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A Study of Professional and Educational
Requirements for Medical Technologists in
the Changing and Evolving Art of Clinical
Laboratory Medicine

presented by

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ABSTRACT

A STUDY OF PROFESSIONAL AND EDUCATIONAL REQUIREMENTS FOR MEDICAL TECHNOLOGISTS IN THE CHANGING AND EVOLVING ART OF CLINICAL LABORATORY MEDICINE

By

Gladys M. Thomas

This study investigates the present and future needs for medical technology education. An expansion of new and better equipment and techniques in medical services has required new skills, functions and adjustment of work roles of medical personnel. The questionnaire was developed to elicit current thinking about the curriculum, and to determine skills and requirements for future medical laboratory methodology.

Population and Sample

The sampling population was drawn from five North Central States: namely, Indiana, Illinois, Michigan, Ohio and Wisconsin. There are a total of 190 AMA approved hospital Schools of Medical Technology in these states. The list of AMA approved schools was obtained from the Board of Schools, American Society of Clinical Pathologist (ASCP). A random selection of 35 schools for the study was made from the total number, utilizing standard random tables. The hospital-based programs are chosen to determine if educators, prospective employers and students

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of medical technology have found academic experiences an adequate preparation for entry into the profession.

The sample is composed of education coordinators, supervisors (department heads or section chiefs) of clinical laboratory divisions, and two medical technology interns from the selected programs. By utilizing the three groups in existing clinical programs, the responses of each group reflect experiences at different levels of the medical technology curriculum.

Analysis Procedure

The research study is a descriptive analysis which provides information about the strengths and weaknesses of the curriculum and recommendations for change. The presentation and discussion of data appear under the main headings:

1. The Medical Technology Curriculum: Present and Future
2. Specialization and the Medical Technology Curriculum
3. Continuing Education and the Medical Technologist

The percentage of responses appears in contingency tables and the Chi Square values are provided. These values assist in determining if there are significant differences in the responses of the three groups.

Findings and Conclusions

The responses to questions concerning the medical technology curriculum such as, basic course requirements and clinical study, in general, conformed to the basic guidelines of the Board of Registry, ASCP. The majority of the respondents view medical technology as a

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four year curriculum in which three years are allocated to academic study and the fourth year to clinical.

The exceptions in course requirements are that biochemistry, genetics, and physics should become requisite courses rather than highly recommended. Immunology and instrumentation are highly recommended as elective courses. Courses in management and communication skills are also recommended as electives.

A change in the work roles of medical technologists is recognized but the majority do not agree to specialization in the undergraduate curriculum. Post graduate education was suggested as the best method for pursuing specialty education.

The majority of subjects viewed continuing education programs as the best means for maintaining an acceptable level of competency in the profession. The continuing education programs offered at the respondents' institutions did not either exist or, if these programs existed, the quality ranged from good to poor. These programs were not used as a means of job advancement.

Recommendations

Education has provided the direction when the professional medical technologist needed a definition of requirements to meet work objectives and goals.

The crucial issue is that the curriculum must not emphasize a restrictive and superficial kind of professional education, but an in-depth scientific knowledge which can only be provided through specialization. The information explosion and technical advances

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in methodology and instrumentation have not resulted in a removal of the technologist, but are requiring a move toward educating more specialists earlier in the training process. Association and competition with other professional groups forces the medical technologist to seek quality education which will provide opportunities to meet new challenges more effectively.

A STUDY OF PROFESSIONAL AND EDUCATIONAL
REQUIREMENTS FOR MEDICAL TECHNOLOGISTS
IN THE CHANGING AND EVOLVING ART OF
CLINICAL LABORATORY MEDICINE

By

Gladys M. Thomas

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Department of Administration and Higher Education

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DEDICATION

This thesis is dedicated to
my mother, Puth, my brother, Pompey,
and dear friends, Frances and Lucille.
You all are a constant source of strength and encouragement.

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I wish to express my sincere appreciation to Dr. William E. Sweetland for his patience, encouragement and guidance throughout the course of this study. My gratitude is extended to the members of my guidance committee, Dr. Loren L. Hatch, Dr. Vandel C. Johnson and Dr. Harry Perlstadt.

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CHAPTER I

INTRODUCTION

Principle Issues

Health care delivery systems have been criticized and, at times, condemned because of cost and lack of resources available to all members of our society. Medicare, Medicaid and prepaid health insurance plans have provided millions of new customers with an opportunity for health services and have also increased the demand for health personnel. Medical care has expanded in its scope from detection and prevention alone to include rehabilitation. The broad spectrum of patient care has forced all practitioners of the health care team to evaluate traditional patterns of patient care and respond to contemporary concepts and needs.

Technological advances in medicine, such as automated, multiphasic testing instruments and computers, have accelerated the development of comprehensive health care programs for the community. These developments have enhanced the quality and availability of health care by providing physicians with broad data upon which to make a rapid diagnosis resulting in a decreased number of admissions and shortened hospital stays. The objectives of a comprehensive health care program are defined by Margaret Olendzki are:

1. Identifying health problems. This procedure must include in part, epidemiological techniques, discussion

of problems with community leaders, provision of medical examinations for people of the community.

2. Bringing the consumers closer to the providers of health care. This is accomplished by steering clients to appropriate care and by persuading the professionals and para-professionals of the health care team to become more community - or population oriented.
3. Experimenting or encouraging or facilitating different models of health care.
4. Solving environmental health hazards. This involves assisting in upgrading housing and occupational health standards.
5. Attempting to improve the whole system of health care delivery. One such modality which can be effectively used for patient information and follow-up is the computer. This would enhance the coordination of medical services.
6. Adding to the body of knowledge. Additional medical information is gained for use in treating the whole patient.
7. Educating professionals, para-professionals and allied health personnel. These persons will be needed to provide, improve and develop further approaches to be used in comprehensive medical care.¹

A vast increase in biomedical knowledge has led not only to the need for more providers of health care services, but has led to a need for highly trained teams of specialists. Amid the great flux of change, an improvement in the education and utilization of physicians and auxiliary personnel must occur. The complexities of health care delivery cause serious concern for educators of medical and paramedical personnel to provide maximal training in order to cope with the demands of contemporary society.

¹Margaret Olendzki and Charles H. Goodrich, editors, "A Health Care Plan for East Harlem - Now", Annals of the New York Academy of Sciences, Vol. 196, Art. 2, April 7, 1972, p. 58.

Simmons states that hospital service had become a great enterprise. In 1964 he reported that hospital service ranked sixth or seventh among the country's business investments in capital outlay for plant and equipment alone. Such an expansion of new and better equipment and techniques in medical services has required new skills, functions and adjustment of work roles of medical personnel.²

Laboratory medicine is one specialty area which has demonstrated an enormous growth. Dr. Bradley Copeland writes:

Our hospital was changing from 350 beds to 500 beds. Our laboratory was changing, and fast. No sooner had one change begun than several other changes followed in quick succession, giving me a helpless feeling similar to that of trying to stop a moving automobile at a red traffic light only to find the brakes not working. Machines and events were not under my control.

He further states that:

While Future Shock is imminent, it is not considered inevitable by Mr. Toffler, who suggests several strategies to prevent or cure the disease: (1) educational reform, (2) reinforcement of the individual's sense of importance, (3) committee oriented control of future change.

To these, I would like to add two items: (4) identification of changes which are needed now; (5) the search for existing models to combat Future Shock.³

The major concern of this treatise is the identification of changes which are needed in medical technology education for the present and future years, and a search for a curriculum which might remain viable in a chameleonic art.

²Leo W. Simmons, Ph.D., and Virginia Henderson, R.N., M.A., Nursing Research: A Survey and Assessment, New York, Appleton-Century-Crofts, 1964, p. 284.

³Bradley E. Copeland, M.D., "Future Shock - A Present Reality in Pathology", Ward Burdick Award Speech, American Journal of Clinical Pathology, Vol. 57, June, 1972, p. 700.

Need for the Study

Comprehensive health care is the key issue in planning and meeting the medical needs of a community. Those needs may be defined in the following broad categories:

1. Prevention and early detection of disease,
2. Diagnosis of disease, and
3. Treatment of disease.

Resources are very important for the achievement of comprehensive health care. Money, plants and equipment are valuable assets, but even more valuable are the involved personnel and their skills.

One area in the community hospital where technological advances have produced opportunities for performing better medicine is the clinical laboratory. The development of automated instruments has made it economically feasible to perform biochemical screening profiles. Physicians can diagnose or evaluate therapy without long delays for results of analyses. If the concept of automation is viewed as an extension of intellectual and practical attainment, the future of medical care is expansive. Dr. James Whittico, Jr., states:

It is only through such instrumentation, it is only through the modalities of computerization and techniques by which tests, and intricate examinations can be performed on a mass basis It is only through these techniques that we will be able to deliver adequate medical care to all people of our nation.⁴

For increased quality and quantity of laboratory services, these objectives must be achieved: (1) delivery of uniformly high quality

⁴Warren Perry, "The Future of Health Care: Conclusion", American Journal of Medical Technology, Vol. 36, March, 1970.

laboratory services to all members of the community, (2) expansion of automated testing to provide excellent services at low costs, and (3) evaluation and interpretation of clinical tests for rapid diagnosis and effective therapy.⁵ In summation,

Technological inventiveness is linked with man's work. It cannot cease unless man in his work ceases to be competitive and no longer tries to find easier and faster ways of performing his tasks. If he manages to take the heaviness out of work, he then feels the need to take the dullness out of it. The inventions that bring satisfaction in work are never sufficient to quench the thirst for still more invention to make work still lighter and more productive and the workday still shorter. Invention makes work increasingly a knowledgeable activity for man and makes the machine more an instrument for his handling.⁶

The education and training requirements for approximately 22 health occupations range from a few weeks of on-the-job training for a nurse aide to 10 or more years of post-high school education and training for a physician. Many studies and innovations are taking place with respect to the education of health workers. The most serious problem with these studies and innovations is that they are isolated from the mainstream of medical practice and are not evaluated by involved professionals and employer groups.⁷ More specifically, the utilization of

⁵Thomas D. Kinney, M.D., Chairman, The Mechanization, Automation, and Increased Effectiveness of the Clinical Laboratory, National Institutes of Health, Bethesda, Maryland, DHEW Publication No. (NIA) 72-145, 1971, p. 76

⁶Nels Anderson, Dimension of Work, New York, D. McKay Company, 1964, p. 125.

⁷Manpower Report of the President, 1970, Manpower Demand and Supply in Professional Occupations, (Reprint), Washington, D.C., Government Printing Office, 1970, p. 177.

allied health personnel for new and different clinical settings will demand a change from traditional roles. The expanding variety of scientific knowledge applicable to health care problems makes it unlikely that traditional academic procedures will produce the needed skills. New concepts for training health specialists must soon be formulated and developed.⁸

Purpose of the Study

Medical laboratory workers are among the top four areas in which manpower requirements will increase very rapidly during the next ten years. Government and private studies predict that white collar jobs will occupy more than half the United States Labor force by 1980. A third of the jobs will call for professional or technical skills. One of the most promising occupations listed is the medical technician.^{9,10}

It is the purpose of this study to define skills and determine requirements for present and future medical laboratory methodology.

The following areas will be explored:

1. The educational requirements of the medical technologists due to technological developments and the information explosion.
2. The changing work roles of the medical technologists relative to the growth and development of clinical laboratory medicine.
3. The need for postgraduate and continuing education for horizontal or vertical job advancement.

⁸Kinney, The Mechanization, Automation, and Increased Effectiveness of the Clinical Laboratory, p. 78.

⁹Hedley Donovan, editor-in-chief, "Jobs for Tomorrow" Time Magazine, February 15, 1971, p. 70.

¹⁰Manpower Report of the President, 1970, Manpower Demand and Supply in Professional Occupations, p. 176

The trend in medicine shows itself not only in burgeoning demand for health care and in shortages of personnel in all traditional categories, but also in the emerging need for skills of new kinds and at new levels of competence. The professional societies concerned with the provision of medical laboratory services have attempted to anticipate and prepare for some of these changes. It is increasingly evident, however, that many of the problems of change confronting the laboratory will demand new approaches to education.¹¹

Dr. Eli Ginzberg best summarizes the purpose of this study as follows:

"It is incumbent upon all leadership groups to make sure that you don't get stuck with the pattern that served you well in the past, but that you develop the flexibility to come out where it makes sense to come out at a decade hence."¹²

Statement of the Problem

There can be little doubt in the mind of anyone engaged in allied health education that this is a time of change, reassessment and revision. The major efforts of those involved in training health care specialists have been directed toward improving the required educational and experiential training they wish their graduates to have.

Curriculum development is important both in preparing students for career entry and in expediting vertical or horizontal career mobility. Perhaps the major problem is the creation of a curriculum which remains functional. This study will investigate present and future needs for

¹¹Carol Kahler, editor, Guide for Program Planning: Medical Laboratory Technician. Washington, D.C., American Association of Junior Colleges, 1969, p. 7.

¹²Eli Ginzberg, Keynote Speech at the Manpower for the Medical Laboratory Conference, October 11-13, 1967. Washington, D.C.

medical technology education in the context of the developments in the comprehensive health care framework.

Most hospital-based educational programs are approved by the American Medical Association (AMA). The AMA delegates authority to the professional organizations to act as certifying agents. The certifying agent for the certified laboratory assistant, medical laboratory technician and medical technologist is the American Society of Clinical Pathologists (ASCP), and American Society of Medical Technologists (ASMT). The certifying agent for the doctorate degree scientist may vary, such as, the American Board of Clinical Chemistry, American Board of Microbiology, National Registry of Microbiologists and so on. The certifying agent for the pathologist is the American Board of Pathology. The certification category is dependent upon one's educational background and clinical training.

A classification of clinical laboratory practitioners and the respective education requirements for each competency level follows:

1. Certified Laboratory Assistant (CLA) requires one year of technical training beyond high school. The clinical training program is conducted in an accredited hospital laboratory.
2. Medical Laboratory Technician (MLT) requires two years training leading to the Associate of Arts or Associate of Science degree in the community college.
3. Medical Technologist (MT) requires four or five years post high school education. Students may meet the minimum requirement of three years of collegiate work plus one year of clinical internship. Upon completion of

this program a degree is conferred. Some students may have a Bachelor's degree and meet required course study then enter a clinical internship.

4. Doctorate Degree Scientist (Ph.D.) may spend variable lengths of time obtaining the doctoral degree granted by the university.
5. The Pathologist (M.D.) requires approximately thirteen years beyond high school. This time is normally divided as follows: four years pre-medical education, four years in medical school for a medical doctor degree, one year of internship and four years residency for specialist requirements.

Although this study deals with the education of the medical technologist, the other categories cannot be totally excluded because of vertical mobility, closeness of the disciplines, and objectives of work requirements.

Description of Responsibilities of Laboratory Groups

CERTIFIED LABORATORY ASSISTANT:

Under supervision, performs the more routine serological, bacteriological, biochemical, hematological and related tests. Training is required in an accredited hospital.

MEDICAL LABORATORY TECHNICIAN:

Makes routine bacteriological, serological, hematological, biochemical and related examinations; assists in the preparation of pathological specimens for examinations and in other procedures in a hospital or

health laboratory; performs related work as required in a semi-supervised environment.

MEDICAL TECHNOLOGIST:

Makes varied or specialized bacteriological, serological, hematological, biochemical and related examinations; assists in the preparation of pathological specimens for examinations and in other procedures. Works in supervisory, teaching and other related positions.

DOCTORATE DEGREE SCIENTIST:

Administers and operates the clinical department of his specialty. Performs research, writes new procedures and teaches students of medical technology and medicine.

PATHOLOGIST:

Directs a hospital or health laboratory. Interprets, and makes diagnoses observed in disease states. Makes recommendations to clinicians and teaches persons involved in health care.

Research Questions

Education of clinical laboratory personnel takes place in two different institutions, the colleges or universities and hospitals. Types of clinical education formats in the hospital are:

1. CONVENTIONAL HOSPITAL-BASED LABORATORY:

Rotation through clinical laboratories in a hospital where on-the-job clinical training and formal lectures are provided by the pathologists, clinical scientists, education coordinators, supervisors and medical technologists.

2. STUDENT CLASSROOM LABORATORY:

Clinical education is provided in a student lecture room and laboratory which is separated from a service laboratory. A service laboratory, such as a hospital laboratory, is used for approximately two months to supplement the program.

3. WORK-STUDY PROGRAM (COOPERATIVE PROGRAM):

Academic course study is alternated with a paying clinical laboratory job for a set period of time. The co-op program is then followed by a year of clinical education in a hospital-based facility. To obtain a Bachelor's degree five years instead of four are required.

Each institution has its own responsibility in the development of the student for his chosen career. Therefore, major consideration must be given to the following stages of the training of clinical personnel:

1. Complete education of candidates with recognition of opportunity for postgraduate education and entry into the medical profession.
2. Technical training from accredited institutions.

To effectively bring about innovations in the area of education and successful career or job entry, these questions must be answered:

1. How can students become well-rounded academically and also knowledgeable practitioners of a changing, evolving art?
2. How can the variable periods for training best be used?
3. What goals must be pursued?
4. How can these goals be achieved?

The following assumptions are made:

1. Present and future developments in clinical laboratory medicine demand new approaches in creating a viable curriculum for clinical laboratory practitioners.
2. Scientific advances, consumer demands, and trends in medicine require early specialization.
3. Opportunities for continuing education must be established in order to keep up to date in laboratory medicine.

Methodology

Thirty-five schools of medical technology were randomly selected from the five north central states, namely, Illinois, Indiana, Michigan, Ohio and Wisconsin. A list of AMA approved schools was obtained from the Board of Schools, ASCP. The schools were assigned numbers from 1 to 190. A table of random numbers was used to select the schools. Schools were not excluded because of low enrollment. The enrollment varied from 3 to 60. Inferences are not made to all existing medical technology programs. Therefore, proportional allocation is not required.

The number of schools chosen for this study is based upon the number required for large sample statistical analysis ($N \geq 30$). The large sample statistic applies when the number of the sampled population is thirty or greater. In the event that some programs were no longer in operation or failed to respond, five schools were chosen in addition to the thirty.

Students of medical technology, education coordinators and supervisors (department heads, section chiefs) involved in the clinical

programs are the target sample population. These groups are closely associated with the curriculum and work roles of the medical technologist. The medical technology student experiences will provide an appraisal of current educational preparation. The active involvement of the education coordinator in the total medical technology curriculum makes him valuable in determining the directions of curricular changes. The supervisory personnel in the clinical institutions also assess the developments in the world of work and how such developments affect curricular change.

All three groups are given the same questionnaire for response. The Chi Square Test of Significance (χ^2) is used to analyze the data. The calculated Chi Square for the responses to the items is used to determine if there are significant differences among the groups at the .05 level of confidence. Recommendations for change in the medical technology curriculum are based upon these results.

The research study is a descriptive analysis of curricular needs for medical technology education. This study should provide some concept of the direction in which the medical technology curriculum should move.

Overview

An historical review of the relevant literature is contained in Chapter II. This demonstrates the developments which have influenced medical technology education to the present time. The experimental design, assumptions in the study, and statistical methods used for analysis of the data are described in Chapter III. The results, including tables designed to clarify the data, are reported in Chapter

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IV. Chapter V contains a summary, discussion of findings, conclusions and implications for future research. Appendices contain instruments relevant to the experimental design.

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CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Clinical Laboratory Medicine is a conglomerate of the natural sciences. It is a melding of chemistry, biology, physics and all the medical counterparts, biochemistry, anatomy, physiology, microbiology, pharmacology and immunobiology, to name a few. To practice laboratory medicine, one must be well versed in the basic sciences, and follow the developments within these areas, for they are the building blocks of the clinical laboratory practice. Therefore, the field of laboratory medicine recruits its members from diverse scientific backgrounds. These scientists have the wide range of knowledge and skills needed to provide the quantity, variety and quality of medical laboratory services which will be required by contemporary medical practices.¹³

This chapter contains a review of literature related to medical technology education and the development of the profession. The effects of automation, legislation and general social trends upon medical technology education are also presented.

¹³Thomas M. Perry, M.D., "Laboratory Medicine: Careers and Challenges," Laboratory Medicine, Jan., 1970, Vol. 1, No. 1, p. 32.

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Historical Development of Medical Technology

The growth of medical technology is directly proportional to the growth and development of the sciences. Other broad changes in our society which have affected not only medical technology, but other health categories are population mobility, shifts in age composition and disease prevalence, scientific orientation to life's issues in contrast to the religiophilosophical concept and the presence and growth of organized pressure groups. Within the health field one must also consider such trends as the vast development of equipment, increase in use of professional and para-professional specialties, and group medical practice.¹⁴

At the beginning of the century the pathologist-physician was capable of performing all clinical laboratory procedures, the most important of which was anatomic pathology. The professional organization for pathologists, ASCP, is just over 50 years old and the specialty of clinical pathology is only a few years older than the organization. In 1928 the registry was established by the ASCP to standardize the educational requirements of the laboratory workers. Since the beginning of the registry, the educational requirements for the medical technologists have been consistently upgraded to meet the range of knowledge and skills for an expanding health care delivery system.¹⁵

¹⁴Simmons, Nursing Research: A Survey and Assessment, pp. 279-283.

¹⁵Marta Jeanne Henderson, M.S., and Betholene F. Lover, M.S., "The Status of Medical Technology Education", Journal of Medical Education, Vol. 47, June, 1972, p. 479.

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Medical technology is a comparatively new profession which has rapidly come of age. From the earliest days of on-the-job training to the present college-hospital programs, pathologists have shown a concern for and interest in the need for qualified workers. In 1928 Dr. Kano Ikeda of St. Paul, Minn. set up a national registry of clinical laboratory technicians. Dr. Ikeda also established educational standards for students. High school graduates were admitted to the laboratory schools, but the requirements soon changed to one year of college, and then two years were required.¹⁶

In 1929 the ASCP began to establish standards and develop hospital schools for educating medical technologists. The cooperation of the Council on Medical Education became an integral part of planning, evaluating and establishing criteria for the curriculum of medical technology. In 1933, registered technicians organized the American Society of Clinical Laboratory Technicians and published a journal, The Bulletin of American Society of Clinical Laboratory Technicians. In 1936 the name of the journal was changed to The American Journal of Medical Technology. With increased educational requirements and better technical training, the term technologist was adopted and the National Society became the American Society of Medical Technologists (ASMT).¹⁷

Today, members of the ASMT cooperate with the ASCP in meeting the growing need for developing model curricula for professional training of

¹⁶Howard M. Vollmer and Donald L. Mills, editors, Professionalization, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1966, p. 20.

¹⁷Ibid., p. 20.

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medical technologists.¹⁸ Both organizations have recognized and continually demonstrate the growing need for competent clinical laboratory personnel. Their response to the complexities of clinical laboratory medicine has been one of meeting these needs with vigor and concentrated efforts.

Educational Requirements for Entry into Medical Technology

A requirement for today's medical technology major, as of December, 1972, is that they must either have a baccalaureate degree or be guaranteed one upon successful completion of their studies. The Board of Schools, ASCP, declares that students of medical technology should be recognized with a diploma for the cost of time, finances and energy placed into the preparation for their profession.¹⁹ There are three recognized pathways a student of medical technology may follow in order to fulfill requirements for professional entrance.

1. The total program: Three years of collegiate study plus one year of clinical education. A student enrolls in a college and declares medical technology as a major. The minimum requirement for academic course work is 90 semester hours (135 quarter hours) which must include appropriate course credit in the essential subjects, biology, chemistry, physics, mathematics. The student must then complete 12 months of clinical study at an AMA-approved school of medical technology. A baccalaureate degree in medical technology is granted after satisfactory completion of the total program.

¹⁸The Alabama Pilot Study, sponsored by the National Committee for Careers in Medical Technology, grant from Cancer Control Program, Public Health Service, U.S. Dept. of Health, Education, and Welfare, Final Report of a Three Year Project, 1959-1962.

¹⁹American Society of Clinical Pathologists, Board of Schools Newsletter, October 12, 1971.

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2. Four years of collegiate study plus one year of clinical education. A student may major in biology, chemistry, microbiology, zoology and so on. He must meet the minimum requirements to enter a hospital-based program for 12 months of clinical study. Upon completion of his studies, he is a medical technologist holding a baccalaureate degree in a science related to medical technology.
3. An integrated four year program. This type of program is generally observed where a university and university hospital coexist, e.g., Temple University, Ohio State University, and University of Michigan. A student enrolls in the medical technology curriculum, and fulfills the academic requirements in chemistry, biology, mathematics and physics. Clinical instruction exists as part of the overall curriculum. Upon completion of the curriculum a baccalaureate degree is granted in medical technology.^{20,21}

The medical technology curriculum is administered by both the university and hospital, with the university playing the predominant role. The university must stress reliability and insist upon excellence and pride in achievement. The hospital educational program must not be minimized, for its responsibility is multifaceted. The hospital has responsibility for providing the student the foundation for professional growth, for providing clinical education which carries college credit, and for nurturing dedication to the goals and objectives of the hospital and the community which it serves. These responsibilities should induce development of a viable medical technology curriculum which will reflect favorably upon both the university and the hospital.

²⁰Carol N. LeCrone, M.S., M.T. (ASCP), "Undergraduate and Graduate Education for the Medical Technologist", Laboratory Medicine, Vol. 4, No. 3, Mar., 1973, pp. 33-36.

²¹The American Society of Clinical Pathologists, The Registry of Medical Technologists, 1972.

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The knowledge explosion has made education a lifetime process for all. Therefore, curricula should not be constructed on what is and has been alone, but on what is going to be.²² Ivor Woodward writes:

How will we train the new technologists? Changes are so rapid that there is no way of teaching today the skills that we must have tomorrow. We must concentrate on understanding the general principles of those features that will transfer into new situations. Specific skills will be taught and developed as they are needed. The teaching of these skills will be one of the chief functions in affiliated clinical laboratories. The corollary is that the student must be so educated that he is never cut off from sources of advanced study. The specifics of technology will need to be updated constantly, and the student of tomorrow²³ must be able to advance and update himself as needed.

The Recruitment and Education of Students for Medical Technology

As the profession of medical technology became visible and the required educational experiences provided the training needed to cope with demanding responsibilities of the profession, the problem of recruiting students in sufficient numbers to meet the demand for graduates was inevitable. Dr. Mary Fried writes, "Every conceivable medium has been employed for telling our story, including pamphlets for high school students, published by the United States Government Printing Office and the Institutes of Health."²⁴ In 1953, the ASCP, the College of American Pathologists (CAP), and the ASMT established the National

²²Darrel J. Mase, Ph.D., "New Direction(s) for Medical Technology", The American Journal of Clinical Pathology, Vol. 50, No. 2, 1968, p. 272.

²³Ivor Woodward, Ph.D., "Another Landmark", The American Journal of Clinical Pathology, Vol. 50, No. 2, 1968, p. 278.

²⁴Mary Fried, Ph.D., "Is Today's Medical Technologist Educated?", Laboratory Medicine, Vol. 1, No. 2, February, 1970, pp. 27-28.

Committee for Careers in Medical Technology. (The name of the committee was changed in 1970 to National Committee for Careers in the Medical Laboratory, NCCML). This organization was originally established to recruit students for study of medical technology. Since the organizations inception it has helped to increase the number of registered technologists from 28,082 in 1952 to 86,915 today.²⁵ Brooks and Blume write that Michigan experienced its first surplus of college medical technology students seeking internships in 1972.²⁶ They have projected that an increased enrollment of medical technology students will be observed through 1975. Dr. George F. Stevenson, Executive Vice President of the ASCP, states that on the national picture the number of applications for medical technology clinical internships has exceeded the number of positions and that a redirection of NCCML activities would take place.²⁷ As the 20 year history of NCCML has unfolded, the activities of the organization have been concerned with other educational matters of medical technology, such as upgrading educational programs, and raising scholarship funds.²⁸

Dr. Fried states that the rush to produce more medical technologists has altered undergraduate training. The scope of the undergraduate

²⁵Thomas M. Peery, M.D., Chairman, National Committee for Careers in the Medical Laboratory. A 20 Year Report - 1953 - 1973.

²⁶Robert A. Brooks, and Christiana S. Blume, "Student Surplus Anticipated: How Much is Too Much?" Cadence, Vol. 4, No. 3, May-June, 1973, p. 33.

²⁷Margaret Howell, editor, "Redirecting NCCML's Activities", Medical Lab, Vol. 9, No. 7, July, 1973, p. 19.

²⁸Ibid., p. 19

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programs were narrowed to a point where only basic science courses were required, thus, a degree in medical technology tended to jeopardize some students' entry into graduate and medical studies. She summarizes this dilemma as follows:

Despite the urgent need for more medical technologists, let us not deprive them of their complete education. Let us not allow applied science to take the place of basic science

Furthermore, let us remember not only that a knowledge of fundamentals is vital to proficiency in every field, but also that a fundamental knowledge of the cultural heritage of the human race is vital to the education of every student.²⁹

Rapid developments in the field of medicine and the philosophy concerning the quality and extent of health care services for the total population have raised many questions concerning the educative process. One projector states that continuing education requirements will be strongly emphasized, resulting in enforced continuing education requirements to update knowledge before granting renewal of certification. It is also projected that a uniform national system for certification of all health services personnel will be established, thereby standardizing qualifications and training so that mobility and distribution of qualified workers are facilitated.³⁰ Questions are being raised concerning the advisability of requiring a baccalaureate degree for a medical technologist prior to a clinical internship.

²⁹Mary Fried, Ph.D., "Is Today's Medical Technologist Educated?", p. 28.

³⁰Margaret Howell, ed., "Medical Technology in 1980: New Job Titles and More Job Openings", Medical Lab, Vol. 9, No. 2, Feb. 1973, p. 18.

Supportive Personnel

To become a medical technologist requires at least three years of college and twelve consecutive months in an AMA-approved School of Medical Technology. There were no short cuts to becoming a medical technologist in order to relieve the urgent shortages in the late 1950's and early 1960's. Medical technologists have a thorough scientific training and education which means that they meet professional standards which are recognized by the medical profession.

There are serious concerns about those students who are educated in non AMA-approved Schools of Medical Technology. Confusion developed when prospective employers attempted to hire qualified personnel who all claimed to be bona fide medical technologists. The educational background of the broad cross section of medical laboratory personnel varied from training in commercial or private schools of medical technology, to on-the-job training, to Armed Forces Schools, to colleges or universities. A study of a commercial school of medical technology in Minnesota listed the following deficiencies:

1. Because the students have virtually no background in scientific and medical subjects, the curriculum is much too ambitious for the time spent in this type of training.
2. A majority of the regular instructors are not qualified by either training or experience to teach medical technology.
3. The facilities are judged inadequate to properly train students in acceptable laboratory technic.
4. Instructor-student ratio is far below accepted standards.
5. The training offered the student almost no clinical experience.

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The evaluation was completed by a committee which was appointed by the Minnesota Department of Education to determine the qualifications of commercial school graduates.³¹

It was also recognized that the highly educated medical technologist performs a wide range of tasks in which a lesser trained individual could adequately perform. As early as 1958, leaders in the junior and community colleges and professional organizations, ASCP and ASMT, had been discussing the kinds of curricula necessary to prepare students for entry into those health occupations which have been termed subprofessional, paramedical, supportive, semiprofessional and technical.³² This movement was to result in standardized, accredited programs for health occupations.

In 1963, a new training program was initiated by the ASCP and ASMT to provide standardized training and national certification under medical auspices for Certified Laboratory Assistant (CLA). In 1969, a joint committee of pathologists, medical technologists and educators conceptualized the associate degree Medical Laboratory Technician (MLT) program. In 1971, the Essentials for Approval of Medical Laboratory Technician programs was forwarded to the AMA for sanction.³³ During the interim many different patterns of MLT programs had developed.

In 1971, 80% of 390 graduates from 51 junior college programs surveyed by the NCCML found jobs.³⁴ The remaining twenty per cent continued their

³¹Robert M. Cunningham, Jr., editor, "Commercial Med Tech Schools", The Modern Hospital, Vol. 97, No. 6, 1961, p. 103.

^{32,33}Dallas Johnson, "Laboratory Training in Junior Colleges: 100 Programs Today, 200 More Tomorrow", The Modern Hospital, Vol. 117, Dec., 1971, pp. 81-82.

³⁴Dallas Johnson, "Research Needed to Find out What Technicians Really Must Know to do Laboratory Work", The Modern Hospital, Vol. 117, Dec., 1971, p. 82.

education. This appears to demonstrate the need for an MLT curriculum which is sufficiently flexible to prepare its graduates for immediate entry into the field or into additional formal training.³⁵ Vested interests, tradition, reluctance to change, are but a few factors which have inhibited opportunities for vertical and horizontal job mobility through the establishment of such a curriculum.

An unanswered question which needs to be carefully studied is the question of what tasks should be assigned to the supportive personnel. Until that question is answered, it will be extremely difficult, if not impossible to develop appropriate curricula for various levels of training.

In summary, the previously cited developments in medical technology education requirements demonstrate the need for constant planning and implementing of newer concepts in the curriculum.

Ivor Woodward has stated the problem very succinctly:

It is a myth that the inclusion of subordinate classifications in medical technology will undermine the technology; quite the contrary, it will strengthen the profession. The skilled and competent will be advanced to a higher status and will be freed from the large amount of routine operations. Furthermore, the approximately 60% of laboratory workers who are without specific formal training or skills can be mobilized into competent, well-defined groups with specific roles. The present ratio of medical technologists to total laboratory workers is likely to decrease, not increase.

He further states:

Judging by the history of the manpower situation in this country, miscellaneous untrained personnel are going to fill the vacancies in laboratories in order to keep them running. The organization of subordinate occupational

³⁵Ina L. Roe, editor, "ASMT Position Paper: Differentiation Among MT, MLT and CLA Expected Capabilities at Career Entry", American Journal of Medical Technology, Vol. 39, September, 1973, pp. 362-364.

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classifications is a wise preparation also in that many of the simple operations are done better by individuals with less training, provided that the proper controls and supervision are instituted. The highly trained individual is likely to become quite bored with such tasks and consequently quite careless.³⁶

Impact of Technology, Legislation, and other Social Trends

Technology

Technology involves change. The nature of this change is almost totally unidirectional, that is, the alteration in one's work involves less physical labor. The impact of automation on the variety of jobs of a medical technologist has been viewed as an alteration in the type of skills and knowledge which is required. Some major findings and conclusions concerning the impact of automation on clinical laboratory operations come from a study conducted for the Division of Medical Care Standards, Community Health Service, U.S. Department of Health, Education and Welfare by Auerbach Associates, Inc. These findings are:

1. A survey of 400 hospital laboratories and 450 independent laboratories, with a total response rate of 51 per cent, showed that 55 per cent of the laboratories used some kind of automated equipment.
2. Essentially all of the automation, as defined by the study, was found in clinical chemistry and hematology.
3. The study showed that there are legitimate roles in automated laboratories for equipment operators who do not have formal technologist qualifications.

³⁶Woodward, "Another Landmark", p. 277.

4. The study stated that technologists' skills and understanding are needed in an automated environment to supervise calibration and quality control, to trouble shoot equipment problems and to review test results.³⁷

Arvo W. Schoen writes:

Traditionally, medicine has insisted on longer incubation periods prior to accepting new technology than most other scientific disciplines. In the last decade, an acceleration has become evident, and the time between introduction and acceptance is likely to shorten in the future, if for no other reason than that the lifetime of new technology is shortening and the demand for higher levels of technology is increasing.

He further states:

Historically, the health professional has relied upon the physical and engineering sciences to develop the instrumentation and sensors used in the clinical environment. Unless dramatic changes are forthcoming, this reliance will very much continue in the future. However, with an increasing demand for sophistication in medical measurements, closer cooperation between the medical and engineering sciences will become more essential; and in the application of information gathering and processing developments, the health professional will have to establish a more prominent role.³⁸

The classical medical technologist's education does not thoroughly cover all facets of automation. For example, some phases of automation, such as maintenance or repair of automated equipment are limited if present in the curriculum. The Department of Health, Education and Welfare study on automation states that automation creates a role in the laboratory for a technician-level individual.³⁹ This further supports

³⁷S. E. Gould, M.D., D.Sc., editor, "Automation and the Medical Technologist", Laboratory Medicine, Vol. 4, No. 9, August, 1973, p. 20.

³⁸Automation in Medicine, sponsored by Cedars of Lebanon Hospital, Miami, Florida, Futura Publishing Company, Inc., Mt. Kisco, N.Y., 1973, p. 40.

³⁹Gould, "Automation and the Medical Technologist", p. 41.

the need for a re-evaluation of the present approach to medical technology education and the current work roles.

Legislation

A very slow, less-visible movement which greatly influences health care is legislation. Kenneth M. Myers states that seven per cent of the gross national product is now spent for health in the United States. He does not foresee additional spending as the solution to improving the nation's health, but the solution is more likely to be observed in increased productivity and distribution of available health resources.⁴⁰ The rate, intensity and pace of change in medical care is very much affected by legislation. Some observable effects are: (1) increased numbers of standards for accreditation of hospitals, (2) required changes in physical plant and staffing structure, (3) requirement for each hospital to become involved in area-wide (community) planning, and (4) reimbursement formula from insurance companies such as Blue Cross, which causes some effect on hospital financing, accounting and cost.⁴¹

An example of this legislation is observed in the Medicare-Medicaid and the Child Health Law, Title V. Formal budgets and plans for three years in advance must be submitted to the administration of hospitals. These budgets are not reviewed by the Government for substance, but this requirement is an effort to get administrators and Boards of Trustees more concerned and involved in the business activities of the hospital.

⁴⁰Automation in Medicine, p. 33.

⁴¹Ibid., pp. 8-11.

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Some health care legislation is pending and many health laws have been enacted. The present and future health care delivery system is slowly being restructured by the government. The goals of state and national legislatures are to bring about better and meaningful innovative procedures in the health care delivery system.⁴²

The Junior College and Health Education

The most viably active curriculum in the junior college educational inventory is the health technology field. Richard C. Richardson, Jr. writes:

The field of occupational education represents a topic that is both promising and perplexing. It is promising because of the tremendous need for technically trained personnel in a society involved in the throes of accelerating technological revolution. It is promising because of the desire of the rapidly growing junior college movement to share in the responsibility for meeting the needs of an automated society. At the same time, it is perplexing because many junior colleges are experiencing difficulties in initiating new programs, and in maintaining those already in existence at an appropriate level of efficiency.⁴³

Norman C. Harris states:

If the junior college belongs to any era, it is to the span of the next three decades. The past has seen the infancy of the junior college; the present views its growth with surprise, and perhaps even a little alarm in some quarters; and the future's vision is as yet⁴⁴ unknown as we look toward the twenty-first century.

The challenge of the health care system is being met by innovative curriculum planning in which the junior colleges are initiating and

⁴²Ibid., p. 10

⁴³Emphasis: Occupational Education in the Two-Year College, American Association of Junior Colleges, 1966, p. IV.

⁴⁴Norman C. Harris, Emphasis: Occupational Education in the Two Year College, ibid., p. 40.

expanding programs for the paramedical fields. It is through imaginative planning and a sensitivity for genuine needs that the junior colleges are helping to meet manpower needs. Such programs as radiology and cardiopulmonary technicians and dental hygiene are but a few innovative programs which appear as part of the community college curricula. The junior college movement demonstrates a vigorous growth. Its impact on issues of the times, especially health care, will be determined perhaps in the next decade.

Equivalency and Proficiency Exams

Traditional methods for career entry are being challenged. There are numerous requests from individuals with non-traditional educational backgrounds or on-the-job training wishing to enter the para-professional or professional ranks. To assist them in achieving their goals, equivalency and proficiency examinations have been established.⁴⁵ "Equivalency testing equates learning gained outside of formal training programs with requirements of courses that constitute recognized formal training programs. Proficiency testing assesses an individual's knowledge and skills related to the actual demands of an occupational specialty or a specific job."⁴⁶ Testing does not exactly present a complete evaluation of the applicant but it does play a significant part in making a provision for the utilization of people who are well qualified but are excluded by lack of formal academic training.

⁴⁵American Society of Clinical Pathologists, Board of Schools Newsletter, June, 1971.

⁴⁶Equivalency and Proficiency Testing, Division of Allied Health Manpower, Bureau of Health Manpower Education, Public Health Service, U.S. Department of Health, Education, and Welfare.

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Summary

In considering some of the facets of health care delivery, and the social trends, the educators, medical technologists and employers must establish some guidelines for determining curricular needs for the future. Graduate medical technologists must be exposed to the knowledge required by the employers. Curricular content must keep pace with developments in medicine. This can be achieved only by defining the kind of educational objectives and goals which must be accomplished for clinical laboratory medicine.

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CHAPTER III

DESIGN OF THE STUDY

Introduction

The status of medical technology education is under constant appraisal. This continual evaluation of the curriculum is directly related to the increased demand for the utilization of clinical laboratory medicine. As clinical laboratory medicine emerged as a discipline, the need for quality educational programs for workers was also recognized in order to achieve the goals of a comprehensive health care delivery system.

This chapter contains (1) a description of the population and sample, (2) development and description of the instrument, (3) data collection procedures, (4) design of the study, (5) statement of the underlying assumptions, (6) statistical analysis of the data, and (7) summary.

Population

The sampling population was drawn from the five North Central states, namely Indiana, Illinois, Michigan, Ohio, and Wisconsin. There are a total of 190 AMA approved hospital schools of medical technology in these states. The hospital based programs are chosen to determine if the educators, prospective employers and students of medical technology have found the academic experiences an adequate preparation for entry

into the profession. The enrollment in the schools ranges from three medical technology interns to 60. No schools were excluded due to size, because the purpose of the survey is to elicit current thinking concerning future curricular needs. Therefore, inferences will not be made to all existing medical technology programs and proportional or optimal allocation within a strata to isolate the atypical respondent is not needed.

A random selection of 35 schools for the study was made from the total number of 190; utilizing standard random number tables. (See Appendix D). The list of AMA approved schools was obtained from the Board of Schools, ASCP. The number of schools chosen for this study is based upon the criterion for large sample statistical analysis ($N \geq 30$). The large sample statistic applies when the number of the sampled population is thirty or greater. In the event that some programs were no longer in operation, or failed to respond, five schools were chosen in addition to the thirty.

Sample

The sample was composed of education coordinators, supervisors (department heads or section chiefs) of clinical laboratory sections, namely chemistry, hematology, blood bank and microbiology, and two medical technology interns from the selected programs. The interns were chosen by the education coordinator, who was requested to give the questionnaires to any two students who had completed at least four months or more of the clinical program. A postal card was enclosed so that the education coordinator might send the names of the two students to the

researcher. This assisted the researcher in the follow-up if no response was received. Two hundred and forty-five questionnaires were mailed. Each school of medical technology received seven questionnaires which were distributed as follows: one questionnaire to the education coordinator, one questionnaire to the supervisor of each clinical department, and one questionnaire each to two medical technology interns enrolled in the program.

By utilizing interns, educators, supervisors or administrators of existing clinical programs, the responses of these events reflect experiences at different levels of the medical technology curriculum. Greater experience and knowledge about the profession of medical technology may give the respondent an opportunity to assess the past and present events in clinical laboratory medicine; and, on the basis of these recommend measures for future trends. On the basis of recent exposure to the academic part of the curriculum, the intern may have insight which more experienced individuals might overlook.

Characteristics of Sample Population

Sex, educational background and types of certification are a few characteristics which might affect an individual's response (See Tables 1, 2, 3, 4, 5, and 6). The researcher does not use this information unless there is a significant correlation to the way a specific group responded to an item(s). An example of such a pattern is: all medical technology interns may react to the need for a shortened period for clinical study whereas the education coordinators may feel strongly that the period for clinical study remain at one year. Perhaps the

experiences of the education coordinators give them insights upon which the differences are based. These findings will be presented in Chapter IV with the pertinent discussion.

Development of Instrument

The questionnaire was designed to examine the current status of the curriculum and to seek ideas and recommendations of the persons responding. The recommendations deal with changes that would be desirable to improve the present quality of the curriculum and to arrive at future requirements based upon technological developments.⁴⁷

TABLE 1.--Number and Percent of Participants Responding According to Group and Sex.

	Female		Male		Total	
	N	%	N	%	N	%
Education Coordinator	23	16.79	3	2.19	26	18.98
Medical Technology Intern	35	25.55	9	6.57	44	32.12
Supervisor (Department Head, Section Chief)	50	36.50	17	12.41	67	48.91
Total:	108	78.83	29	21.17	137	100

⁴⁷Walter R. Borg, Educational Research, An Introduction, David McKay Company, Inc., New York, 1967, p. 205.

TABLE 2.--Highest Levels of Educational Attainment.

	Two Years of College		Three Years of College		Bachelor's Degree		Master's Degree		Doctorate Degree		Medical Doctor		Totals	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	-	-	17	12.41	8	5.84	1	0.73	-	-	26	18.93
Medical Technology Intern	-	-	18	13.14	26	18.98	-	-	-	-	-	-	44	32.12
Supervisor (Department Head, Section Chief)	4	2.92	2	1.46	46	33.58	5.	3.65	8	5.84	2	1.46	67	48.91
Total:	2	2.92	20	14.60	89	64.96	13	9.49	9	6.57	2	1.46	137	100.01

TABLE 3.--Types of Certification.

	MT (ASCP)		Reg. Micro (NRM)		Clin. Chem. (NRCC)		BB (ASCP)		Spec. in B.B. (AABB)		Spec. in Hemat. (ASCP)		Spec. in Chem. (ASCP)		Other**		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	25	18.25	1	0.73	-	-	-	-	-	-	-	-	-	-	-	-	26	13.98
Medical Technology Intern	44*	32.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	32.12
Supervisor (Department Head Section Chief)	38	27.74	-	-	2	1.46	4	2.92	6	4.38	2	1.46	2	1.46	9	6.57	63†	45.99
Total	107	78.11	1	0.73	2	1.46	4	2.92	6	4.38	2	1.46	2	1.46	9	6.57	133	97.09

*Interns are eligible to take the National Registry Examination for MT (ASCP) certification upon completion of the requirements of the clinical program.

**M.D.'s and Ph.D.'s are in this group. The M.D.'s are certified by different agencies. The Ph.D.'s represented are not certified by a professional organization.

†Four participants (2.92%) gave no response at this time.

TABLE 4.--Principal Place of Employment.

	Hospital		Physician's Private Office or Clinic		Independent Laboratory*		College or University		Industry		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	23	16.78	-	-	-	-	3	2.19	-	-	-	-	26	18.98
Medical Technology Intern	44†	32.12	-	-	-	-	-	-	-	-	-	-	44	32.12
Supervisor (Department Head, Section Chief)	67	48.91	-	-	-	-	-	-	-	-	-	-	67	48.91
Total:	13.4	97.81	-	-	-	-	3	2.19	-	-	-	-	137	100

*47.73% of the interns had just completed the internship either July 1 or September 1 and remained at the institution as staff medical technologist (see Table 6).

†South Bend Medical Foundation is the only clinical facility which is an independent laboratory. Since most of the respondents checked hospital, they are all grouped in this category for consistency.

TABLE 5.--Principal Job Classification.

	Administrative Technologist		Education Coordinator		Supervisory Technologist		Staff Technologist		Laboratory Technician		Other*		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	2	1.46	21	15.33	2	1.46**	-	-	-	-	1	0.73	26	18.98
Medical Technology Intern	-	-	-	-	-	-	21	15.33††	-	-	23+	16.79	44	32.12
Supervisor (Department Head, Section Chief)	6	4.38	-	-	47	34.30	3	2.19	-	-	11	8.03	67	48.91
Total:	8	5.84	21	15.33	49	35.76	24	17.52	-	-	35	25.55	137	100.00

*Representatives of this group are M.D.'s and Ph.D.'s.

**Responsibility divided between Education Coordinator and listed titles.

†Represents the number of medical technology interns who were currently enrolled in a program.

††Represents recent graduates.

TABLE 6.--Work Experience.

	0-2 Years		3-5 Years		5-10 Years		11 or more Years		Total	
	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	3	2.19	6	4.38	17	12.41	26	18.98
Medical Technology Intern	44	32.12	-	-	-	-	-	-	44	32.12
Supervisor (Department Head, Section Chief)	2	1.46	11	8.03	27	19.71	25	18.25	65*	47.14*
Total:	46	34.07	14	10.37	33	24.44	42	31.11	135*	98.54*

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Number of years in present position ranged from 1 to 20. (Interns are not included).

*Two supervisors did not respond to this question. They represent 1.46%.

The basis for the questions is found in the literature concerning paramedical educational programs and medical technology education in particular. The current developments and technological advances also provide a premise for determining curricular needs for future health care workers.

A pilot study was conducted to ascertain any difficulties which might arise in interpreting the questions and to add or delete any concepts which were deemed to be important or insignificant to the study. Instructions were given to check only one choice for each item. The respondents were requested to make comments about the questionnaire itself and items which were found to be vague, ambiguous, or unrelated to the study. A representative group involved in medical technology education and prospective employers of medical technologists were asked to respond to the original questionnaire. Fifty questionnaires were distributed in California and Michigan. Participants in the pilot study were chosen so that the group would not be involved in the final study. Representatives of this group were: two M.D.'s, specialists in Pathology; three Ph.D.'s, specialists in Microbiology with principal employment in a university, hospital-based clinical laboratory, and a State Department of Health; a director and assistant director of a university-based medical technology department; five department heads of clinical laboratory departments; nine medical technology interns; and twenty-nine medical technologists who are gainfully employed. The medical technology interns and nineteen of the working medical technologists are from the researcher's hospital. The remaining ten medical technologists are from California. When randomly selecting schools in the five North Central

states, the researcher's hospital was not selected. Comments and suggestions from participants in the pilot study resulted in the final edition of the instrument.

Examples of questions which were deleted or rewritten and reasons for the action follow:

1. These items represent two questions in one.
 - a. Specialization implies division of responsibility and efficiency.
 - b. Medical technology education should be independently planned and organized by the different educational institutions.
2. The following procedure is no longer used in dentistry because it is not a valid measurement.
 - a. Screening tests should be given prospective medical technology students prior to acceptance into the clinical program similar to those given to dental students prior to admission into dental school.

These questions and others like them were redefined and restructured so that the respondents could select the closest answer to their views without pondering over implications.

After receipt of the pilot questionnaire (100% return), a new instrument was constructed based upon comments from the participants. The Chi Square test of significance was planned to be used for summarizing and quantifying the data. A discussion of the Chi Square follows.

Description of Instrument

The instrument is composed of two types of questions: (1) Fixed alternative items and (2) Open-ended items. The fixed alternative items give greater uniformity of measurement and therefore, greater reliability by forcing the respondents to answer in a way that fits

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the response categories. A five point scale is used in the study. The disadvantage is that in-depth information will not be gained. To gain more information the open-ended questions are added. This type of question does not put a minimum restraint on the answers and expressions of the respondents. Greater flexibility may be gained and new ideas may be brought forth which were not previously considered. (See Appendix B).

Data Collection Procedures

A brief letter emphasizing the importance of the study was submitted to each respondent along with the questionnaire. (See Appendix A). Included with the questionnaire and letter were a stamped, self-addressed envelope and postal card so that the individual could respond with minimal inconvenience. A follow-up letter was sent to those individuals who had not responded in order to avoid sampling bias. (See Appendix C).

A period of four weeks was given for a reply to the first mailing of the 245 questionnaires. At the end of this period 132 (53.88%) completed questionnaires were returned. A follow-up request was mailed seeking additional returns. Particular attention was directed to those in which less than 50% (3 or less) of the participants had responded. An additional twenty-one questionnaires were mailed to three schools which had no returns. A two week period was given as the limit for receipt of the questionnaires. Five (2.04%) questionnaires were returned. The total percent received was 55.9% (See Table 7).

TABLE 7.--Total Percentage of Questionnaire Return.

	Returned		Mailed	
	N	%	N	%
Education Coordinator	26	10.6	35	14.3
Medical Technology Intern	44	18.0	70	28.6
Supervisor (Department Head, Section Chief)	67	27.3	140	57.1
Total	137	55.9	245	100

The responses to each item of the questionnaire were coded onto data processing cards. The data was then analyzed using Michigan State University Computer Laboratory and the Control Data Corporation 3600 Computer. The data was contained in contingency tables with percentage breakdowns and Chi Square values. The results reported in this study are those deemed most pertinent.

Design of the Study

The research study is a descriptive analysis. The objective of the survey is to provide information not only about the strengths and weaknesses of the curriculum but also to arrive at recommendations for change. The survey requests respondents to review past and current curricular revisions and to determine what changes and improvements should be implemented.

Chapter II contains a treatise of the emergence of clinical laboratory medicine and developments in medical technology education. The descriptive study as presented provides a tool in educational planning and also a means of evaluating the curriculum. The presentation and discussion of data will appear under three main headings:

1. The Medical Technology Curriculum: Present and Future.
2. Specialization and the Medical Technology Curriculum
3. Continuing Education and the Medical Technologist.

The percentage of responses appears in tables and the Chi Square values are provided. The values assist in determining if there are significant differences in the responses of the three groups. An explanation of variance will be given when possible.

Underlying Assumptions

The underlying assumptions of the study as presented earlier are:

1. Present and future developments in clinical laboratory medicine demand new approaches in creating a viable curriculum for clinical laboratory practitioners.
2. Scientific advances, consumer demands, and trends in medicine require early specialization.
3. Opportunities for continuing education must be established in order to keep up to date in laboratory medicine.

These assumptions are made because of the recognition of the effect of the industrial revolution upon society. Notably important is the need to continually monitor current systems and to be prepared for newer effective systems in the future. Therefore, two types of educational systems are needed. One system must be geared toward the newcomer who must master a new curriculum and acquire the skills

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and behavioral goals sufficient to join the medical laboratory team. The second type of system needed is to prevent the professional's skills from becoming obsolescent.

Statistical Analysis of Data

The Chi Square test is used to compare samples to determine if they are consistent in their responses to items dealing with the medical technology curriculum. Three groups, working in the same profession but demonstrating varying degrees of professional growth, are employed in the study. The research problem is to determine if the groups agree upon what are future needs for the medical technology curriculum. The statistic will demonstrate if there are significantly different responses to the items among the three groups. From these responses will come recommendations for the curriculum.

The Chi Square tables are constructed presenting the frequencies for each of the responses. The calculated Chi Square values are reported. Statistical significance is reported at a specific level of confidence which provides a means of estimating the accuracy of the findings. The level of significance employed in this study is .05. The level of significance is determined by checking a Chi Square table at the .05 level of confidence and the specific degrees of freedom. If the table value exceeds the calculated value, the groups are not in agreement on the particular concept. The underlying assumptions will be discussed in view of the findings from the analysis.

Summary

The sample of this study is composed of one hundred and thirty-seven education coordinators, supervisors (department heads, section chiefs) and medical technology interns associated with Medical Technology education in five North Central states; namely, Illinois, Indiana, Michigan, Ohio and Wisconsin. The data was compiled and summarized for analysis by use of the Computer Institute for Social Science Research (CISSA) Data Analysis System. The Chi Square statistic is used to analyze the data. The descriptive study provides an evaluation of the medical technology curriculum and presents future suggestions for curricular change.

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CHAPTER IV

RESULTS AND DISCUSSION OF THE STUDY

Introduction

The purpose of the study, as previously stated, is to determine future needs for medical technology education. The underlying assumptions and related data to each are presented and discussed. The major headings are: (1) A Look at the Medical Technology Curriculum, (2) Specialization and the Medical Technology Curriculum, and (3) Continuing Education for the Medical Technologist.

Contingency tables are used for the summation of data. Percentages of each group's responses are tabulated. The total replies for all respondents are given infrequently where the data lends itself to a better comparative analysis. The Chi Square values are recorded; the significance of the value is designated.

Underlying Assumptions of the Study

The underlying assumptions are:

1. Present and future developments in clinical laboratory medicine demand new approaches in creating a viable curriculum for clinical laboratory practitioners.
2. Scientific advances, consumer demands, and trends in medicine require early specialization.
3. Opportunities for continuing education must be established in order to keep up to date in laboratory medicine.

The assumptions provide three major areas for exploration. A review of present medical technology education, and the evaluation of the basic knowledge and skills taught to graduates from the curriculum, provide a method of determining if the curriculum is meeting the goals of the educational program. Secondly, an assessment of developments within the field of medical technology and the impact on the future curriculum must occur. Finally, means for upgrading practitioners must be both functional and effective.

The Medical Technology Curriculum:
Present and Future Medical
Technology Curriculum
Planning

The Board of Registry, ASCP, guidelines state that a student of medical technology must fulfill a minimum academic requirement in order to become eligible for certification by the Board (See Table 8).⁴⁸

To determine thinking about medical technology education, items 14 through 20 of the questionnaire pertain to the appropriation of time and a list of courses for meeting academic requirements (See Appendix B). The questions elicited such information as: the total period of time for educating a medical technologist; minimum periods for academic and clinical studies; when clinical education should commence; and what chemistry, biological and physical science courses should remain in the curriculum (See Tables 9 through 15).

⁴⁸The American Society of Clinical Pathologists, Board of Registry, pamphlet, 1973, pp. 4,5.

TABLE 8.--Required Academic Courses for Certification of Medical Technologists by the Board of Registry.

Disciplines			
	Chemistry	Biological Sciences	Mathematics
<u>Required</u>	General College Chemistry		College Level Mathematics
<u>Strongly Recommended</u>	Quantitative Analytical Chemistry	Basic Bacteriology	Physics
<u>Other Requirements may be selected from list</u>	Biochemistry, Organic Chemistry, or Any chemistry which requires one full academic year of General Chemistry	General Biology, Zoology, Botany, Physiology, Comparative Anatomy, Parasitology, History, histologic technic, Genetics or Any other course acceptable toward a biological science Major.	
Minimum Required Credit Hours	16 Semester Hours (24 quarter Hrs.)	16 Semester Hours (24 quarter hours)	Variable

The direction of the medical technology curriculum has been one of increased basic academics in order to meet new demands of the profession. The minimum requirement for a degree in medical technology is three years of academic course work and one year of clinical education. Table 9 indicates that the majority of the responders (70.08%) perceive medical technology as a four year curriculum. Twenty-four and

eighty-two hundredths percent (24.82%) of the responders view medical technology as a five year curriculum.

Tables 10 and 11 demonstrate the assignment of time for the academic and clinical studies. The majority of the subjects' responses agree with the present curricular design; that is, three years of academic study and one year for clinical (50.36% and 76.64% respectively). Two medical technology interns' replies to minimum academics were one year and five years. Perhaps the response of one year might arise when no relationship is observed between the academic preparation and the professional's work assignment, or the intern might have low expectations in terms of perceiving his role as a medical technologist. The intern's response of five years might be evidence of a very high expectation of his role as a medical technologist or the recognition of a need for more time to gain a thorough background in the academics.

The minimum time for clinical study ranges from three months to eighteen months. A total of thirty subjects (21.90%) concludes that a year of clinical study is either too long or too short a period. This variation may be due to either over-emphasis of materials which could be removed from the clinical year without weakening the curriculum or to a lack of time in which newer materials may be adequately taught. Again, expectancy levels expressed in behavioral goals, objectives and achievements of involved persons may account in part for the variation. The Chi Square values for Tables 9, 10 and 11 indicate that the responses are not significant at the .05 level.

TABLE 9.--Total Time for Post-High School Education of a Medical Technologist.

No															
Response		1 Year		2 Years		3 Years		4 Years		5 Years		Total			
N	%	N	%	N	%	N	%	N	%	N	%	N	%		
Education Coordinator	1	0.73	-	-	-	-	-	20	14.60	5	3.65	26	18.98		
Medical Technology Intern	-	-	-	-	-	2	1.46	31	22.63	11	8.03	44	32.12		
Supervisor (Department Head, Section Chief)	1	0.73	-	-	-	3	2.19	45	32.85	18	13.14	67	48.91		
Total	2	1.46	-	-	-	5	3.65	96	70.08	34	24.82	137	100		

Chi Square = 3.525
Not significant at the .05 level.

TABLE 10.--Minimum Time for Academic Study.

	Response		1 Year		2 Years		3 Years		4 Years		5 Years		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	3	2.19	-	-	2	1.46	12	8.76	9	6.57	-	-	26	18.98
Medical Technology Intern	-	-	1	0.73	7	5.11	21	15.33	14	10.22	1	0.73	44	32.12
Supervisor (Department Head, Section Chief)	1	0.73	-	-	8	5.84	36	26.28	22	16.06	-	-	67	48.91
Total:	4	2.92	1	0.73	17	12.41	69	50.36	45	32.85	1	0.73	137	100.00

Chi Square = 13.849

Not significant at the .05 level.

TABLE 11.--Minimum Time for Clinical Study.

	Response		3 Months		6 Months		9 Months		12 Months		18 Months		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	1	0.73	2	1.46	2	1.46	3	2.19	15	10.95	3	2.19	26	18.98
Medcial Technology Intern	-	-	1	0.73	2	1.46	3	2.19	32	23.36	6	4.38	44	32.12
Supervisor (Department Head, Section Chief)	1	0.73	-	-	-	-	2	1.46	58	42.34	6	4.38	67	48.91
Total:	2	1.46	3	2.19	4	2.92	8	5.84	105	76.64	15	10.95	137	100.00

Chi Square = 16.266
Not significant at the .05 level.

Academic and Clinical Education

The medical technology curriculum is criticized for the chasm between academic and clinical studies. These criticisms are directed toward (1) the lack of integration between theoretical materials and applicability,⁴⁹ (2) the absence of early clinical exposure in the curriculum which results in students' unawareness of what is medical technology,⁵⁰ and (3) a need for affiliation agreements between colleges or universities and the clinical institutions or hospitals to insure equal educational experiences.⁵¹

When asked where should the commencement of clinical education occur, forty-eight (35.04%) stated during the senior year and eighteen (13.14%) stated post-senior year. A total of sixty eight (49.64%) of the subjects specified that clinical studies should be introduced at either freshman year, sophomore year or junior year (See Table 12). Early introduction of clinical instruction into the curriculum is believed by some to dilute out the concentration in the basic science prerequisites and reduce the curriculum to a level of technical experiences only.

In the emergence of medical technology as a profession, the following criteria have been manifested:

⁴⁹Hamstra, Roger D., "Medical Technology Education - A Program with Maximum Use of Student Classroom - Laboratory Facilities", American Journal of Medical Technology, Vol. 39, June, 1973, p. 245.

⁵⁰Margaret Howell, Editor, "A Real World Approach to M.T. Education", Medical Lab, Vol. 8, January, 1972, pp. 12-13.

⁵¹Board of Schools (ASCP), Accreditation Workshop, Chicago, Illinois, October 19-20, 1973.

(1) A basis of systematic theory, (2) authority recognized by the clientele of the professional group, (3) broader community sanction and approval of this authority, (4) a code of ethics regulating relations of professional persons with clients and with colleagues, and (5) a professional culture sustained by formal professional associations.⁵² Trolio writes: "The justification for professionalism is that the worker has competence to deal with a given process, structure or situation which is important to the community but potentially dangerous in the hands of the unqualified. Because of the supposed competence involved, control over the profession should be in the hands of professionals. The three most important aspects of control are training the new member, regulating the quality of practice of the members; and certifying the competence of those allowed to practice."⁵³ Those who state that clinical studies should occur during the senior or post-senior years perhaps see the increased need for concentrated basic science backgrounds which might produce a more flexible medical technologist in a very changeable field. Also, increased educational levels conceivably may assist in maintaining professional status.

The majority of the subjects either strongly agree (63; 45.99%) or agree (54; 39.42%) that the medical technology curriculum should be planned as a whole academic and clinical. Ten (7.30%) disagree and one (0.73%) strongly disagree with this question. (See Table 13).

⁵²Vollmer, Howard M., and Mills, Donald L., ed., Professionalization, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1966, p. 9.

⁵³Trolio, William M., "Medical Technology: A Profession in Turmoil", Medical Lab, Vol. 10, January, 1974, p. 18.

TABLE 12.--Commencement of Clinical Education.

	No Response		Freshman Year		Sophomore Year		Junior Year		Senior Year		Post Senior Year		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	1	0.73	4	2.92	1	0.73	7	5.11	10	7.30	3	2.19	26	18.38
Medical Technology Intern	-	-	2	1.46	6	4.38	12	8.76	17	12.41	7	5.11	44	32.12
Supervisor (Department Head, Section Chief)	2	1.46	3	2.19	10	7.30	23	16.79	21	15.33	8	5.84	67	48.91
Total:	3	2.19	9	6.57	17	12.41	42	30.66	48	35.04	18	13.14	137	100.00

Chi Square = 8.679

Not significant at the .05 level.

TABLE 13.--Plan Medical Technology Curriculum as Whole Academic and Clinical.

	No Response		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	11	8.03	8	5.84	3	2.19	3	2.19	1	0.73	26	18.98
Medical Technology Intern	-	-	19	13.87	22	16.06	-	-	3	2.19	-	-	44	32.12
Supervisor (Department Head, Section Chief)	2	1.46	33	24.09	24	17.52	4	2.92	4	2.92	-	-	67	48.91
Total:	2	11.46	63	45.99	54	39.42	7	5.11	10	7.30	1	0.73	137	100.00

Chi Square = 13.894
Not significant at the .05 level.

Planning the curriculum as a total unit would involve less curricular duplication and the presence of recommended courses in the curriculum. Designing a total curriculum would involve all faculty, academic and clinical, and students; and, perhaps lead to quality programs. Those subjects who disagreed or strongly disagreed a total of 11 (8.03%) may see this action as one leading to an undesirable situation in which the theory is taught entirely in the academic institutions and only technical skills in clinical ones. Such a system would lead to a less stimulating educational environment in which educational and behavioral goals would not be achieved. Technical experiences without the theoretical explanation of the why's and how's are somewhat sterile. The Chi Square values are not significant at the .05 level.

Academic Course Work and the Medical Technology Curriculum

In requesting information concerning basic science courses prior to entering clinical studies, the educational patterns conformed to the basic guidelines of required and recommended courses by the Board of Registry, ASCP (See Tables 8, 14, and 15). In Tables 14 and 15 the percentages represent total responses.

The Chi Square values for the following basic chemistry and physical science courses found to be significant at the .05 level are: (1) mathematics, (2) biochemistry and physics (See Table 14). Only four responders (2.92%) could not see where mathematics applied in the curriculum. These subjects are represented by one medical technology intern and three supervisors. Mathematics is a required course by

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the Registry and is important to the curriculum in that a graduate finds that mathematics is essential in calculating and reporting results of clinical findings. The Chi Square value may be explained in that all three groups are consistent in noting that mathematics is an essential course.

The Chi Square value for biochemistry is significant at the .05 level. Representatives of the groups who were neutral or disagreed about the importance of biochemistry to the medical technology curriculum are: (1) three medical technology interns' replies were neutral, (2) three supervisors' responses were neutral, and (3) one medical technology intern disagreed that biochemistry is a desirable course. This Chi Square value may also be explained in that the majority of the subjects see a strong relationship between the biochemistry requirement and the medical technology program. Concepts of biochemistry are found in nearly every aspect of clinical laboratory medicine.

The last Chi Square value which was found to be significant at the .05 level is physics. Thirty-nine responders (28.47%) were neutral. Eleven subjects (8.03%) disagreed. The representation of those who are neutral are: four education coordinators, eleven medical technology interns and twenty-four supervisors. Those who found physics an undesirable prerequisite are nine medical technology interns and two supervisors. The explanation of this value may be the lack of understanding where physics is applicable in a clinical setting. Classical physics as taught in most curricula may be too far removed to appreciate its application in precision instruments in the laboratories.

TABLE 14.--Basic Chemistry and Physical Science Courses which are Considered Desirable as Pre-requisites to or for the Curriculum of Medical Technology.

Percentage of Total Responses															
	No Response		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	Chi Square	
	N	%	N	%	N	%	N	%	N	%	N	%			
Mathematics	1	0.73	73	53.28	59	43.07	4	2.92	-	-	-	-	137	100	12.681*
General Chemistry	-	-	104	75.91	31	22.63	1	0.73	1	0.73	-	-	137	100	4.816
Qualitative Chemistry	1	0.73	74	54.01	46	33.58	15	10.95	1	0.73	-	-	137	100	5.984
Quantitative Chemistry	2	1.46	84	61.31	44	32.12	5	3.65	2	1.46	-	-	137	100	6.037
Organic Chemistry	1	0.73	56	40.88	61	44.53	16	11.68	3	2.19	-	-	137	100	12.604
Biochemistry	-	-	88	64.23	42	30.66	6	4.38	1	0.73	-	-	137	100	13.134*
Physical Chemistry	10	7.30	15	10.95	36	26.28	52	37.96	23	16.79	1	0.73	137	100	8.121
Instrumentation	-	-	84	61.31	43	31.39	10	7.30	-	-	-	-	137	100	9.251
Physics	5	3.65	23	16.79	59	43.07	39	28.47	11	8.03	-	-	137	100	22.304*
Other	137	100	-	-	-	-	-	-	-	-	-	-	137	100	.639

*Significant at the .05 level.

The basic biological science courses which were added to the list were genetics, hematology, developmental biology, cell physiology and virology (See Table 15). Perhaps these courses are added because of a need to better understand disease processes which are congenital or involve a different causative agent than bacteria. The developments and deeper understanding of relative new sciences are opening more avenues for investigation.

The request for recommendations for future academic work shows two courses which were found to be significant at the .05 level (See Table 16). Personnel management and communication skills, written and verbal, show that the majority of the subjects (69; 50.37% and 105; 67.83%, respectively) agree to strongly agree that these are important courses for future additions to the curriculum.

The variation in responses and significance level to a course in personnel management may be explained in that the need is recognized; but, would a course be more effective at the undergraduate level or graduate. Perhaps the principles of management are most effective when the application is observed and vitalized. Communication skills, written and verbal, demonstrate a large Chi Square value. At all levels of the curriculum and in the practice of medical technology, verbal and written skills are important. Perhaps, the lack of effective use of such skills could explain the Chi Square value.

An instrumentation course was present twice on the questionnaire (See Tables 14 and 16). This course is a fairly new addition to a few medical technology programs. The subjects on both occasions are in agreement that such a course is desirable. The Board of Registry

ASCP, will accept a chemical instrumentation course as a satisfactory alternative for a biochemistry one.⁵⁴ The researcher does not fully support such a substitution. Presentations of biochemical concepts may be absent or limited in the course content.

One subject recommended that psychology become a part of future course work. The responder specified that such a course should deal with effects of tending the ill and dying. In the open-ended questions, which will be discussed later in this treatise, another subject stated that the psychological effects of automation on medical technologists should be explored. In most medical technology curricula, electives are pertinent in achieving a well-rounded student. Perhaps psychology should appear as an elective. It is conceivable that many of the recommendations for future academic study be considered as electives or part of postgraduate studies.

Clinical Study and the Medical Technology Curriculum

Most professional courses, such as blood banking, clinical chemistry, hematology, medical microbiology, and urinalysis are taught in the medical technology school, which is hospital-based. In the majority of cases the twelve months of clinical study in a hospital is equivalent to the fourth year of college.

The formats for this year may vary among institutions. Three widely used formats are: (1) work-study program in which the student alternates academic and clinical work for set periods of time,^{55,56}

⁵⁴The American Society of Clinical Pathologists, Board of Registry, Pamphlet, 1973, p. 4.

⁵⁵Margaret Howell, editor, "A 'Real World' Approach to M.T. Education", p. 12.

⁵⁶Copeland, Bradley E., "Future Shock-A Present Reality in Pathology", p. 704.

(2) student laboratories in which procedures, methods, principles are given all students followed by rotation in clinical laboratories,⁵⁷ and (3) conventional clinical rotations in which medical technology interns rotate through the clinical laboratories on an individual basis, and lectures, which are not synchronized with clinical rotations, are given to all students simultaneously. Other types of formats suggested were synchronized lectures and clinical rotations. This format was suggested by five medical technology interns (3.65%). No further explanation was given about the detail of this format. All responders who suggested different formats believe that they would be very effective.

Tables 17, 18, and 19 show the results to the three listed formats for clinical studies. It is found that the majority of the subjects believe that all three formats are effective to very effective. These responses may be due to the recognition of positive educational stimuli and dedicated instructors; therefore, under these conditions the learning processes for medical technology interns will occur. The Chi Square values are not significant at the .05 level.

The conventional clinical rotation is found less effective by fourteen subjects (10.22%) because most clinical facilities are service oriented and education is a secondary function. This priority might weaken the instructional function. In comparison with the student-classroom-laboratory format where teaching is a primary function, the criticism is that the medical technology intern does not easily adapt to the work pressure environment of a hospital-based laboratory.

⁵⁷Hamstra, Roger D., "Medical Technology Education - A Program with Maximum Use of Student Classroom-Laboratory Facilities", p. 245.

TABLE 15.--Basic Biological Science Courses which are Considered Desirable as Prerequisites to or for the Curriculum of Medical Technology.

Percentage of Total Responses																					
No Response			Strongly Agree			Agree			Neutral			Disagree			Strongly Disagree			Total		Chi Square	
N	%		N	%		N	%		N	%		N	%		N	%		N	%		
General Bio.	2	1.46	73	53.28	49	35.77	9	6.57	4	2.92	-	-	-	-	137	100	-	137	100	-	4.912
Botany	5	3.65	9	6.57	12	8.76	61	44.53	40	29.20	10	7.30	137	100	-	-	-	137	100	-	14.613
Zoology	3	2.19	32	23.36	59	43.07	34	24.82	8	5.84	1	0.73	137	100	-	-	-	137	100	-	6.885
Anatomy	1	0.73	68	49.64	50	36.50	17	12.41	1	0.73	-	-	-	-	137	100	-	137	100	-	6.357
Histology	4	2.92	21	15.33	42	30.66	46	33.58	23	16.79	1	0.73	137	100	-	-	-	137	100	-	15.977
Physiology	2	1.46	76	55.47	50	36.50	9	6.57	-	-	-	-	-	-	137	100	-	137	100	-	5.598
Parasitology	1	0.73	77	56.20	52	37.96	5	3.65	2	1.46	-	-	-	-	137	100	-	137	100	-	11.030
Mycology	1	0.73	67	48.91	56	40.88	11	8.03	2	1.46	-	-	-	-	137	100	-	137	100	-	11.178
General Microbiology	3	2.19	92	67.15	31	22.63	10	7.3	1	0.73	-	-	-	-	137	100	-	137	100	-	9.919
Medical Bacteriology	2	1.46	111	81.02	19	13.87	4	2.92	1	0.73	-	-	-	-	137	100	-	137	100	-	8.108
Immunology	4	2.92	84	61.31	45	32.85	2	1.46	2	1.46	-	-	-	-	137	100	-	137	100	-	12.927
Other	118	86.13																			
Genetics	-	-	12	8.76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hematology	-	-	-	-	4	2.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Developmental Biology	-	-	-	-	1	0.73	-	-	-	-	-	-	-	-	137	100	-	137	100	-	8.525*
Cell Physiology	-	-	-	-	1	0.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Virology	-	-	-	-	1	0.73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Significant at the .05 level.

TABLE 16.--Recommendations for Future Academic Work.

	No Response		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	Chi Square	
	N	%	N	%	N	%	N	%	N	%	N	%			
Personnel Management	2	1.46	21	15.33	48	35.04	46	33.58	17	21.41	3	2.19	137	100	19.683*
Current issues, i.e., legislation, legal ability, bargaining units	1	0.73	5	3.65	43	31.39	59	43.07	27	19.71	2	1.46	137	100	9.282
Computer Science	1	0.73	33	24.09	71	51.82	25	18.25	7	5.11	-	-	137	100	11.704
Biostatistics	-	-	24	17.52	63	45.99	42	30.66	8	5.84	-	-	137	100	5.128
Instrumentation	-	-	87	63.50	42	30.66	7	5.11	1	0.73	-	-	137	100	12.075*
Communication Skills, Written and verbal	1	0.73	41	29.93	65	47.45	25	18.25	4	2.92	1	0.73	137	100	33.775*
Education, Teacher Preparation	1	0.73	19	13.87	46	33.58	48	35.04	22	16.06	1	0.73	137	100	15.035
Business, Budgeting and purchasing	2	1.46	9	6.57	55	40.15	48	35.04	23	16.79	-	-	137	100	6.155
Professional ethics	1	0.73	47	34.31	62	45.26	23	16.79	4	2.92	-	-	137	100	11.370
Scientific writing	1	0.73	12	8.76	54	39.42	57	41.61	13	9.49	-	-	137	100	12.479
Other	136	99.27											137	100	1.052
Psychology			1	0.73											

*Significant at the .05 level.

TABLE 17.--Appraisal of Clinical Programs: Work Study.

	No Response		Very Effective		Effective		Neutral		Less Effective		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	3	2.19	2	1.46	12	8.76	7	5.11	2	1.46	26	18.98
Medical Technology Intern	2	1.46	16	11.68	16	11.68	4	2.92	6	4.38	44	32.12
Supervisor (Department Head, Section Chief)	6	4.38	18	13.14	25	18.25	15	10.95	3	2.19	67	48.91
Total:	11	8.03	36	26.28	53	38.69	26	18.98	11	8.03	137	100.00

Chi Square = 13.055

Not significant at the .05 level.

TABLE 18.--Appraisal of Clinical Program: Student Laboratory.

	No Response		Very Effective		Effective		Neutral		Less Effective		Ineffective		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	2	1.46	7	5.11	13	9.49	2	1.46	1	0.73	1	0.73	26	18.98
Medical Technology Intern	2	1.46	18	13.13	15	10.95	2	1.46	7	5.11	-	-	44	32.12
Supervisor (Department Head, Section Chief)	2	1.46	25	18.25	28	20.44	4	2.92	6	4.38	2	1.46	67	48.91
Total:	6	4.38	50	36.58	56	40.88	8	5.84	14	10.22	3	2.19	137	100.00

Chi Square = 7.186
Not significant at the .05 level.

TABLE 19.--Appraisal of Clinical Programs: Conventional Clinical Rotation.

	No Response		Very Effective		Effective		Neutral		Less Effective		Ineffective		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	7	5.11	17	12.41	-	-	2	1.46	-	-	26	18.98
Medical Technology Intern	2	1.46	5	3.65	28	20.44	4	2.92	5	3.65	-	-	44	32.12
Supervisor, (Department Head, Section Chief)	5	3.65	12	8.76	31	22.63	12	8.76	7	5.11	-	-	67	48.91
Total	7	5.11	24	17.52	76	55.47	16	11.68	14	10.22	-	-	137	100.00

Chi Square = 12.103

Not significant at the .05 level.

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Fourteen (10.22%) found this format less effective and one (0.73%) found it ineffective. The work-study program is not as prevalent as the other two formats; but, those who consider it less effective might consider the interruptions of the academic studies as undesirable. This may also apply to the clinical studies in that comprehension of course materials may be better attained by continuous exposure to either academics or clinical studies so that integration and application of the course materials may occur more easily.

Curriculum Planning

Two questions were asked to ascertain the involvement of clinical instructors in medical technology curriculum planning at affiliated colleges and universities (See Appendix B, items 24A, 24B, and 24C). The percentages of responders giving curricular advisement and the incorporation of the curricular recommendations are found in Table 20. The Chi Square values are significant at the .05 level.

In response to whether curricular recommendations were made, forty-one (29.93%) subjects stated the affirmative in comparison to ninety-two (76.15%) who had not. Twenty-seven (19.71%) of the recommendations had been incorporated in parallel to eight (5.84%) which had not been included in the curriculum.

Affiliation agreements between the hospital and colleges or universities are important in communicating, and evaluating the total medical technology curriculum. Without this avenue, relevancy of the medical technology curriculum may be quickly lost in both academic and clinical studies. Not only is the affiliation agreement important, but once established the avenue of communication must be kept open

beyond the initial agreement and used by all involved academic and clinical faculties and students of medical technology. As demonstrated by the data, the evaluation of the curriculum by this means receives limited use. This might partially explain such high Chi Square values.

A list of course recommendations appears in Table 21. Physics, genetics, and biochemistry are recommended by the Board of Registry, ASCP. The responders state that these courses should be required as a part of the curriculum. Mycology and parasitology were suggested to be considered electives. In a comprehensive clinical or medical microbiology course, a survey of these courses might be included in the subject matter. Immunology and instrumentation are recognized as valuable basic science preparatory courses for medical technologists. Such an evaluation might result in the suggestion that these courses become a requisite. These disciplines are paramount in clinical laboratory medicine. The Seminar in Medical Technology is suggested as a tool for introducing and defining medical technology. It is suggested that such a course be offered early in the curriculum for maximum benefit to the students. Medical terminology as an accredited course might be rather idealistic. Incorporation of medical and scientific terminology might be more beneficial if taught as a part of science and medical courses.

TABLE 20.--Medical Technology Curriculum Planning.

Have you given any curricular advisement?								
	No Response		Yes		No		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	1	0.73	15	10.95	10	7.30	26	18.98
Medical Technology Intern	1	0.73	4	2.92	39	28.47	44	32.12
Supervisor, (Department Head, Section Chief)	2	1.46	22	16.06	43	31.39	67	48.91
Total	4	2.92	41	29.93	92	67.15	137	100.00

Has the curricular suggestion been incorporated?								
	No Response		Yes		No		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	13	9.49	12	8.76	1	0.73	26	18.98
Medical Technology Intern	41	29.93	-	-	3	2.19	44	32.12
Supervisor, (Department Head, Section Chief)	48	35.04	15	10.95	4	2.92	67	48.91
Total	102	74.45	27	19.71	8	5.84	137	100.00

Have you given any curricular advisement?

Chi Square = 19.710

Significant at the .05 level.

Has the Curricular suggestion been incorporated?

Chi Square = 22.626

Significant at the .05 level.

TABLE 21.--List of Course Suggestions for Medical Technology Curriculum.

Instrumentation

Clinical Microbiology

Physics*

Genetics*

*Make these courses a requirement rather than an elective.

Biochemistry*

Seminar in Medical Technology

Immunology

Mycology**

**Offer these courses as electives.

Parasitology**

Medical Terminology

Summary

The educational patterns in medical technology, in general, conform to the basic guidelines for three years of college and twelve months training in clinical facilities. The recommendations for course work follow very closely the guidelines set up by the Board of Registry, ASCP. The exceptions are that biochemistry, genetics, and physics should become required course work. Immunology and instrumentation are recommended as elective courses.

Specialization and Medical Technology

Why Specialization?

The extent of scientific and medical knowledge no longer permits a comprehensive coverage of all materials for the generalist. The Coggeshall Report defined the trends in medical education and practice as moving toward hospital-based specialty practice and away from community-based general practice.⁵⁸ The findings and recommendations of this document have relevance not only to the medical profession but also to every member of the allied health profession. Sister Mary Clare Heath writes, "Twenty years ago, a technologist could be a generalist, but today, it is impossible. Each laboratory department has become much too sophisticated for a generalist to obtain an expertise in each."⁵⁹

The questions concerning specialization were asked to determine if the responders have considered curricular differentiation as a new direction in curriculum planning.

The Undergraduate and Specialization

The subjects, who view specialization as a positive attempt in better meeting behavioral goals and objectives in educating medical technologists of the future, represent 11.68% (sixteen). One hundred and nineteen (86.86%) of the responders do not agree with the provision

⁵⁸L.T. Coggeshall, Planning for Medical Progress Through Education, Association of American Medical Colleges, April, 1965.

⁵⁹Sister Mary Clare Heath, O.S.F., "Our Impact on the Future", Medical Lab, Vol. 10, p. 18.

for specialization at the undergraduate level (See Table 22). Those who provided a reason for their responses state that most students would find it difficult to determine their interests at the undergraduate level. It was also stated that the experiences of a general curriculum would enable the student to become more familiar with the areas of specialties, thereby giving him better decision-making abilities. It is also important to note that the responses of two doctorate scientists were: (1) 'If I were to hire a technologist for a position in the clinical lab, I would hire an individual with a degree in microbiology rather than a medical technologist', and (2) 'The chief complaint which I find with the medical technologist is the lack of a basic scientific background'. The specialties of the two subjects are clinical microbiology and biochemistry.

The commencement of specialization ranged from the second year of study to after the fourth year (See Table 23). Eighty-one (59.12%) of the responders believe that specialization should occur after the fourth year. This specialization was to be obtained through post-graduate study. Several subjects stated that a new graduate should even work several years before specializing.

Job Opportunities and Medical Technology

The increased numbers of medical technology students seeking internship reached its highest peak in 1972. The medical technology clinical programs had reached capacity. Not only had the programs reached capacity, but medical technology graduates had difficulties

finding positions.⁶⁰ This forces the student who has found an internship to seek another field of interest.

TABLE 22.--Specialization and Medical Technology.

Should specialization take place in the undergraduate medical technology curriculum?

	No Response		Yes		No		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	-	-	2	1.46	24	17.52	26	18.98
Medical Technology Intern	1	0.73	5	3.65	38	27.74	44	32.12
Supervisor, (Department Head, Section Chief)	1	0.73	9	6.57	57	41.61	67	48.91
Total	2	1.46	16	11.68	119	86.86	137	100.00

Chi Square = 1.228
Not significant at the .05 level.

These observations led to the questions concerning the need for curricular emphasis which would prepare the student for employment in institutions other than hospitals; types of job classifications and degree requirement; and, a need for a definition of supportive personnel in the hospital-based laboratory (See items 22, 26, and 32, Appendix B).

⁶⁰ Margaret Howell, editor, "Reader Survey: How's the Job Market?", Medical Lab, Vol. 9, July, 1973, p. 18-19.

TABLE 23.--Specialization and Medical Technology: Year specialization should commence.

	No		Response		1st Year		2nd Year		3rd Year		4th Year		After 4th Year		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	7	5.11	-	-	1	0.73	3	2.19	-	-	15	10.95	26	18.98		
Medical Technology Intern	8	5.84	-	-	2	1.46	4	2.92	-	-	30	21.90	44	32.12		
Supervisor (Department Head, Section Chief)	19	13.87	-	-	2	1.46	7	5.11	3	2.19	36	26.28	67	48.91		
Total	34	24.82	-	-	5	3.65	14	10.22	3	2.19	81	59.12	137	100.00		

Chi Square = 5.532
Not significant at the .05 level.

Perhaps curriculum evaluation and revision would aid students in medical technology to prepare for other job opportunities in which on-job-training is required rather than a clinical internship. The counseling of students is the most crucial issue. A student must be explicitly advised to the lack of internship positions, alternative curricula and chances for employment. A student in a program which requires three years of college and one year of clinical study might be advised to obtain the baccalaureate degree in order to seek employment in other institutions.

A few institutions, other than hospitals, which employ medical technologists are listed in Table 24. The majority of the subjects do not respond or state that a particular course of study should be emphasized. Additions to this list are college-university and abortion clinics.

The Chi Square values for Public Health Laboratory and Veterinary Clinic were found to be significant at the .05 level. In examining the data for each group, it was found that more medical technology interns believe that certain course work should be emphasized for employment in these two institutions than those who did not respond or stated no. The frequencies for Public Health, which are in the affirmative, are education coordinator, two (1.46%); medical technology interns, twenty-two (16.06%) and supervisors, sixteen (11.68%). The frequencies reporting the affirmative for special course work for a veterinary clinic by the groups are education coordinator, seven (5.11%); medical technology interns, twenty-four (17.52%); supervisors, twenty (14.60%). The Chi Square values may also be significant because

TABLE 24.--Need for different curricular emphasis for employment in clinical and non-clinical institutions.

Percentage of Total Response									
	No Response N	No Response %	N	Yes %	N	No %	Total N	Total %	Chi Square
Public Health Laboratory	47	34.31	40	29.20	50	36.50	137	100	19.562**
Reference Laboratory	41	29.93	33	24.09	63	45.99	137	100	15.081
Research Laboratory	42	30.66	50	36.50	45	32.85	137	100	6.330
Veterinary Clinic	43	31.39	51	37.23	43	31.39	137	100	12.693**
Industry	54	39.42	30	21.90	53	38.69	137	100	7.374
Crime Laboratory	45	32.85	63	45.99	29	21.17	137	100	5.179
Private Clinical Laboratory	44	32.12	17	12.41	76	55.47	137	100	1.475
Other*	135	98.54	2	1.46	-	-	137	100	1.682

*Other institutions listed were college-university and abortion clinics.

**Significant at the .05 level.

of familiarity with the work requirements in Public Health and Veterinary Medicine.

Some responders explained that they believed curricular emphasis for a job was not important because an employer should provide on-job-training for special requirements. Responders who saw the need for supplementary courses believed that such a course might appear as an elective. A list of these courses appears in Table 24. One responder stated that these courses should be available as electives; the entire curriculum should not be changed.

Several positions are listed in item 26 (See Appendix B). The information requested is used to determine if any particular curricular pattern might prepare a student of medical technology for such a position. The degree requirement for the positions are listed in Table 26.

TABLE 25.--List of Desirable Courses for the Employment in Institutions other than Hospitals.

<u>Public Health Laboratory</u>	<u>Crime Laboratory</u>
Epidemiology	Epidemiology
	Pharmacology
<u>Reference and Research Laboratories</u>	Basic Law Course
Philosophy of Science or Approach	Toxicology
to Interpretation of Scientific	Psychology, Psychiatry
Data	Forensic Medicine
Instrumentation	Sociology
Scientific Writing	<u>Private Clinical Laboratory</u>
Advanced Chemistry	Business Administration
Microbiology	
<u>Abortion Clinic</u>	
Psychology, Psychiatry	
Sociology	

TABLE 26.--Positions and Degree Requirements: Percentage of Total Responses.

	No Response		B.A., B.S.		M.A., M.S., M.P.H.*		Ph.D., D.P.H.**		M.D.		Total		Chi Square
	N	%	N	%	N	%	N	%	N	%	N	%	
Quality Control Officer	11.00	8.03	105	76.64	21	15.33	-	-	-	-	137	100	13.446***
Supervisory Technologist	8	5.84	82	59.85	46	33.58	1	0.73	-	-	137	100	31.302***
Research and Development Technologist	9	6.57	39	28.47	69	50.36	20	14.60	-	-	137	100	10.229***
Administrative Technologist	10	7.30	46	33.58	71	51.82	7	5.11	3***	2.19	137	100	24.237***
Hospital Epidemiologist	12	8.76	30	21.90	49	35.77	29	21.17	17	12.31	137	100	5.324***
Computer Coordinator	15	10.95	80†	58.39	39	28.47	3	2.19	-	-	137	100	2.928***
Other††	134	97.81	-	-	2	1.46	1	0.73			137	100	14.104

*M.P.H., Master's of Public Health

**D.P.H., Doctor of Public Health

***Significant at the .05 level

****Not significant at the .05 level

*****Represents medical technology interns responses

†One responder states that an individual with less than a Bachelor's degree can fill this position.

††Other positions listed were Education Coordinator, MA, MS, or MPH, Microbiologist, Ph.D. or D.P.H.

The Chi Square values for quality control officer, supervisory technologist, were found to be significant at the .05 level. The two positions listed under other are education coordinator and microbiologist. The Chi Square values might be explained in that the groups are consistent in their responses about the degree requirement.

It must be noted that one subject stated that a Doctorate in Public Health may be a better degree for an Epidemiologist than a Ph.D. in microbiology. The argument given is that the required courses for the degree relate more directly to the duties of an epidemiologist. One responder stated that a computer coordinator could be someone with less than a Bachelor's Degree; one who has had essential computer-related training in basic programming and computer language. Three medical technology interns placed medical doctors in positions of administrative technologists. Administrative technologists are not an adequate title for a medical doctor whose specialty is pathology. Their position is more aptly entitled director of a clinical laboratory.

The course emphasis for the positions in Table 26 are biostatistics, personnel management, business administration, epidemiology, and instrumentation. Again several subjects stated that postgraduate education is essential for these positions.

Medical Technologists and Supportive Personnel

The following major questions must be answered concerning supportive personnel:

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1. How do we prevent medical technologists from becoming involved in work for which they are overly educated?
2. What rationale and method(s) can be employed to differentiate between the functions of a CLA, MLT and MT?
3. And to what extent is differentiation in function at such levels possible?

An appointed ASMT Committee attempted to delineate among the three groups.⁶¹ The technique is to devise activity lists which are appropriate to each level. One soon discovers that techniques performed by workers at each level differ only marginally. Further difficulties in refining the differentiation may occur in terms of bureaucratic rules, regulations and job classifications.

The question concerning supportive personnel (Item 32, Appendix B) was included to determine if through curriculum planning, delineation of each group's responsibilities and coordination of each group's activities might be more easily achieved. A related question about future work roles was included in the open-ended questions. The discussion of the latter will follow.

In Table 27, it is shown that a total of 104 (75.92%) agreed to strongly agree that the relationship of supportive personnel to the medical technologist must be defined. The Chi Square value is significant at the .05 level. The variation in the responses among supervisors might account for the high value. The total number of subjects (nine, 8.76%) who disagreed to strongly disagree on the need for a definition of the supportive personnel, perhaps have definite

⁶¹ Anna Lee Roe, editor, "ASMT Position Paper: Differentiation Among MT, MLT and CLA Expected Capabilities at Career Entry", American Journal of Medical Technology, Vol. 39, September, 1973, p. 362.

work roles of their own in terms of job title, status, and salary. The three medical technology interns might aspire to higher levels, and therefore see no conflict in work assignments.

Job promotion or career mobility are most important issues when defining the roles of supportive personnel. Principles for effectively achieving a job promotional system are: (1) education must be directly and specifically associated with the career or job; (2) levels and the sequence of the levels within a profession must be established; and (3) education at one level should contain core knowledge and skill development that are applicable at the next level.⁶²

Items 30 and 31 (See Appendix B) were used to gain information about the views of the responders on job promotion (See Tables 28 and 29). It is difficult to generalize that either educational background or technical competence is the only factor used in determining job promotion. Other criteria are equally necessary and important. The amount of supervision necessary for a given level of worker depends not only on his ability to perform a particular technique, but also on his ability to understand the desired result and undesirable alternatives. Several subjects stated that they would consider education and technical excellence together rather than separate.

⁶²Sally Holloway and Robert G. Holloway, Ph. D., "Work-Study Career Mobility Program", Hospitals, Vol. 46, August 16, 1972, pp. 74-75.

TABLE 27.--Supportive Personnel.

Definitions of relationship of supportive personnel must be defined.														
	No Response	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total		
		N	%	N	%	N	%	N	%	N	%			
Education Coordinator	-	-	13	9.49	12	8.76	-	-	1	0.73	-	-	26	18.98
Medical Technology Intern	3	2.19	8	5.84	20	14.60	10	7.30	3	2.19	-	-	44	32.12
Supervisor, (Department Head, Section Chief)	1	0.73	19	13.87	32	23.36	7	5.11	5	3.65	3	2.19	67	48.91
Total:	4	2.92	40	29.20	64	46.72	17	12.41	9	6.57	3	2.19	137	100.00

Chi Square = 19.970

Significant at the .05 level.

TABLE 28.--Job Promotion and Educational Background.

Job Promotion Based Upon Educational Background														
	No Response		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	-	-	13	9.49	7	5.11	4	2.92	2	1.46	26	18.98
Medical Technology Intern	3	2.19	5	3.65	15	10.95	11	8.03	9	6.57	1	0.73	44	32.12
Supervisor, (Department Head, Section Chief)	2	1.46	3	2.19	22	16.06	12	8.76	23	16.79	5	3.65	67	48.91
Total:	5	3.65	8	5.84	50	36.53	30	21.90	36	26.28	8	5.84	137	100.00

Chi Square = 13.673

Not significant at the .05 level.

TABLE 29.--Job Promotion and Technical Excellence.

Job Promotion Based Upon Technical Excellence														
	No Response		Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree		Total	
	N	%	N	%	N	%	N	%	N	%	N	%		
Education Coordinator	-	-	4	2.92	17	12.41	3	2.19	2	1.46	-	-	26	18.98
Medical Technology Intern	3	2.19	7	5.11	25	18.25	6	4.38	3	2.19	-	-	44	32.12
Supervisor (Department Head, Section Chief)	2	1.46	8	5.84	38	27.74	13	9.49	5	3.65	1	0.73	67	48.91
Total	5	3.65	19	13.87	80	58.39	22	16.06	10	7.30	1	0.73	137	100.00

Chi Square = 4.889
 Not significant at the .05 level.

Summary

Specialization in related disciplines to medical technology at the undergraduate level was not recommended by the majority of responders. Recommendation for commencement of specialization was after the fourth year of college. This view is believed to enhance the students' abilities in making a more critical evaluation of the related disciplines in arriving at his choice for future studies.

The clinical education of the medical technology curriculum is taught in clinical facilities, such as hospitals and medical centers. It is most often assumed that all graduates will work in an institution like the ones in which they have been educated. Counseling on job opportunities outside of a hospital setting, types of job classifications and educational requirements have been limited or absent. In response to questions regarding preparation for these types of job opportunities, the majority of responders either did not reply or stated that there was not a need for any specific course work. Those who stated that some courses should be afforded to facilitate working in these institutions believed that providing them as electives would be sufficient. It was also stated that these institutions are responsible for on-job-training of the employees if special knowledge and skills are needed. Differentiation within the curriculum for employment outside the clinical setting was found to be necessary. Therefore, clinical internship must still remain a part of the curriculum for those who might be bound for non-clinical jobs.

Definition of supportive personnel and the relationship to medical technologists was found to be importantly necessary. It was also found that job promotion may be related to educational background only, and technical skills only or both. Differentiation in the curriculum should reflect the opportunity for job mobility, both horizontally and vertically. Therefore, the curriculum must contain levels for providing required course work and skills. Perhaps through curriculum the delineation between supportive personnel and the medical technologist would become more understandable.

Continuing Education and the Medical Technologists

Definition of Continuing Education

Continuing education is not new to the education process. Early in the history of education this aspect existed without a name.

Historically, education was reserved for the most privileged persons. In the early 1900's, college was not a common goal for the young. At the end of World War II, and the birth of the GI Bill of Rights, higher education became a possibility for the "common man". The 1960's showed rapid increase in college and university enrollments. The junior college movement quickly became and still remains as an important element in the education system.⁶³

With the recognition of increased scientific and biomedical knowledge, education is a continuous process. Norman C. Harris writes: "Just as change is a permanent fixture of our society, so is

⁶³Lindberg, David, "Professional Societies and Continuing Education, Cadence, Vol. 4, November/December, 1974, p. 9.

continuing education the key to continued economic productivity in the decades ahead."⁶⁴ Continuing education may, therefore, be defined as education which is pursued for reasons other than preparation for career entry; but which is pursued to extend or build upon previous experiences in the same general realm of knowledge.⁶⁵

Development of Continuing Education Programs for Professionals

Licensure and certification of professionals by examinations are one time endeavors. This does not insure competency throughout one's professional career. It is recognized in the area of medical technology education that requirements for continued improvement of skills, knowledge and status within a profession require constant instructive stimuli.

Continuing education programs are concerns of the professional societies, health-related industrial companies, hospitals and universities. Continuing education programs are open to students with a wide variety of backgrounds. In most programs, the usual academic requirements such as grade point averages, minimum Graduate Record Examination scores, assignment of grades for student performance are eliminated.⁶⁶

⁶⁴Norman C. Harris, "Curriculum and Instruction in Occupational Education", in Emphasis: Occupational Education in the Two-Year College, Conference sponsored by the Midwest Technical Education Center and The American Association of Junior Colleges, St. Louis, Missouri, May 12-14, 1966, p. 61.

⁶⁵Ruth I. Heinemann, "Continuing Education in Medical Technology", American Journal of Medical Technology, Vol. 37, April, 1971, p. 150.

⁶⁶David Lindberg, "Professional Societies and Continuing Education", p. 12.

The opportunity for job promotion, horizontally or vertically, may be enhanced by continuing education programs. A question concerning this aspect of continuing education was asked (See Table 30). The majority of the subjects (73; 53.28%) stated that continuing education programs at their institution were not geared toward job promotion. The quality of the program ranged from excellent to poor (See Table 31). Some responders stated that such endeavors were new to their institution; but, with more experience in presenting seminars, improvement is being observed. The majority of subjects (109; 79.56%) viewed continuing education as the best method for post graduate education (See Table 32). This view supports the concept that post graduate education is a means of reinforcement and review of knowledge and for gaining additional knowledge to keep pace with change.

The Chi Square for Tables 31 and 32 are significant. An explanation for the value in Table 31, is perhaps, individuals who responded negatively have no desire to see the application of continuing education. The traditional science backgrounds for medical technologists might have deterred them from exploring different related areas to clinical laboratory medicine. Examples are teaching in health career programs, sales in related industry, technical consultations and management.

The quality of the programs is dependent upon the efforts of the individuals involved. If application is not visible, quality may be a lesser criterion for the programs. "One cannot afford to merely let things happen; if one seeks success, he will have to make things happen."⁶⁷

⁶⁷Annamarie Barros, "Continuing Education: Why is it Necessary?", Cadence, Vol. 4, November/December, 1974, p. 63.

TABLE 30.--Continuing Education and Job Promotion

Continuing Education Means of Job Promotion at Your Institution									
	No Response		Yes		No		Total		
	N	%	N	%	N	%	N	%	
Education Coordinator	-	-	10	7.30	16	11.68	26	18.98	
Medical Technology Intern	14	10.22	15	10.95	15	10.95	44	32.12	
Supervisor, (Department Head, Section Chief)	1	0.73	24	17.52	42	30.66	67	48.91	
Total:	15	10.95	49	35.77	73	53.28	137	100.00	

Chi Square = 30.395
Significant at the .05 level.

TABLE 31.--Quality of Continuing Education Programs at Your Institution.

	No Response		Excellent		Very Good		Good		Satisfactory		Poor		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	9	6.57	-	-	8	5.84	5	3.65	4	2.92	-	-	26	18.98
Medical Technology Intern	33	24.09	-	-	2	1.46	7	5.11	2	1.46	-	-	44	32.12
Supervisor (Department Head, Section Chief)	35	25.55	5	3.65	11	8.03	12	8.76	3	2.19	1	0.73	67	48.91
Total:	77	56.20	5	3.65	21	15.33	24	17.56	9	6.57	1	0.73	137	100.00

Chi Square = 22.722
Significant at the .05 level.

TABLE 32 .--Continuing Education and Post Graduate Education.

View continuing education as best method for post graduate education.									
	No Response		Yes		No		Total		
	N	%	N	%	N	%	N	%	
Education Coordinator	1	0.73	19	13.87	6	4.38	26	18.98	
Medical Technology Intern	5	3.65	34	24.82	5	3.65	44	32.12	
Supervisor (Department Head, Section Chief)	3	2.19	56	40.88	8	5.84	67	48.91	
Total:	9	6.57	109	79.56	19	13.87	137	100.00	

Chi Square = 4.550

Not significant at the .05 level.

1

Summary

Education for the present and future must respond to change. In summation, the following factors must be dealt with in order to plan for the permanency of change:

1. The increasing complexity of everyday life in all facets-cultural, intellectual, and occupational.
2. The explosion of scientific and technical knowledge, the scope of which nearly doubles every decade.
3. The hard fact that in our society education stands between man and his job.
4. Recognition of the fact that much, if not nearly all, of the occupational education of the future will have to be conducted at post-high school levels.⁶⁸

Norman Harris states "Lack of education is today's guarantee of leisure."⁶⁹ To paraphrase this statement--lack of continued education is tomorrow's guarantee of leisure.

The Future of the Medical Technology Curriculum

Core Curriculum

In the earlier discussion of supportive personnel, career mobility (job promotion), was found to be important factors if a career ladder is to be functional. Occupational mobility requires an individual at a lower level, such as an MLT, to acquire additional knowledge and skills through a combination of education and experience without excessive loss of past investments.

⁶⁸Norman C. Harris, "Curriculum and Instruction in Occupational Education", in Emphasis: Occupational Education in the Two-Year College, p. 60.

⁶⁹Ibid, p. 60.

The question addressed to the development of a core curriculum for MLT, MT and medical students, drew twenty-nine positive and seven negative responses (See Appendix B, Item 39). Those who replied positively stated that:

1. Integration of curricula would delete needless duplication of required basic science courses, and cut down on cost.
2. Integration of curricula at the basic level would assist in maintaining high standards for a course, and
3. Integrated education experiences of groups would promote job or career mobility by making each group aware of course material, interests and promote an appreciation for all allied health and medical workers.

A summation of negative replies are:

1. Large classes would result in less individual attention.
2. Course spectrum may become too wide ranged.
3. Level of instruction may deteriorate to minimal level in order to reach the lesser requirements.
4. MLT, MT students could not perform competitively with medical students.

The basic concept of the core curriculum is that pre-counseled students can enroll in the required basic courses, such as biology, chemistry, anatomy and physiology, and mathematics, then move into specialized courses for the chosen health field. The concept is not exactly new and is currently functioning in some colleges and universities. If career mobility is to be realized, the concept of core curriculum should begin to appear in more related education programs.

Automation in Medicine

The impact of automation on men and their jobs is paramount. Automation in medicine was accepted slowly. Since its acceptance,

the trend will be apparently increased automation for the future.

Fifty-five subjects' responses are summarized:

1. Biomedical engineers are expected to be the leaders in laboratory automation.
2. Recognition that job classification and responsibilities will change as automation increases.
3. Computer systems and electronics must be included in the medical technology curriculum.
4. Emphasis on principles and concepts in quality control of instruments will be required.
5. Recognition that instrumentation, as taught in the current medical technology curriculum, rapidly outdates due to ever-changing automation.

The educational programs of the future must seek new directions.

Some of the new directions will be dictated by the occurrences in the applied fields. Indeed, this is the dictum for the medical technology curriculum.

Medical Advances in Patient Care

Discovery of new medical techniques may require new developments in related fields. Forty responders foresee that such advances may affect medical technology as follows:

1. Development of new clinical laboratory procedures.
2. Emphasis on continuing education.
3. Need for strong basic background in order to adapt to change.

Thinking about the future always implies changes. New developments are impossible to incorporate into a curriculum. Therefore, individuals must be thoroughly educated in basic concepts for adaption to meet future requirements.

Types of Work Roles

The future, as expected, will bring about an alteration in present duties and responsibilities of the health care worker. The direction in which a medical technologist's responsibilities are changed must be appropriately reflected in the education process.

Forty-three subjects responses are summarized below:

1. Need for education to qualify as teachers, supervisors and managers.
2. Necessitates specialization at postgraduate level.
3. Need for more refined definition on supportive personnel.
4. Educate fewer medical technologist and more CLA's and MLT's.
5. Curriculum should prepare flexible students.

One subject stated that types of work roles is a counseling function and cannot be reflected in the curriculum. Another stated that he found no relationship between curriculum and types of work roles.

Prior to initiating or changing a curriculum or courses, two essential steps are necessary: (1) determining need and, (2) determining capability. An assessment of identifiable needs and unfilled demands must be made. This applies to medical technology, especially in future curriculum planning for work roles.

Methods of Teaching

The information explosion makes some materials obsolete within a short period of time. Medical technologists, experienced in their field, may not be quality instructors. Methods of teaching may assist

in meeting objectives and goals of the medical technology program.

The summary of responses of forty subjects follows:

1. Self instruction modules would allow students to work at their own pace.
2. Improvement may be facilitated in instruction and updating materials.
3. Early specialization in curriculum may be facilitated through self instruction modules.

Several subjects stated that a stimulating instructor, who is selective, can effectively use audiovisuals. One subject wrote, "There is no substitute for a human being -- this is a recorded message."

Another replied that he did not see a relationship between teaching methods and curriculum. Better ways for presenting new concepts and information has, and will continue to be, explored. The use and effectiveness of the methods and materials is directly proportional to the instructor's enthusiasm for his subject matter.

Other occurrences believed to affect the medical technology curriculum are:

1. Government regulations through licensure of medical workers,
2. Early required specialization, and
3. Need for counselors -- academic and job.

The goal in our work is to improve competence. The apparent trend is to educate adaptable generalists. Goal determination and role allocation are two major issues which challenge the medical technologist, today and tomorrow.

Summary

The pace of change poses real problems for medical technology. Questions which must be answered are: How can teachers be prepared, curriculum developed, students counseled, unless there can be better forecasts than now exists? No systematic or organized program has been developed to provide a method to keep abreast of present and future change. Observations are made from different fields and some opinions expressed are divergent, but the improved implementation of a viable curriculum in medical technology is the goal.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

In view of increasing developments in clinical laboratory medicine, the medical technology curriculum of the future must seek new directions. The medical technology curriculum is somewhat an anomaly in that an allocation of three or four years of education takes place in the college or university and the fourth or fifth year is spent in the hospital. The evolution of a new curriculum must be fostered by both the college or university and the hospital.

A questionnaire designed to gain information about the future needs in medical technology was mailed to education coordinators, medical technology interns and supervisors (department heads, section chiefs) of each clinical laboratory section of thirty-five randomly selected Schools of Medical Technology in five north central states; namely, Illinois, Indiana, Michigan, Ohio, and Wisconsin. Two hundred and forty-five questionnaires were mailed. One hundred and thirty-seven questionnaires were returned (55.9%). The responses were coded onto data processing cards and analyzed using Michigan State University Computer Laboratory and Control Data Corporation 3600 Computer. The Chi Square statistic is used in analyzing the data.

The research study is a descriptive analysis. The objective of the survey is to provide information about the need for revisions in the medical technology curriculum, which would prepare knowledgeable, capable, and acceptable professionals. The underlying assumptions analyzed are:

1. Present and future developments in clinical laboratory medicine demand new approaches in creating a viable curriculum for clinical laboratory practitioners.
2. Scientific advances, consumer demands, and trends in medicine require early specialization.
3. Opportunities for continuing education must be established in order to keep up to date in laboratory medicine.

The responses to questions concerning the medical technology curriculum, such as basic course requirements and clinical study, in general, conform to the basic guidelines of the Board of Registry, ASCP. The majority of the responders view medical technology as a four-year curriculum in which three years of study are at an academic institution and the fourth year is at a hospital. The exceptions in course requirements are that biochemistry, genetics, and physics should become requisite courses rather than highly recommended. Immunology and instrumentation are highly recommended as elective courses. Responses to management and communication skills produced a significant Chi Square value. These courses were suggested as elective course work. Management studies were also suggested for postgraduate education.

Specialization in related disciplines to medical technology at the undergraduate level was not recommended by the majority of subjects.

Postgraduate education was suggested as the best means to pursue specialist education. This view is believed to enhance the student's ability in making a more critical evaluation of the related disciplines in arriving at his choice for future studies.

The majority of subjects viewed continuing education programs as the best means for maintaining an acceptable level of competency in the profession. The continuing education programs at their institutions were not geared toward job promotion, and a few stated that the quality of the programs was poor. In spite of poor programs, recognition of postgraduate education, formal or informal, is an important issue in planning to meet future educational needs.

It is recognized that supportive personnel will affect the roles and functions of the medical technologist. The curriculum must assist in reflecting and delineating the positions of all laboratory workers. The subjects agree that the content of the curriculum must prepare the graduate with a basic foundation in scientific and managerial knowledge and skills in order to effectively enable him to assume future work roles.

Findings

Students of medical technology are required to meet minimum academic and clinical education requirements in order that a baccalaureate degree be granted upon completion of their studies. The total period for education prepares the student academically and technically for entry into the field of medical technology. The major objective of the curriculum is to insure knowledgeable practitioners.

When the respondents were asked about the minimum requirement for academic studies, twelve (46.15%) education coordinators, twenty-one (47.73%) medical technology interns, and thirty-six (53.73%) supervisors thought that a minimum of three years be devoted to academics. In comparison, nine (34.62%) education coordinators, fourteen (31.82%) medical technology interns, and twenty-two (32.84%) supervisors believed that four years of academic study is a better period of time (See Table 36, Appendix E).

In response to a minimum time for clinical study, fifteen (57.69%) education coordinators, thirty-two (72.73%) medical technology interns, and fifty-eight (86.57%) supervisors replied that twelve months were the optimum period for clinical education (See Table 37).

The two periods of time given by the majority of respondents to achieve a total education and meet the educational goals for a medical technologist are three years and one year for academic and clinical studies, respectively. However, it must be noted that a large number of the respondents view four years of academics as the best period for academic studies. These responses may reflect the type of programs from which the respondents received their education (See Table 34).

To determine when clinical education should begin, thirteen (50%) education coordinators, twenty-four (54.55%) medical technology interns, and twenty-nine (43.28%) supervisors stated that clinical education should take place during the senior year or later (See Table 38). The

medical technology interns' responses are somewhat surprising because relevancy of the curriculum or academic preparation may be lost if clinical exposure is held for a later time during the curriculum. However, placing clinical studies later may provide an uninterrupted period for concentrated basic science studies.

The clinical programs which provided the greatest variation among respondents, as to effectiveness, was the work study and conventional rotation formats (See Tables 39, 40, 41). Thirty-two (72.72%) medical technology interns stated that the work study format is effective to very effective in comparison to fourteen (53.84%) education coordinators and forty-three (64.18%) supervisors. The conventional clinical rotation was supported by twenty-four (92.30%) education coordinators in comparison to thirty-three (75%) medical technology interns and forty-three (64.18%) supervisors. The differences among agreement on the formats may be due to expected behavioral goals and guidelines to insure the attainment of the objectives of the program. By the response of the education coordinators to the conventional clinical rotation, perhaps they view this type of program as most effective for educating medical technologists as generalists. The supervisors who are specialists may foresee that a scheduled rotation limits the depth of the presentations in their areas of interest.

The medical technology interns' responses to the work study program is directly opposite to their responses concerning the commencement of clinical education (See Tables 38 and 39). The medical technology interns' (54.55%) stated that clinical education should begin in the senior

year or thereafter. In a work-study program, exposure to some aspects of clinical work may occur as early as the freshman year. Relevancy of the curriculum and knowledge of the profession can be achieved in such a program. Some students may view this type of program as a method of relieving anxieties in obtaining an internship; that is, the clinical faculty where the co-operative study was completed may be willing to provide the student with an internship, if he has performed well.

When asked if curricular advisement had been given to affiliated colleges and universities, fifteen (57.69%) education coordinators, four (9.09%) medical technology interns, and twenty-two (32.84%) supervisors participated in an exchange. Twelve of the education coordinators, and fifteen of the supervisors who had advised the affiliated colleges and universities found the suggestions incorporated into the curriculum (See Table 42). None of the student proposals was accepted. The curricular change suggested by the medical technology interns was to synchronize the clinical rotation with the formal lecture program. This is a difficult task to achieve in a clinical setting and perhaps explains the lack of incorporating this suggestion in the curriculum. Forty-three (64.18%) supervisors did not communicate changes in the curriculum in comparison to ten (38.46%) education coordinators. The education coordinators use this means of communications to the colleges and universities most effectively. This does indicate their proximity to the lines of communication in the program in comparison to the supervisors. The supervisors may give curricular feedback to the education coordinators which is not reflected in their responses. The route of communication

for the supervisors is indirect and is dependent upon the good public relations of the education coordinator and the extent to which the education coordinator is in agreement with the suggestions.

Twenty-four (92.31%) education coordinators, thirty-eight (86.36%) students and fifty-seven (85.07%) supervisors suggest that specialization should not take place in the undergraduate curriculum (See Table 43). The majority of the education coordinators are medical technologists, M.T. (ASCP) without any further special certification (See Table 33). This may, in part, explain their view for desiring to educate generalists. Twenty-five (37.33%) supervisors have diverse backgrounds. Their views may have been supported by past work experiences and personal reasons why they specialized.

In general, the respondents view the total medical technology curriculum as a four year program in which a minimum of three years be allocated for academic studies and one year for clinical. The majority of the respondents replied that clinical education should begin the senior year or later. The work study, student laboratory, and conventional laboratory rotation formats for clinical studies were found to be effective to very effective by the majority of the respondents. Specialization in the undergraduate curriculum was not recommended. It is generally agreed that specialization should occur after the fourth year of study.

Conclusions

The medical technology curriculum has provided the direction when the professional medical technologist needed a definition of

educational and work goals. The great technical advances in of methodology and instrumentation have not resulted in a removal the technologist from the laboratory organization, but has caused a changing of the role of the technologist. Many laboratories are utilizing the services of people who have been trained to do certain types of work for which the trained technologist is not necessarily required or capable of performing. In view of these facts, the curriculum is the critically important factor in providing individuals with the knowledge and skills for the future.

The last decade has brought about a great awareness of laboratory medicine. It is a complicated system in which several professionals and non-professionals work together in a coordinated and cooperative manner in order to provide quality health care to patients.

Dennis Gabor speaks of technology in The Mature Society as follows:

I cannot (and I do not even wish to) visualize anything like a 'final' state, or more realistically, an almost stationary state which transforms the majority of human beings into the highest types of Homo sapiens, and the highest types into 'supermen'. But I think that I can visualize a state of transition towards it. This would still be a 'consumer society' in the sense that it supplies its citizens lavishly with material goods. In addition it also provides them with ample opportunities for education and entertainment. But it also provides them with work; enough work to bear their leisure without boredom. It goes without saying that in the next stage of technology no work need be back-breaking or stultifying . . .

I will assume, for the transitional period, a level of technology not higher than the present, but much better organized. Until such time as the new education (with as little biological intervention as possible) has transformed 'human nature' sufficiently, so that we can trust it not to fall back into the murderous follies of the past or

into a dull and sterile decadence, I believe that we must keep up a level of occupation not very different from the present. But, though the time occupied need not change much, the distribution of occupations will have to be made, gradually, very different. Instead of driving the consumer society ad absurdum, that part of time which is no longer needed for the production of goods will have to be used for the improvement of the quality of life by an immense extension of services, among which education must have a prominent part.⁷⁰

This is indeed the case in the education of medical technologists for the future.

Discussion

The Bureau of Labor Statistics, U.S. Department of Labor, predicts that 12,000 to 19,000 openings a year will exist with a total of 190,000 medical laboratory workers by the year 1980. According to the present trends in government sponsored health programs, more training programs will exist. These programs will be subsidized by the Federal Government through Allied Health Professions Personnel Training Acts and special Training Grants for required additional manpower needs.⁷¹

Some of the predicted positions will be filled by medical technologists whose qualifications must be predetermined for future work roles. Earlier in the treatise, it was stated that automated equipment reduces human involvement in the clinical laboratory in which the medical technologist is a key personnel. It is already recognized that there are legitimate roles in automated laboratories for equipment operators who do not have formal technologist qualifications.

⁷⁰Jennis Gabor, The Mature Society, Praeger Publishers, New York, 1972, pp. 87-88.

⁷¹Margaret Howell, editor, "Medical Technology in 1980: New Job Titles and More Job Openings", Medical Lab, Vol. 9, Feb. 1973, p. 18.

It is also noted that technologists' skills are needed in an automated environment to supervise, teach and work in expanded roles which are more challenging and commensurate with their skills.

Another positive development in the health care field and the education of the workers is the junior or community college movement. Monies from the Federal Government have been given generously to educate health workers to meet manpower demands. The apparent trend in junior colleges is to provide a comprehensive curriculum including vocational-technical curricula leading to occupational employment. Clinical laboratory curricula provided at the junior or community college are the Medical Laboratory Technician and Cytotechnologist's programs. These and other social trends have a tremendous effect upon the medical technology curriculum.

RECOMMENDATIONS

The predictors which are used for arriving at recommendations for curricular changes in medical technology are: (1) manpower studies, (2) general government funding for education for allied health workers, (3) veterans entering the health field, (4) medical technologists reentering the profession, (5) growth of the community college and the development of health programs, (6) effect of automation on health care, and (7) impact of legislation on the health care delivery system.

Another crucial issue is that in the past five years, the medical technology programs have been unable to accommodate the number of students seeking internships. The students who have come from programs of three

years of academic studies and are applying for an internship for the fourth year have been counseled to obtain a Bachelor's degree prior to reapplying to a clinical program in order to make themselves more competitive.

The number of jobs for medical technologists has decreased due to (1) the need for technician level personnel to provide some services formerly performed by medical technologists, (2) the impact of automation has required other kinds of educational backgrounds and skills, and (3) governmental regulations requiring persons with non medical technology backgrounds.

In the medical technology curriculum, the education coordinator is the communicator between the college or university and hospital. Pathologists, doctorate scientists, and supervisors transmit curricular needs and required skills to the education coordinator to convey to affiliated colleges and universities. In final analysis, all involved professionals may participate in evaluating and contributing to the medical technology curriculum. It is very necessary to maintain affiliation agreements between colleges and universities and the hospital, if effective lines of communication and assessment and revisions of the curriculum are to occur.

The challenges of tomorrow will have to be solved in part through curricular development. The new direction for the medical technology curriculum is to provide specialization at the undergraduate level.

To achieve the type of specialization needed, a five-year curriculum must be instituted. Two major reasons for medical technology specialization are: (1) the growth of knowledge makes it essential that time is provided for a professional to develop a strong basic scientific background, and (2) a well-defined rationale for work assignments for the medical technologist will aid in determining educational needs.

Medical laboratory technician and certified laboratory assistant may be more easily derived if educational preparation, goals and objectives are defined. A dominant theme concerning professions is the great growth of the professions and the conflict between the needs and demands of professionals and the organizations that employ them. Articulation between employers and educators might assist in better defining what educational provisions should be made available to students of medical technology. Other clinical specialists, such as biochemists, and microbiologists, must be included in order to obtain a complete picture of the needs.

Medical technologists are being taught as generalists. But after employment there is a tendency to become specialized in a particular area. This trend is already well established, and its value is found increasingly more an asset in clinical laboratory medicine. If a medical technology curriculum would provide specialization at the undergraduate level, a possible format would be that specialization may begin at the junior year. Clinical exposure would be provided after the fourth year in which a general

rotation of three months is scheduled, followed by a six to nine month rotation in the area of specialty. Management, problem solving, teaching and other coordinating activities in the clinical laboratory could be explored in depth. This would provide the medical technologist with the needed specialization to oversee the operations of the medical laboratory technician, the generalist.

A very crucial issue is that the education of the medical technologist is totally directed toward the clinical environment. Since the clinical internship is provided in the hospital, most graduates seek employment opportunities in these institutions. In the clinical laboratory, there are only so many good hours, favorite locations, desirable duties, money and prestige. Therefore, educators of the medical technologist must not emphasize a restrictive kind of professional education.

Perhaps employers of medical technologists, other than hospitals should participate in the development and evaluation of the medical technology curriculum. For exclusive claims to a particular competence forces a professional group to evaluate their position when associating with other professionals. Competition with other professionals may lead to overcoming rigidities within the curricula which have been developed.

A strong sense of competence is important if authority is to rest upon it. If medical technologists are to be managers, supervisors and educators of tomorrow they must not only provide credentials, but in final analysis show a great degree of competence.

Implications for Future Research

A curriculum leading to occupational employment cannot be totally planned without a task analysis. An analysis would seek information concerning an individual's performance requirements; that is, the identification and assignment of competency levels could be made and determination of how many functions and responsibilities can be effectively assigned to an individual.⁷²

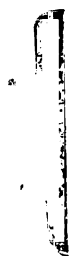
In order to develop a viable medical technology curriculum in an evolving and chameleonic art -- clinical laboratory medicine -- a task analysis of the laboratory and an identification of matching knowledge and skills must be made.

⁷²Isreal, Light. "Education for the Laboratory - Credential or Competence," Health Laboratory Science, Vol. 9, No. 2, April, 1972, p. 99.

APPENDICES

APPENDIX A

LETTERS OF REQUEST
FOR PARTICIPATION TO
SAMPLE POPULATION



COLLEGE OF EDUCATION • DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

31 August 1973

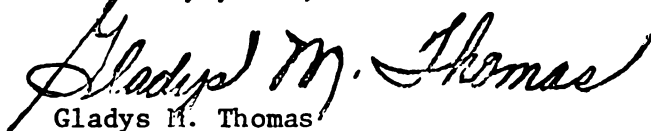
Dear Education Coordinator:

The enclosed questionnaire is part of a study to determine present and future curricular needs in medical technology education. It is a partial requirement for a doctoral degree in Higher Education and Administration at Michigan State University. I am requesting the assistance of Education Coordinators, Supervisors of Clinical Laboratory sections and Medical Technology interns.

Enclosed you will find three questionnaires. Would you please give two of the questionnaires to your medical technology interns who have completed at least four or more months of their internship. Please instruct the intern to return the questionnaire to you for mailing along with yours. A self-addressed, stamped envelope is included for this purpose. Also enclosed is a postal card. Please send the names of the two medical technology interns who received the questionnaires.

Your cooperation is very much appreciated. Thank you in advance for your assistance.

Sincerely yours,


Gladys M. Thomas

GMT/sew

COLLEGE OF EDUCATION • DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

31 August 1973

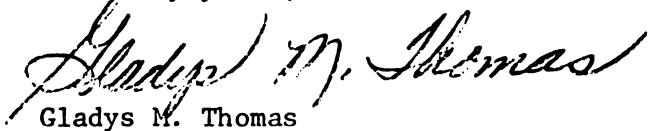
Dear Medical Technology Intern:

The enclosed questionnaire is part of a study to determine present and future curricular needs in medical technology education. It is a partial requirement for a doctoral degree in Higher Education and Administration at Michigan State University.

I am requesting your assistance in evaluating the academic and clinical preparation which you have received for your career choice. You may feel that you cannot respond to some of the questions. To those questions, please write "no response" over the question.

Please return the questionnaire to your Education Coordinator to mail. Your cooperation is very much appreciated. Thank you in advance for your assistance.

Sincerely yours,


Gladys M. Thomas

GMT/sew

COLLEGE OF EDUCATION • DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

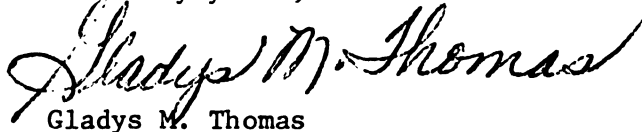
31 August 1973

Dear Department Head:

The enclosed questionnaire is part of a study to determine present and future curricular needs in medical technology education. It is a partial requirement for a doctoral degree in Higher Education and Administration at Michigan State University. I am requesting the assistance of Education Coordinators, Supervisors of Clinical Laboratory sections and Medical Technology interns.

Your cooperation in responding to the questionnaire is very much appreciated. Thank you in advance for your assistance.

Sincerely yours,

A handwritten signature in cursive script that reads "Gladys M. Thomas". The signature is written in dark ink and is positioned above the printed name.

Gladys M. Thomas

GMT/sew

APPENDIX B

QUESTIONNAIRE

QUESTIONNAIRE

Please check one choice to each item:

1) Sex

☐ Female

☐ Male

2) Age

☐ 18-22

☐ 23-30

☐ 31-40

☐ 41-55

☐ over 55

3) Indicate highest level of education attained:

☐ High school diploma

☐ Associate degree; or two years of college

☐ 3 years of college

☐ Bachelor's degree

☐ Master's degree

☐ Doctorate degree

☐ M.D.

☐ Other (Please specify) _____

4) Indicate where clinical training attained:

☐ On the job training

☐ Internship - hospital laboratory

☐ Other (Please specify) _____

5) What kind of educational program did you enter?

☐ 2 years of college + 1 year of clinical education.

☐ 3 years of college + 1 year of clinical education.

☐ 4 years of college + 1 year of clinical education.

☐ Other (Please specify) _____

6) Type of certificate

- ☐ Certified Laboratory Assistant (ASCP)*
☐ Medical Laboratory Technician (ASCP)
☐ Medical Technologist (ASCP)
☐ Registered Microbiologist (NRM)*
☐ Clinical Chemistry Technologist (NRCC)*
☐ Clinical Chemist (NRCC)
☐ Microbiology Technologist (ASCP)
☐ Chemical Technologist (ASCP)
☐ Blood Banking Technologist (ASCP)
☐ Specialist in Blood Bank Technology (AABB)*
☐ Specialist in Hematology (ASCP)
☐ Specialist in Microbiology (ASCP)
☐ Specialist in Chemistry (ASCP)
☐ Specialist in Medical Laboratory
and Public Health (NRM)
☐ Other (Please specify) _____

7) Place of principal employment:

- ☐ hospital
☐ physician's private office or clinic
☐ independent laboratory
☐ college or university
☐ industry
☐ other (Please specify) _____

*American Society of Clinical Pathologists

*National Registry of Microbiologists

*National Registry of Clinical Chemistry

*American Association of Blood Banks

8) Select the item most closely identifying your principal job classification:

- ☐ administrative technologist
- ☐ education coordinator
- ☐ supervising technologist
- ☐ staff technologist
- ☐ laboratory technician
- ☐ other (Please specify) _____

9) Years of work experience:

- ☐ 0-2 years
- ☐ 3-5 years
- ☐ 5-10 years
- ☐ 11 or more years
- ☐ Number of years in present position

10) Do you instruct medical laboratory personnel?

- ☐ yes
- ☐ no

11) If you hold an academic appointment indicate professional rank:

- ☐ instructor or lecturer
- ☐ assistant professor
- ☐ associate professor
- ☐ professor

12) Are you presently a student?

- ☐ yes
- ☐ no

13) What is your present location?

- ☐ Indiana ☐ Ohio ☐ Michigan
- ☐ Illinois ☐ Wisconsin

- 14) The total period of time for post-high school education of a medical technologist should be:
 _____ 1 year _____ 2 years _____ 3 years _____ 4 years _____ 5 years
- 15) The minimum amount of time for academic study for a medical technologist should be:
 _____ 1 year _____ 2 years _____ 3 years _____ 4 years _____ 5 years
- 16) The minimum amount of time for the clinical internship for a medical technologist should be:
 _____ 3 months _____ 6 months _____ 9 months _____ 12 months _____ 18 months
- 17) Clinical education should commence during
 _____ freshman year _____ sophomore year _____ junior year _____ senior year
 _____ after senior year
- 18) The total educational period in medical technology (academic and clinical) should be planned as a whole.
 _____ strongly agree _____ agree _____ neutral _____ disagree _____ strongly disagree
- 19) The following chemistry and physical science courses should remain in an academic program for medical technology:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Mathematics	_____	_____	_____	_____	_____
General chemistry	_____	_____	_____	_____	_____
Qualitative analysis	_____	_____	_____	_____	_____
Quantitative analysis	_____	_____	_____	_____	_____
Organic chemistry	_____	_____	_____	_____	_____
Biochemistry	_____	_____	_____	_____	_____
Physical chemistry	_____	_____	_____	_____	_____
Instrumentation	_____	_____	_____	_____	_____
Physics	_____	_____	_____	_____	_____
Other (Please specify)	_____	_____	_____	_____	_____

20) The following biological sciences should remain in an academic program for medical technology:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
General biology	_____	_____	_____	_____	_____
Botany	_____	_____	_____	_____	_____
Zoology	_____	_____	_____	_____	_____
Anatomy	_____	_____	_____	_____	_____
Histology	_____	_____	_____	_____	_____
Physiology	_____	_____	_____	_____	_____
Parasitology	_____	_____	_____	_____	_____
Mycology	_____	_____	_____	_____	_____
General microbiology	_____	_____	_____	_____	_____
Medical bacteriology	_____	_____	_____	_____	_____
Immunology	_____	_____	_____	_____	_____
Other (Please specify)	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

21) Future academic work for medical technology at the undergraduate level should include:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Personnel management	_____	_____	_____	_____	_____
Current issues, i.e., legislation, legal ability, bargaining units	_____	_____	_____	_____	_____
Computer science	_____	_____	_____	_____	_____
Biostatistics	_____	_____	_____	_____	_____
Instrumentation	_____	_____	_____	_____	_____
Communication skills, written and verbal	_____	_____	_____	_____	_____
Education, teacher preparation	_____	_____	_____	_____	_____
Business, budgeting & purchasing	_____	_____	_____	_____	_____

21) continued ...

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Professional ethics	_____	_____	_____	_____	_____
Scientific writing	_____	_____	_____	_____	_____
Other (Please specify)	_____	_____	_____	_____	_____

22) Should a medical technology student have any particular curricular emphasis if he is to work in institutions other than a hospital laboratory?

	Yes	No	Course
Public Health Laboratory	_____	_____	_____
Reference Laboratory	_____	_____	_____
Research Laboratory	_____	_____	_____
Veterinary Clinic	_____	_____	_____
Industry	_____	_____	_____
Crime Laboratory	_____	_____	_____
Private Clinical Laboratory	_____	_____	_____
Other (Please specify)	_____	_____	_____

23) Listed are types of programs which can be employed to introduce and teach students of medical technology during the clinical internship. Please check how you evaluate the effectiveness of these methods in preparing a student for his future work role.

	Very effective	Effective	Neutral	Less effective	Ineffective
<u>Work-study program</u> (Co-operative program. Student alternates academic and clinical work for set periods of time)	_____	_____	_____	_____	_____
<u>Student Laboratories</u> (Procedures, methods, principles are given all students followed by rotation in the clinical laboratories)	_____	_____	_____	_____	_____
<u>Conventional Clinical Rotation</u> following the academic years.	_____	_____	_____	_____	_____
Other (Please specify)	_____	_____	_____	_____	_____

24A) Have you made any curricular suggestions to affiliated schools?

____ Yes

____ No

24B) Curricular suggestion:

24C) Was the curricular suggestion incorporated into the Medical Technology program?

____ Yes

____ No

25) What educational experience do you consider desirable in a newly graduated medical technologist?

	Very desirable	Desirable	Neutral	Less desirable	Undesirable
Basic knowledge of instrumentation	____	____	____	____	____
Basic laboratory techniques	____	____	____	____	____
Interpretive skills for tests	____	____	____	____	____
Organizational ability for work	____	____	____	____	____
Ability to construct lab procedures	____	____	____	____	____
Strong theoretical background	____	____	____	____	____
Ability to instruct others	____	____	____	____	____
Other (Please specify)	____	____	____	____	____
_____	____	____	____	____	____

26) What degree should be required for the following positions?

POSITION:	DEGREE:			
	B.A., B.S.	M.A., M.S., M.P.H.*	Ph.D., D.P.H.*	M.D.
Quality control officer	____	____	____	____
Supervisory technologist	____	____	____	____
Research and development technologist	____	____	____	____
Administrative technologist	____	____	____	____

26) continued

	B.A., B.S.	M.A., M.S., M.P.H.*	Ph.D., D.P.H.*	M.D.
Hospital Epidemiologist	_____	_____	_____	_____
Computer Coordinator	_____	_____	_____	_____
Other (Please specify)	_____	_____	_____	_____

*M.P.H. = Master's of Public Health

*D.P.H. = Doctor of Public Health

27) Should particular attention be given in the curriculum for the positions listed in item 26 at the undergraduate level?

_____ Yes

_____ No

Course emphasis: (Please list)

28) Should specialization in one phase of medical technology take place at the undergraduate level?

_____ Yes

_____ No

If yes, what type of specialization?

When should specialization begin?

_____ 1st year _____ 2nd year _____ 3rd year _____ 4th year _____ After 4th year

29) The medical technology curriculum prepares students for easy entry into the job market.

_____ strongly agree _____ agree _____ neutral _____ disagree _____ strongly disagree

- 30) In clinical laboratory medicine job promotion is based upon educational background.

☐ strongly agree ☐ agree ☐ neutral ☐ disagree ☐ strongly disagree

- 31) In clinical laboratory medicine job promotion is based upon technical excellence.

☐ strongly agree ☐ agree ☐ neutral ☐ disagree ☐ strongly disagree

- 32) The relationship of supportive personnel (medical laboratory technician and certified laboratory assistant) to medical technologists must be defined.

☐ strongly agree ☐ agree ☐ neutral ☐ disagree ☐ strongly disagree

- 33) Conflict among professional organizations, accrediting agencies and institutions are factors which inhibit job promotion.

☐ strongly agree ☐ agree ☐ neutral ☐ disagree ☐ strongly disagree

- 34) The MT curriculum should prepare students as:

☐ specialists

☐ generalists

- 35) Preoccupation with routine methods or ways of performing duties often delays the acceptance of new ideas and developments.

☐ strongly agree ☐ agree ☐ neutral ☐ disagree ☐ strongly disagree

- 36) Are continuing education programs offered as a means of job promotion at your institution?

☐ Yes

☐ No

- 37) How do you rate these programs according to quality?

☐ excellent ☐ very good ☐ good ☐ satisfactory ☐ poor

- 38) Do you view continuing education programs as the best method for post graduate education?

☐ Yes

☐ No

- 39) The future of the medical technology curriculum is directly related to future developments in medicine. Briefly state what present and future effects the following would have on curriculum planning:

Development of core curriculum for MLT, MT, Medical students.

Automation in Medicine.

Medical Advances in Patient Care.

Types of Work Roles.

Methods of Teaching.

Other Areas (Please Specify).

APPENDIX C

FOLLOW-UP
LETTER

COLLEGE OF EDUCATION • DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

1 October 1973

Dear Department Head:

A few weeks ago you received a questionnaire concerning medical technology education. I would appreciate your returning the questionnaire by 1 December 1973.

I hope you will take the time to fill out the questionnaire, as your answers will have significant bearing on the outcome of the study.

Thank you for your time and consideration.

Sincerely,



Gladys M. Thomas
c/o Dr. William Sweetland
424 Erickson Hall
Michigan State University
East Lansing, Michigan 48823
GMT/sew

APPENDIX D
AMA APPROVED SCHOOLS

RANDOMLY SELECTED APPROVED SCHOOLS OF MEDICAL TECHNOLOGY

<u>State</u>	<u>Name of School</u>	<u>Minimal Entrance Requirement</u>	<u>Student Capacity</u>	<u>Length of Internship Program</u>
Illinois	Burnham City Hospital	3 years college	4	12 months
	Grant Hospital of Chicago	3 years college	6	12 months
	Northwestern University Medical School and Passa- vent Memorial Hospital	2 years college	--*	24 months
		3 years college	13	12 months
		4 years college**	--	27 months
	Evanston Hospital	3 years college	13	12 months
	Lutheran General Hospital	3 years college	12	12 months
	St. Mary Hospital	3 years college	8	12 months
Indiana	Swedish-American Hospital	3 years college	12	12 months
	St. Francis Hospital Center	3 years college	6	12 months
	St. Mary Mercy Hospital	3 years college	16	12 months
	St. Margaret Hospital	3 years college	10	12 months
	South Bend Medical Foundation	3 years college	20	12 months
Michigan	Grace Hospital	3 years college	10	12 months
	Henry Ford Hospital	Degree	25	21 months
	Mount Carmel Mercy Hospital	3 years college	12	12 months
	Sinai Hospital of Detroit	3 years college	6	12 months
	McLaren General Hospital	3 years college	8	12 months
	W. A. Foote Memorial Hospital	3 years college	4	12 months
	Borgess Hospital	3 years college	8	12 months
	Hackley Hospital	3 years college	12	12 months
	Providence Hospital	3 years college	12	12 months
Ohio	Barberton Citizens Hospital	3 years college	6	12 months
	Cleveland Clinic Educational Foundation	3 years college	12	12 months

* No Student Capacity Listed

**Master's Degree Granted

<u>State</u>	<u>Name of School</u>	<u>Minimal Entrance Requirement</u>	<u>Student Capacity</u>	<u>Length of Intern- ship Program</u>
Ohio	Ohio State University	3 years college	60	15 months
	St. Elizabeth Medical Center	3 years college	20	12 months
	Mansfield General Hospital	3 years college	3	12 months
	Licking County Memorial Hospital	3 years college	4	24 months
	Mercy Hospital	3 years college	9	12 months
	St. Elizabeth Hospital	Degree	12	12 months
Wisconsin	St. Agnes Hospital	3 years college	8	12 months
	St. Francis Hospital	3 years college	10	12 months
	Madison General Hospital	3 years college	16	12 months
	St. Mary's Hospital	3 years college	10	12 months
	Deaconess Hospital	3 years college	10	12 months
	Milwaukee County General Hospital	3 years college	16	12 months
	St. Luke's Memorial Hospital	3 years college	9	12 months

APPENDIX E

TABLES OF PERCENTAGES

BY CATEGORY

TABLE 33.--Certification Background of Respondents Denoting Generalist or Specialist.

	Generalists MT (ASCP)		Specialists (All other certifications)		Total	
	N	%	N	%	N	%
Education Coordinator	25	96.15	1	3.85	26	100
Medical Technology Intern	44	100	-	-	44	100
Supervisor (Department head, Section Chief)	38	56.72	25	37.33	63*	93.05*
						138

* 4 (5.97%) Supervisors did not respond.

TABLE 34.--Description of Educational Program Respondents.

	2 Yr. + 1		3 Yr. + 1		4 Yr. + 1		Other*		Total	
	N	%	N	%	N	%	N	%	N	%
Education Coordinator	3	11.54	11	42.31	11	42.31	1	3.85	26	100
Medical Technology Intern	-	-	28	64.36	14	31.82	2	4.55	44	100
Supervisor (Department Head, Section Chief)	-	-	39	58.21	12	17.91	11	16.42	66**	98.51**

*Representatives in this group are persons with advanced degrees. The medical technology interns are in programs which confers a master's degree at the end of the clinical education.

**One (1.49%) supervisor gave no response.

TABLE 35.--Years of Work Experience.

	0 - 5		5 - 10		11 or more		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	3	11.54	6	23.08	17	65.38	26	100
Medical Technology Intern	44	100	-	-	-	-	44	100
Supervisor (Department Head, Section Chief)	13	19.41	27	40.30	25	37.31	65*	97.01*

*2 (2.99%) Supervisors did not respond.

1

TABLE 36.--Minimum Time for Academic Study.

	1 Yr.		2 Yr.		3 Yr.		4 Yr.		5 Yr.		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	-	-	2	7.69	12	46.15	9	34.62	-	-	23*	88.46*
Medical Technology Intern	1	2.27	7	15.91	21	47.73	14	31.82	1	2.27	44	100
Supervisor (Department Head, Section Chief)	-	-	8	11.94	36	53.73	22	32.84	-	-	66**	98.51**

* 3 (11.54%) Education Coordinators did not respond.

** 1 (1.49%) Supervisors gave no response.

TABLE 37.--Minimum Time for Clinical Study.

	3		6		9		12		18		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Education Coordinator	2	7.69	2	7.69	3	11.54	15	57.69	3	11.54	25*	96.15*
Medical Technology Intern	1	2.27	2	4.55	3	6.82	32	72.73	6	13.64	44	100
Supervisor (Department Head, Section Chief)	-	-	-	-	2	2.99	58	86.57	6	8.96	66**	98.51**

*1 (3.85%) Education coordinator gave no response.

**1 (1.49%) Supervisor did not respond.

TABLE 38.--Commencement of Clinical Education.

	Freshman Year		Sophomore Year		Junior Year		Senior Year or later		Total	
	N	%	N	%	N	%	N	%	N	%
Education Coordinator	4	15.38	1	3.85	7	26.92	13	50	25*	96.15*
Medical Technology Intern	2	4.55	6	13.64	12	27.27	24	54.44	44	100
Supervisor (Department Head, Section Chief)	3	4.48	10	14.93	23	34.33	29	43.28	65**	97.01**

143

*1 (3.85%) Education coordinator gave no response.

**2 (2.99%) Supervisors did not respond.

TABLE 39.---Appraisal of Clinical Program: Work Study.

	Effective to Very Effective		Neutral		Less Effective to Ineffective		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	14	53.84	7	26.92	2	7.69	23*	88.54*
Medical Technology Intern	32	72.72	4	9.09	6	13.64	42*	95.45*
Supervisor (Department Head, Section Chief)	43	64.18	15	22.39	3	4.48	61*	91.05*
								144

*3 (11.54%) Education coordinators,
 2 (4.55%) Medical Technology Interns,
 6 (8.96%) Supervisors gave no response.

TABLE 40.--Appraisal of Clinical Program: Student Laboratory.

	Effective to Very Effective		Neutral		Less Effective to Ineffective		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	20	76.92	2	7.69	2	7.70	24*	92.31*
Medical Technology Intern	33	75	2	4.55	7	15.91	42*	95.45*
Supervisor (Department Head, Section Chief)	53	79.10	4	5.97	8	11.95	65*	97.02*

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*2 (7.69%) Education Coordinator,
 2 (4.55%) Medical Technology Interns and
 2 (2.99%) Supervisors gave no response.

TABLE 41.--Appraisal of Clinical Program: Conventional Clinical Rotation.

	Effective to Very Effective		Neutral		Less Effective to Ineffective		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	24	92.30	-	-	2	7.69	26	100
Medical Technology Intern	33	75	4	9.09	5	11.36	42*	95.45*
Supervisor (Department Head, Section Chief)	43	64.18	12	17.91	7	10.45	62*	92.54*
								146

*2 (4.55%) medical technology interns and 5 (7.46%) supervisors did not respond.

TABLE 42.--Medical Technology Curriculum Planning.

Have you given any curricular advisement?								
	No Response		Yes		No		Total	
	N	%	N	%	N	%	N	%
Education Coordinator	1	3.85	15	57.69	10	38.46	26	100
Medical Technology Intern	1	2.27	4	9.09	39	88.64	44	100
Supervisor (Department Head, Section Chief)	2	2.99	22	32.84	43	64.18	67	100
Has the curricular suggestion been incorporated?								
Education Coordinator	13	50	12	46.15	1	3.85	26	100
Medical Technology Intern	41	93.18	-	-	3	6.82	44	100
Supervisor (Department Head, Section Chief)	48	71.64	15	22.39	4	5.97	67	100

TABLE 43.--Specialization and Medical Technology.

	Should specialization take place in the undergraduate medical technology curriculum?					
	No Response		Yes		No	
	N	%	N	%	N	%
Education Coordinator	-	-	2	7.69	24	92.31
Medical Technology Intern	1	2.27	5	11.36	38	86.36
Supervisor (Department Head, Section Chief)	1	1.49	9	13.43	57	85.07
					67	100

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