X^2 = 0.498$, df (2), $p>2.706$. Gender was not statistically significant for either of the groups. This means at the 1% level of significance, there is not enough evidence to reject the null hypothesis. Gender was not statistically significant

when comparing consideration of a career in a clinical laboratory and the surveyed samples.

Table 10

Students' consideration of a career in laboratory health science

Institution	Strongly agree /agree		Don't Know		Strongly disagree /disagree	
	n	%	n	%	n	%
SIUC	41	36	23	20	49	43
JALC	27	24	29	36	42	39
SIC	28	33	32	38	24	29
Total	97		96		113	
Chi-Square Gender	SIU/JALC X^2=2.584 JALC/SE X^2=0.498		Not significant p<0.01			

Table 10 indicates the likelihood of respondents considering a career in laboratory health science. SIUC reported only 4.5% (n=5) of respondents strongly agreeing to consider a career in laboratory health science. SIUC did have the highest combined positive responses, strongly agree to agree of thirty-six (n=41) in this study. The highest combined negative responses, disagree to strongly disagree, for considering a career in laboratory health science, was also SIUC at 43% (n=49). 10% (n=11) of SIUC respondents indicated they strongly disagreed with considering a career in laboratory health science. SIC reported a little over 10% (n=9) strongly agreeing and 33% (n=28) combined positive responses and JALC reported 4.5% (n=5) strongly agreeing totaling the lowest combined positive responses of 24% (n=27). Both JALC at 36% (n=39) and SIC at 38% (n=32) had comparable percentages of respondents indicating they did not

know if they would consider a career in a laboratory science. SIUC reported the lowest percentage, 20% (n=23), of the students not knowing if they would consider a career in laboratory health science.

A Chi-square test performed comparing on the three surveyed samples to determine if there was a significant difference among the three surveyed groups in regards to student's attitude toward considering a career in clinical laboratory science? X^2 at the 5% level for 4 df is 9.48 and 13.277 at the 1% level. The calculated X^2 of 13.295 when comparing all three samples is within the critical region. As illustrated in Table 11, for a significance level of 0.01, I reject the null hypothesis and conclude there is enough sample evidence from the three surveyed colleges, to determine that the observed difference is statistically significant. The contingency coefficient measures strength of relationship, with 1.0 being perfect. The calculated contingency coefficient of .011 indicates a very weak relationship. A Post Hoc Chi-square test was performed to discover which pairs of cells were significantly different. When comparing SIUC and JALC, the calculated Chi-square (X^2) is 7.047. The critical X^2 at the 5% level for 2 df is 5.991. Therefore, observed difference between SIUC and JALC is statistically significant. The contingency coefficient remained the same at 0.011. The calculated Chi-square for JALC and SIC is 3.411. Since the critical X^2 at the 5% level for 2 df is 5.991, I fail to reject the null hypothesis and conclude no significant difference occurred between these two groups in their consideration of a career in laboratory health science.

Table 11

Chi-Square test: consider a career in laboratory

Institution	X^2	df	Significant
SIUC vs. JALC vs. SIC	13.295	4	yes
SIUC vs. JALC	7.047	2	yes
JALC vs. SIC	3.411	2	no

Educational institutions that promote allied health careers can influence students' career choice.[78] Table 12 shows frequencies, percentages, and relationships between their institution promoting laboratory science and their consideration of a laboratory science career.

Table 12

College promotes lab careers vs. consideration of laboratory career

	College promotes laboratory science careers		Consider a laboratory science career		(r)
	n	%	n	%	
SIUC	90	78	41	36	0.017
JALC	87	80	27	24	0.096
SIC	53	63	28	33	0.048
Total	n=306				

A high proportion of both SIUC 78% (n=90) and JALC 80% (n=87) respondents indicated that their colleges promote careers in laboratory science. SIC respondents reported the lowest numbers at 63% (n=53). This means that a minimum of 50% of the students surveyed felt their college promotes careers in laboratory science. The

correlation coefficients for SIUC (0.017), JALC (0.096) and SIC (0.048) indicate little or no linear relationship exists between respondents' perception on how their college promotes careers in laboratory science and their consideration of a career in laboratory sciences.

Research question 3

Does a relationship exist between perceived of working conditions in a laboratory and consideration of a career in laboratory health science?

A review of the related literature suggested that assessment of interests can help with career counseling.[70] ASCP's 2005 wage and salary survey cited that 38.8% of recruits viewed the laboratory as having less desirable working conditions compared to other careers.[14] The respondents in this study were asked to select qualities they would expect of a career in laboratory health science. These qualities were used to gauge students' perceptions of laboratory working conditions and were compared to whether or not students would consider a career in a laboratory health science. Of the eight variables, three were positive descriptive answers (challenging, rewarding, highly skilled), and five were negative descriptive answers (mundane, isolated, oppressive, exposure to disease, low prestige).

Table 13 reports data of respondents' perceptions of laboratory working conditions compared with their willingness to consider a career in laboratory science. Respondents from all three surveyed groups selected positive qualities more often than the negative qualities. Ninety-one percent (n=103) of these students attending SIUC felt that a career in laboratory health science would be "rewarding", but only 36% (n=41) of SIUC students surveyed indicated they would consider a career in a laboratory health science.

SIC reported 65% (n=55) of respondents felt a career in laboratory health science would be “rewarding” but only 33% (n=28) of respondents indicated they would consider this career. Twenty-five percent (n=27) of JALC students surveyed would consider a job in laboratory health science, yet 66% (n=72) considered the career to be “rewarding”. SIC students had the lowest percentage, 65% (n=55) of respondents’ rating a laboratory science job as “rewarding” and 33% (n=28) indicating they would consider a career in laboratory science. Both community colleges, JALC and SIC, ranked the qualities of “challenging” and “highly skilled” higher than “rewarding”. Eighty eight percent (n=99) of SIUC students, 96% (n=105) of JALC and 94% (n=79) of SIC considered a career in laboratory health science “challenging”, yet less than 50% of SIUC students and less than 30% of JALC and SIC students would consider a career in this field.

Percentages for the surveyed groups selecting negative qualities of “disease exposure” and “isolation” ranged from 37% (JALC) to 57% (SIC). 31% (n=35) of SIUC students indicated that laboratory work would be “mundane” as compared to 14% (n=15) from JALC and 15% (n=22) from SIC.

Table 13

Laboratory Career vs. Working conditions

	SIUC		JALC		SIC	
	n	%	n	%	n	%
Will consider a career in laboratory science	41	36	27	25	28	33
Rewarding	103	91	72	66	55	65
Challenging	99	88	105	96	79	94
Highly Skilled	89	79	95	87	67	80
Disease exposure	58	51	54	49	48	57
Isolated	58	51	40	37	40	48
Mundane	35	31	15	14	13	15
Low prestige	22	19	9	8	4	5
Oppressive	12	11	7	6	9	11

Nineteen percent (n=22) of SIUC students equated the quality of “low prestige” to working in a laboratory as compared to JALC’s 8.0% (n=9) and SIC’s 5.0% (n=4). Few respondents selected “oppressive” as a value they would equate to working in a clinical laboratory. Only 11% (n=12) of SIUC students, 6.0% (n=7) JALC and 11% (n=9) of SIC respondents felt that a career in laboratory science would be “oppressive”.

A Pearson’s correlation matrix was calculated to show the relationship between perceived working conditions of this type of profession and respondents’ likelihood of considering a career in laboratory health science.

Table 14

Correlation: working conditions vs. career choice in lab

Will consider a career in laboratory health science	SIUC (r)	JALC (r)	SIC (r)	Average Response %
Challenging	0.116	0.006	0.063	92.6
Highly skilled	0.078	0.141	0.009	82.0
Rewarding	0.069	0.161	0.095	74.0
Disease exposure	-0.001	-0.063	-0.174	52.0
Isolated	-0.075	-0.008	-0.083	45.3
Mundane	-0.107	-0.058	-0.166	20.0
Low prestige	0.047	-0.030	0.017	10.6
Oppressive	-0.021	0.134	0.048	9.5

Table 14 represents the correlation matrix between these two variables. As shown, no significant linear relationships between respondents who perceived working conditions in the laboratory and their degree of consideration of a career in laboratory health science. Although not statistically significant, it is interesting that all three surveyed samples had positive values (0.009 to 0.161) associated with positive qualities of “rewarding”, “skilled”, and “challenging” and negative values (-0.001 to -0.166) associated with the negative qualities of “mundane”, “disease exposure”, and “isolated”. Both “low prestige” and “oppressive” qualities reported both correlation values that did not adhere to the pattern of the other responses. Response percentages for the negative qualities of “low prestige”, 10.6% and “oppressive”, 9.5% were significantly lower than the

response rate of the other qualities. Low response rate suggests these qualities are unreliable as measures of perceived clinical laboratory working conditions.

Table 15

Consider careers involved with patient care

Survey Question	SIU		JALC		SIC	
	n	%	n	%	n	%
Desire career in patient care	100	87	78	72	74	88
Consider career as Dr./Nurse	80	71	56	51	48	57
Consider Laboratory career	41	36	27	24	28	33

As seen in Table 15, the majority of respondents at all three colleges, 87% of SIUC, 72% of JALC, and 88% of SIC expressed a desire to be involved in patient care. 71% of SIUC respondents indicated they were pursuing careers as doctors or nurses as compared to JALC's 51% and SIC's 58%. The correlation coefficients, SIUC (r=0.067), JALC (r=0.088), SIC (r=-0.011) indicate little or no linear relationship existed between the respondents' desire to be involved in patient care and the likelihood of considering a career in laboratory health science.

Research Question 4

What proportion of 2-year college science students compared to 4-year college science students meet the minimum educational requirements for certification as histology technicians and technologists?

The American Society for Clinical Pathology sets educational guidelines of eligibility for certification for histology technicians (HT) and technologists (HTL).[1] To be eligible of certification as a histology technician, the applicant must have an associate's degree

from a regionally accredited college/university with a combination of 12 semester hours (18 quarter hours) of biology and chemistry. A bachelor's degree is required for the histology technologist certification, with a combination of 30 semesters of biology and chemistry (45 quarter hours).

Table 16

Educational Eligibility

ASCP class requirements	SIU		JALC		SIC	
	n	%	n	%	n	%
Eligible HT *	108	96	68	62	42	50
Eligible HTL **	80	71				

*HT=Histology Technician
**HTL=Histology Technologist

Table 16 represents the surveyed samples educational eligibility for ASCP certification in histology. JALC had 62% (n=68) of the surveyed students meeting the minimum educational requirements for the HT certification. Seven percent of JALC group failed to qualify due to insufficient math courses. Compared to JALC, SIC at 50% (n=42) had a lower percentage of surveyed students meeting the minimum requirements. 25% (n=21) of SIC students did not meet the math course requirements to be eligible for ASCP's HT exam. Of the SIUC surveyed students, 96% (n=108) met educational requirements for the HT exam and 71% (n=80) met the requirements for the HTL exam. Only 3.0% (n=3) of SIUC students surveyed did not meet the minimum math requirements to be eligible for the HT exam.

Research Question 5

To what extent are students' considerations of a career in histology related to their awareness of the profession?

The questionnaire gave participants a chance to report that they had no knowledge of histology as a career as the rationale for not considering this profession. Table 17 illustrates that between 41 and 45% of the surveyed samples in this study were unfamiliar with histology as a career. Forty nine percent of SIUC students surveyed indicated they had no interest in histology as a career. JALC reported a slightly higher percentage, with 53% indicating they had no interest in a histology career. SIC showed the largest percentage of 59% of those surveyed as not being interested in a career in histology.

Table 17

Unfamiliar with histology career vs. no interest in histology career

	Unfamiliar with histology as career		No interest in histology career		(r)
Institution	n	%	n	%	
SIUC	49	43	56	49	-0.582
JALC	49	45	58	53	-0.538
SIC	43	41	50	59	-0.604

Results of Pearson correlation matrix, as shown in Table 17, compared these two variables. The correlation coefficients for SIUC (r=-0.582) and JALC (r=-0.538) indicated moderately negative linear relationships while SIC (r=-0.604) showed a moderately high negative linear relationship. This correlation suggested that as the frequency of individuals who are unfamiliar with histology as a career increase, the frequency of individuals with no interest in histology would decrease.

Respondents were instructed to select from a list of professions those jobs that had an impact on patient care. Surprisingly, the majority of respondents acknowledged that histology impacted patient care as summarized in Table 18.

Seventy-three percent (n=82) of SIUC students surveyed acknowledged that histology had an impact on patient care and 72% (n=81) indicated they were familiar with the duties of a histologist working in a clinical field.

Table 18

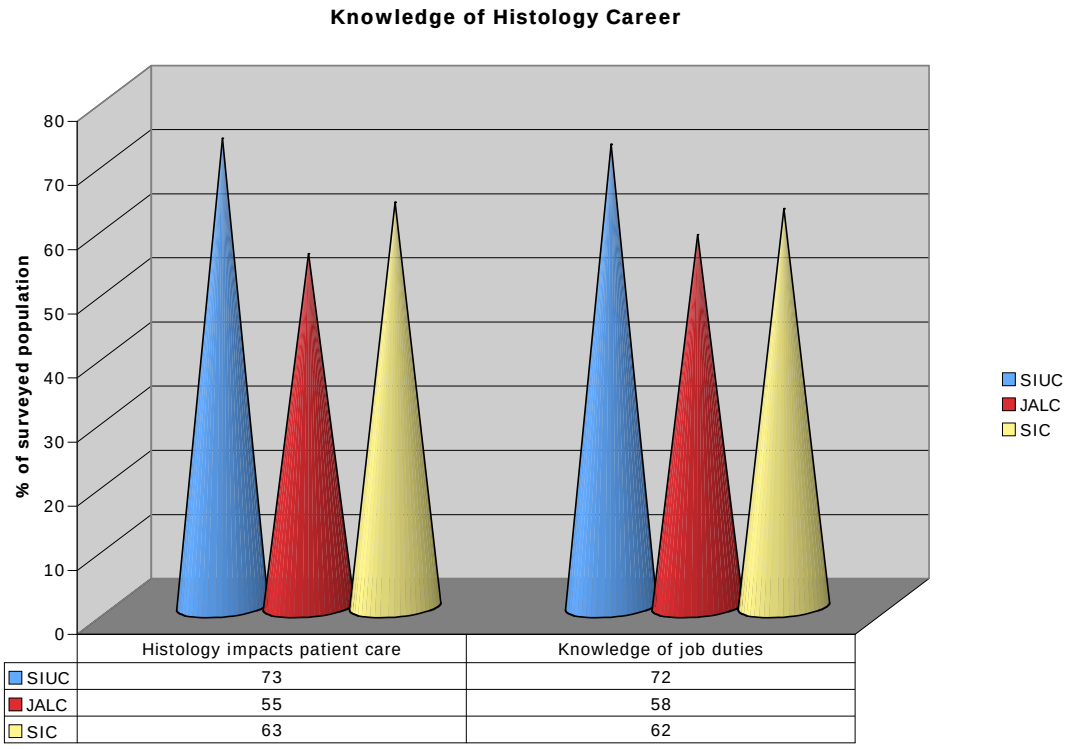
Histology: Knowledge of Clinical impact/duties

	Knowledge of histology impact on patient care		Knowledge of histology duties		Correlation
	n	%	n	%	(r)
SIUC	82	73	81	72	0.317
JALC	60	55	63	58	0.348
SIC	53	63	52	62	0.466

SIUC's correlation coefficient of (r=0.317) indicates a slight positive linear relationship between these two variables. JALC showed similar results with 55% (n=60) acknowledging the impact of histology on patient care and 63% (n=58) being familiar with a histologist's job duties. JALC correlation coefficient of (r=0.348) like SIUC represents only a slight positive linear relationship. Sixty-three percent(n=53) of SIC college students knew the impact of histology on patient care and 62% (n=52) were knowledgeable of the duties of a histologist. The correlation coefficient for SIC, (r=0.466) indicates a moderate positive linear relationship between these two variables. This positive correlation means that as the frequency of knowing that histologists impact patient care increases, the frequency of respondents knowing the duties of a histologist also increases. Both variables increase in the same direction.

Nonreactive measures are passive measures of behavior that do not change whatever is being measured.[64] Measures are vulnerable to sampling biases. One method to decrease uncertainty in interpretation is to use multiple outcomes for a given concept. This measurement strategy is referred to as triangulation. It uses more than one measure to evaluate an event.

Figure 2 represents responses of students surveyed in regards to knowledge of histology as a career. Frequencies on the left represent the percentage of respondents who correctly answering that histology has an impact on patient care. The frequencies on the right represent the percentage of respondents who correctly identified duties of a clinical histologist. Figure 2 shows the similarity of the three surveyed samples in their responses to these two survey questions dealing with the same concept.



	Histology impacts patient care	Knowledge of job duties
SIUC	73	72
JALC	55	58
SIC	63	62

Figure 2. Knowledge of Histology Career

Research Question 6

What relationship exists between students' anticipated post-graduation salary and the average starting salaries for new hires in science and entry-level salaries for histologists?

For purposes of job outlook analysis and wage comparison, laboratory occupations are usually grouped with other healthcare professions such as nurses, occupational and physical therapists, and physician assistants. The median annual reported salary for medical and clinical laboratory technicians with an associate degree in science is $30,840.13[14]

Table 19

Anticipated Salary: A.A.Degree

A.A.Degree	SIU		JALC		SIC	
Anticipated Salary	n	%	n	%	n	%
10–15,000	17	15	14	13	8	10
16–20,000	34	30	28	26	13	16
21–30,000	38	33	37	34	25	30
31–40,000	17	15	16	15	26	31
41–50,000	8	7	14	13	12	14
HT Average Salary			$36,000			

As listed in Table 19, 33% (n=38) of SIUC, 34% (n=37) of JALC and 30% (n=25) of SIC surveyed students chose 21-30,000 as the anticipated salary range for an associate degree in science. Forty-five percent of SIUC surveyed students' anticipated annual earnings, $10–20,000, which is below the reported average salary for an associate degree in science. 21% anticipated higher salaries, ranging from $31–50,000, for graduates in

science with an associate's degree. Thirty-eight percent of JALC surveyed students anticipated salaries below $30,000 while 28% anticipated salaries above $30,000. Twenty-five percent of SIC surveyed sample anticipate salaries below the reported annual salary and 45% indicated they anticipated earning salaries above $30,000. Histology technicians with an associate's degree in science can expect to earn an average salary of $36,000. The median annual reported salary for medical and clinical laboratory technicians with a Bachelor's degree in science is $45,730.[14]

Table 20

Anticipated Salary: Bachelor Degree

B.A.Degree	SIU		JALC		SIC	
Anticipated Salary	n	%	n	%	n	%
15–20,000	2	2	2	2	1	1
21–30,000	13	11	14	13	5	5
31–40,000	33	29	29	27	15	18
41–50,000	35	31	23	21	26	31
51–60,000	31	27	41	38	37	44
HTL Average Salary			50,000			

As listed in Table 20, 31% (n=35) of SIUC, 21% (n=23) of JALC and 31% (n=26) of SIC surveyed students chose 41–50,000 as the anticipated salary range for a bachelor's degree in science. Forty-two percent of SIUC surveyed student's anticipated annual earnings, $15–40,000, which is below the reported average salary for a bachelor's degree in science. Twenty-seven percent anticipated higher salaries ranging from $51–60,000 for graduates in science with a bachelor's degree. Forty-five percent of JALC surveyed

students anticipated salaries below $41,000 and 38% anticipated salaries above $51,000. Twenty-five percent of SIC surveyed samples anticipate salaries below the reported annual salary and 44% indicated they anticipated earning salaries above $51,000. According to a senior accountant executive at On Assignment, a division of Lab Support, job seekers with a B.A. degree in science can expect salaries in the Midwest to vary depending on their specialty. Environmental companies consider a broad range of science type backgrounds, but they pay on the lower end of the pay scales, $12–15/hour (23,040–28,880). Applicants with degrees in chemistry, molecular biology, and microbiology are more marketable and can expect to make $15–20/hr (28,880–38,400). Biology degrees are the least marketable in industry. These applicants may have better opportunities in clinical labs. Histology technologists with a bachelor's degree in science can expect to earn an average salary of $50,000. Salaries for certified histology technicians and medical laboratory technicians are approximately ten percent higher than for non-certified laboratory workers.[83]

Requirements for entry-level positions as a clinical laboratory technician or technologist include associate or bachelor's degree and some degree of training or skills in that field. Certification or eligibility for certification from an accrediting agency often is required.[1] Some employers will allow a combination of education and on-the-job training, but typically these positions will start at a lower than average salary. Salary is an important aspect of every job, but it is not the only factor an applicant considers when seeking employment. The surveyed students were asked to rate several factors, including salary, when considering a job. The ratings scale was: 1="most important", 2="less important", 3="least important". Fifty-four percent of SIC students, 44% of JALC

students and 39% of SIUC students surveyed ranked salary as the most important factor when considering a job. Eighty percent of JALC, 78% of SIUC, and 61% of SIC students rated job satisfaction as the most important factor when considering a job. Job satisfaction received the most 1="most important" ratings from all three schools therefore ranking it number 1 out of the 6 variables. Table 20 shows a ranking system of numbers from 1 through 6. Number 1 indicates the job factor that received the most 1="most important" ratings, number 2 the second highest and number 6 indicating the factor that received the least amount of number 1="most important" ratings. An overall rank for each job factor was obtained by calculating the means from the school rankings.

Table 21

Factors when considering a job

	SIU	JALC	SIC	
	Rankings by school			Mean
Salary	3	5	2	3.3
Benefits	4	3	3	3.3
Working Conditions	2	2	4	2.6
Location	6	6	5	5.6
Job Satisfaction	1	1	1	1.0
Opportunity for Advancement	5	4	6	5.0

1=highest percentage of students rating the factor "most important"

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

Nature of the Problem

Shortages of clinical laboratory workers are making it increasingly difficult for the healthcare system in the US to meet the demands of its aging population. It is a challenge for healthcare providers to recruit qualified applicants for laboratory positions due to the reduction in certified training programs. Histology is experiencing some of the highest job vacancy rates, leaving histopathology laboratories understaffed and the quality of patient care less than optimum.

Purpose of the Study

The purpose of the study was to provide a better understanding of the attitudes and perceptions of college students towards careers in the clinical laboratory, with a particular focus on histotechnology. More specifically, the study attempted to gather information that may be useful for academic science advisors and educators seeking to meet the vocational needs of college students pursuing degrees in science. The following research questions guided the study:

1. Does a significant correlation exit between how students perceive their college experience has prepared them for a career in science and how they rate their job opportunities after graduation?
2. Does a relationship exist between 2-year community colleges students and 4-year college students in their likelihood to consider a career in laboratory health science?
3. Does a relationship exist between perceived working conditions in a laboratory and consideration of a career in laboratory health science?

4. What proportion of 2-year college science students compared to 4-year college science students has the minimum educational requirements for certification as histology technicians and technologists?
5. To what extent are students' considerations of a career in histology related to their awareness of the profession?
6. What relationship exists between students' anticipated post-graduation salary, and the average starting salaries for new hires in science and entry-level salaries histologists?

Conclusion and Discussion

1. The majority of college students felt their college course work prepared them well for a career in science.

SIUC and SIC reported about the same percentage of individuals indicating college prepared them for a career in science. About the same proportion at each school rated their job opportunities in science after graduation as good. It is interesting that SIC had almost double the correlation value between the variables of college preparation for a career in science and rating of job opportunities in science. This suggests that SIC are felt very confident of their career prospects after graduation. SIC is a 2-year community college. These students completed fewer science classes than SIUC students yet a higher percentage of SIC students related their science curriculum with having good job opportunities for a career in science. It is possible that SIUC students have higher expectations in regards to the type of science jobs they would consider, as indicated by their desire to become physicians or nurses. On the other hand, SIC students may be more flexible in the type of science job they would consider. Therefore they feel they have more opportunities for employment. SIC offers more vocational career track

programming, such as Certified Nursing Assistant (CNA), so these students have more specific career goals than SIUC students. JALC, like SIC, is also a community college with a more vocational focus than SIUC. These students did not indicate there was any correlation between their college education preparing them for a science career and their job opportunities in science. Because JALC and SIC have similar programs, I expected little variation in their perceptions on how their college courses prepared them for a career in science. Differences in the sample dynamics between JALC and SIC could be a possible explanation for these results. Many people who have recently lost jobs due to plant closings have enrolled in JALC re-training/ educational programs. Many of these students may rate their job opportunities low because of their past experiences. Also, JALC is in close proximity of SIUC and has more transfer students to SIUC than SIC. JALC students may view their college course work as a stepping-stone to more education whereas SIC students see their college experience as creating job opportunities.

2. Students do not equate careers in laboratory health care as having an impact on patient care.

An overwhelmingly high percentage of the students surveyed indicated a desire to be involved in patient care. More than half of the respondents indicated they would consider a career in laboratory health science. Most of the students surveyed will not pursue jobs in laboratory health science. According to the agencies monitoring labor statistics, BLS and ASCP, the vacancy rates are high and will continue to increase in the future. Using the Chi-square test at the 5% level, it was determined that there was a significant difference between the surveyed populations of SIUC and JALC regarding their consideration of a career in laboratory health science but there was no significant

difference between JALC and SIC. I suspect this difference is related to SIUC having a 4-year program and JALC and SIC being community colleges that focus on 2-year programs. This study attempted to explore some possible explanations for the discrepancy between having the qualifications for a laboratory profession and choosing not to pursue employment in the clinical laboratory. A potential explanation for the lack of interest in careers in the clinical laboratory could be that a large majority of SIUC respondents and over half of both JALC and SIC students surveyed indicated they were considering careers in medicine as physicians or nurses. The mind set that these occupations are the ultimate and/or only careers that affect patient care may contribute to the small proportion of qualified candidates seeking career in laboratory health sciences.[84]

3. Perception of laboratory working conditions does not have an impact on career choice.

Students perceived laboratory-working conditions had no correlation with their consideration for a career in laboratory health science. Previous research suggested that perceived working conditions of certain occupations could affect an applicant's willingness to consider employment.[71] The respondents in this study rated working conditions as the second most important factor when considering a job. For this study, it was assumed that negative qualities regarding working conditions in a laboratory would result in negative correlations regarding a respondent's attitude toward a career in a clinical laboratory. On the other hand, it was predicted that respondents who attributed positive qualities to working conditions in a clinical laboratory would be more likely to consider a career in this field. This study failed to find any significant correlation

between the participants' perceived working conditions in the laboratory and their consideration of a career in the clinical laboratory. Although not significant, there was an observable pattern of in regards to working conditions. The working conditions that were positive had positive correlation values. The negative working conditions had negative correlation values. Items with less than a 10% response rate did not have an observable pattern.

4. Students have the educational requirements for certification as histologists.

Most of the students surveyed at SIUC met the minimal education requirements for certification as histological technologists by the accreditation agency (ASCP). These students were unaware that upon completion of their science degree they met educational qualifications for this technical job. Of course, the vocational skill requirement, 1 year training in a histopathology laboratory, is an important, but missing factor, for these students. The demand for histologists in the U.S. outweighs the supply. There are 30 accredited associate degree programs for histology technicians (HT) in the country. Hospitals aggressively compete for these graduates. There are only three accredited bachelor degree programs for histological technologist, (HTL). One of the 3 HTL programs is hospital-based and only accepts 2 students every 12 months.[85] With so few technicians available, hospitals will seek out university students with science backgrounds, hoping for some exposure to histological techniques or, better yet, a formal course in histology. Hospitals will invest time and energy into on-the-job training for prospective employees who have the required educational background, predicting they can technically train the individual in the skills necessary for the job. It is a much bigger gamble, to expect a technically skilled laboratory employee to successfully complete a

college degree while continuing employment in the healthcare setting. I expected a greater percentage of community college students to meet the minimum educational requirements for the HT certification, than what this study indicated. However, the strong commitment of SIC and JALC to vocational studies and the success of their existing programs, suggests that additional laboratory health science programs such as histology technician would be successful.

5. College science students are unfamiliar with histology as a career.

College students inevitably will examine microscope slides as part of their course work in science. Logically, the respondents who were knowledgeable of the duties performed by histologists were aware of the impact these duties had on patient care. The data in table 12 supports the correlation between these two variables. At the same time, many students pursuing science degrees will never experience the scientific techniques required to produce the slides they use in class or realize the impact this type of information has on patient care. Lack of interest in histology as a career is linked to being unfamiliar with the career. Simply stated, “How can you be interested in something you know nothing about”. Certainly, the low visibility of the histology professionals has contributed to the public’s ignorance of the profession, but it is surprising that science students at the college level are unaware of the field of histotechnology. It stands to reason that students with a strong interest in being involved with patient care may consider a career in histotechnology, if they were exposed to the technical skills required of this profession.

6. Students expect salaries to reflect their level of education.

The majority of the surveyed sample anticipated yearly earnings much higher than the average median salaries of new hires with science degrees, assuming they have no marketable skills. However, the average median salary for both a histology technician and histology technologist meet or exceed the anticipated salary of the surveyed students. Certified laboratory worker's salaries average $9,000/year more than non-certified workers. According to the results of this survey, salary was not the most important factor when considering employment to these respondents. Students from all 3 colleges ranked job satisfaction as the most important factor when considering a career. Working conditions was ranked the second most important factor when considering a job. The majority of the surveyed sample perceived laboratory work as rewarding and challenging.

Recommendations

1. A task force could be useful to define and evaluate the role of academic science programs in matching the career needs of graduates. It will be essential to identify key individuals who could work closely with students and academic administration.
2. Science guidance/career advisors need to promote laboratory science professions. Informational seminars could be used to educate advisors of these career options for science majors.
3. Laboratory health sciences could be promoted through promotional literature and/or guest speaker at college programs targeting freshmen and transfer students. For example, SIUC's SOAR and University 101programs would be appropriate and effective places to present this type of information.

4. College career counselors could network with the professional laboratory science organizations to identify existing resources such as internships, incentives and scholarships available to students interested in clinical laboratory careers.
5. Science departments and/advisement should develop working relationships with laboratory recruiters. The recruiters provide listings of job openings, interview contacts for potential qualified candidates and monetary incentives for referrals.
6. Expand science programming to include technical skills that are marketable in research, industry, and the clinical laboratory.
7. The development and/or expansion of existing science certificate programs. Graduate students would be recognized for a focused area of study of a laboratory science. This would include specific coursework and laboratory experience to develop marketable skills.
8. Informational interviews could be used as another means of helping potential job candidates not only learn about new careers but also gain confidence in the job application procedure.[86] On-site tours can be extremely valuable to future job applicants. This approach also gives students time to learn about different aspects of jobs and allows time for the student to change course.
9. Invite guest speakers from laboratory sciences for seminars. Promote science seminars with informal question and answer format with various science professionals presenting information about their duties in their scientific career.

10. Developing summer science career programs for high school students will increase interest in science careers and interest in SIUC as an option for post-secondary education.[87] The Women in Science & Engineering group has developed very successful one-day science programs, targeting 9^{th}–12^{th} grade. Expanding this program in the summer to a "Science Camp" could function to increase awareness of science careers and promote enrollment in the university science programs.
11. Develop a science survey course that gives an overview of scientific skills used in the marketplace. Ex.(HPLC, RIA, ELISA, Electrophoresis, PCR)
12. Develop a career web site for youth. This web site could provide information on laboratory health occupations and educational opportunities. A description of each occupation could be posted along with quotes from laboratory professionals about their career. Career information would be available that lists schools that offer programs and financial aid. The site could include interactive elements such as games, puzzles and to career videos as podcasts.
13. Work with informational resource groups in regards to setting up histology career pop-ups on college websites.
14. Annual open house of laboratory during Medical Lab Week. Emphasizing the ties of laboratory sciences to medical research and forensics may increase interest and be used as a marketing tool.

Suggestions for Future Research

1. Survey larger more diverse population. This study should be revised and replicated to include other community colleges, universities and high schools in different geographic locations and socioeconomic settings, to present stronger analyses. The intent should be to expose distinguishing factors related to college science students' attitudes towards careers in laboratory medicine. This survey failed to identify factors that impact student's choice of careers. As an example, in this study the respondents indicated that benefits were important when considering a career. However it is not clear what the respondent's interpreted benefits to be. (bonuses, health plan, vacation time…)
2. In order to improve reliability of the instrument, the researcher could increase the number of knowledge questions in the survey and select survey items that are more unidimentional.
3. This survey may be modified to include additional information about effective career counseling techniques in order to gather more information to address the laboratory workforce shortage.
4. Surveying educational counselors and advisors to assess their knowledge, attitudes and perception of laboratory health sciences.
5. Further research is needed to gather data about current job trends in science including the clinical laboratory professions.

Summary

In summary, this study indicates the majority of science students surveyed at both community colleges and 4-year university wanted to be involved in patient care. Most

respondents chose physician or nursing as their career of choice. Realistically, only a small fraction of these students will be accepted to a medical or nursing program. SIUC offers few career options to science students not pursuing post-graduate work or professional schools. It stands to reason that academia has strong support networks for students who plan to continue post-graduate studies either in research or professional schools. Professors are competent in these areas because they themselves have taken this same career path. Providing mentoring and guidance to students in areas outside this familiar educational comfort zone will be more challenging. Offering science courses with an occupational focus does not dilute the science but rather enhances the material through practical application. This is an optimum time to promote careers in laboratory health science such as histology. We should encourage and support college graduates with associates and bachelors degrees in science to consider a career in the laboratory health fields. SIUC has a large percentage of science majors who will not become doctors or nurses but desire to be involved with patient care. Their perception of laboratory working conditions is positive and they meet the minimum educational requirements for a career in histology. The salaries of histologists and other lab professionals are at or above levels anticipated by the students. I have concluded that a potential pool for candidates exists at SIUC for careers in laboratory health fields such as histology. SIUC should support the development of a curriculum for undergraduate science students for training and certification as histology technologists. This is an opportunity to address the needs of the students and provide service to the community.

Partnerships between colleges and the laboratory profession groups could benefit both groups by providing a potential pool of educationally qualified candidates to fields in

need of applicants at the same time, providing career opportunities to science graduates. This will heighten awareness of career opportunity in laboratory sciences and enhance academic and career planning.

The challenge is to define educational and career pathways for science students that provide them with an opportunity to develop a strong educational foundation along with vocational skills. When students feel they are prepared for a career, it gives them confidence, and enables them to truly evaluate career options. Their college experience should support their decision-making in regards of a career.[70]

The ability to do something well is gained through experience. The college experience should prepare science students for both post-baccalaureate schooling and the workforce. Incorporating technical skills into science curriculum not only enhances the student's laboratory experience but also reveals aptitude toward a trade or profession.[72] By providing students with a good solid foundation in science education, and science skills we can accomplished a major goal of giving the student the opportunity to apply the knowledge in a real life situation.

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APPENDICES

APPENDIX A

Survey Item and Statistical Analysis by Research Question

Research Question	Items #	Research index	Statistical Analysis
My college experience has prepared me for a career in science & After graduation, I rate my job opportunities in science as:	2, 6	Attitude Attitude	Pearson Correlation
Having the minimum educational requirements for ASCP certification Check the courses you have taken in college.	21	Demographic	Freq, percentage
I may consider a career in a laboratory health science	5	Attitude	Pearson Correlation Chi-square
Describe laboratory working conditions & I may consider a career in a laboratory health science	12, 5	Attitude	Mean, Pearson correlation
Desire to be involved in patient care	13	Behavior	Percentages
What is the your anticipated post-graduation salary	18,19,16		Percentages
Factors effecting career choice			Rank

APPENDIX B

I, Maureen Doran, am currently enrolled at SIUC pursuing a Masters in the departments of Biology and Health Education. As partial fulfillment of my thesis, I have developed a survey addressing the knowledge, attitudes and behaviors toward careers in laboratory sciences. I am asking that you help me with this project by completing this survey. It is entirely voluntary, and in no way will have any effect your grade in this class. It will take about 10 minutes to complete the survey. This survey is anonymous so I am asking that you do not put your name, or any other identifying marks, anywhere on this survey. If you should have any questions, please feel free to contact me 618-453-1584 or my advisor, Dr. Kittleson at 618-453-2777.

Please circle your answers to the questions or check boxes.

1. I have taken a vocational aptitude test.
   A. Yes B. No

2. My college experience has prepared me for a career in science:
   A. Strongly Agree B. Agree C. Don't Know D. Disagree E. Strongly Disagree

3. My college promotes careers in laboratory science.
   A. Strongly Agree B. Agree C. Don't Know D. Disagree E. Strongly Disagree

4. I am considering a career as a physician or nurse.
   A. Yes B. No

5. I may consider a career in a laboratory health science.
   A. Strongly Agree B. Agree C. Don't Know D. Disagree E. Strongly Disagree

6. After graduation, I rate my job opportunities in science as:
   A. Excellent B. Good C. Average D. below average E. Poor

7. There are adequate training opportunities for laboratory science jobs in Southern Illinois.
   A. Strongly Agree B. Agree C. Don't Know D. Disagree E. Strongly Disagree

8. Select the following jobs that impact patient care? (Circle all that apply)
   A. Medical Technician B. Stenographer
   C. Histologist D. Serologist
   E. Herpetologist F. Microbiologist

9. With an associates degree in science I am qualified to: (circle all that apply)
   A. Apply for a registered nurse job at a small hospital
   B. Apply for a trainee position in a hospital laboratory
   C. I am not qualified for any position in a hospital
   D. Apply for a histology technician job

10. In a hospital, whose job is it to prepare microscope slides from patient's tissue samples for identification of cancers and other abnormalities in tissues.

A. Hematologist
B. Oncologist
C. Histologist
D. Radiologist

11. There more jobs than applicants in the field of histology.

A. True B. False

12. Indicate the qualities you would expect of a career in laboratory science:

A. Challenging [ ] B. Mundane [ ]
C. Isolated [ ] D. Rewarding [ ]
E. Oppressive [ ] F. Exposure to disease [ ]
G. Low prestige [ ] H. Highly skilled [ ]

13. I would describe my desire to be involved in patient care as:

A. Very strong B. Strong C .Don't know D.Weak E. No desire

14. I rely on this venue for locating job opportunities: (circle one)

A. Newspaper B. Radio
C. TV D. Job fairs
E. Internet F. Professional magazines/journals
G. Word of mouth

15. I have been encouraged to pursue a career in science by: (circle all that apply)

A. Teacher C. Family member
B. Friend D. Health care professional
E. I have not been encouraged

16. Rate these factors when considering a job: 1=most important, 2 =less important, 3= least important

A. Salary [ ]
B. Benefits [ ]
C. Working conditions [ ]
D. Location of employment [ ]
E. Job satisfaction [ ]
F. Opportunity for advancement [ ]

17. I am <u>not</u> considering a career in histology because: (circle all that apply)

A.I have no interest in this career
B. There are few jobs in southern Illinois
C. The job does not pay enough
D. I am not qualified
E. I am not familiar with this career
F. I am considering a career in histology

18. With an associate degree in science I expect this annual salary: (circle one)
    A. 10,000-15,000
    B. 16,000-20,000
    C. 21,000-30,000
    D. 31,000-40,000
    E. 41,000-50,000

19. With a bachelors degree in science I expect this annual salary: (circle one)
    A. 15,000-20,000
    B. 21,000-30,000
    C. 31,000-40,000
    D. 41,000-50,000
    E. 51,000-60,000

20. Indicate locations where you would consider employment? (circle all that applies)
    A. Southern Illinois
    B. Cape Girardeau
    C. St. Louis
    D. Central Illinois (Springfield)
    E. Northern Illinois (Chicago
    F. Anywhere in US

21. Check the courses you have taken in college. (check all that applies)
    A. Biology: 1 semester [ ] 2 semesters [ ] 3 or more semesters [ ]

    B. Chemistry: Inorganic [ ] Organic [ ] Biochemisrty [ ]

    C. Physiology: 1 semester [ ] 2 semesters [ ] 3 or more semesters [ ]

    D. Anatomy: 1 semester [ ] 2 semesters[ ] 3 or more semesters [ ]

    E. Microbiology: 1 semester [ ] 2 semesters[ ] 3 or more semesters [ ]

    F. Zoology: 1 semester [ ] 2 semesters[ ] 3 or more semesters [ ]

    G. Math: Algebra [ ] Algebra & Trig [ ] Calculus [ ] Statistics [ ]

22. Circle all that applies:
    A. I attend a 2 yr college [ ] Freshman[ ] Sophmore[ ]
    B. I attend a 4 yr college [ ] Freshman[ ] Sophmore[ ]
    Junior [ ] Senior [ ]
    C. Graduate student[ ]

23. My gender is; A. Male [ ]B Female [ ]

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