Scanning the Radiologic Sciences Workforce in North Carolina

A Report of the Technical Panel on the Radiologic Sciences Workforce

Principal Authors:
Susan L. Dyson, MHA
Erin P. Fraher, MPP
R. Bert Wilkins, MHA
Laura M. Smith, BS

Sponsored by the NC Area Health Education Centers (AHEC) Program with funding from The Duke Endowment.

July 2003

The Radiologic Sciences Workforce Assessment Project is a collaborative effort of:

The Council for Allied Health
in North Carolina
CB#7335, TR 48
The University of North Carolina
at Chapel Hill
Chapel Hill, NC 27599-7335
(919) 843-6176

http://www.alliedhealthcouncilnc.org

NC AHEC Program
CB#7165, 101 Medical Drive
The University of North Carolina
at Chapel Hill
Chapel Hill, NC 27599-7165
(919) 966-2461

http://www.ncahec.net

Cecil G. Sheps Center for
Health Services Research
CB#7590, 725 Airport Rd
The University of North Carolina
at Chapel Hill
Chapel Hill, NC 27599-7590
(919) 966-7112

http://www.shepscenter.unc.edu/hp

Suggested Citation: Dyson, S., Fraher E., Wilkins B., Smith, L. *Scanning the Radiologic Sciences Workforce in North Carolina.* Chapel Hill, North Carolina. The Council for Allied Health in North Carolina, July 2003.

North Carolina Radiologic Sciences Workforce Assessment Technical Panel

Members of the Technical Panel provided information, expertise, and guidance in the development of the report and participated in panel discussions held on March 13 and April 10, 2003. Panel members reviewed the best available data and developed conclusions and recommendations on the radiologic sciences workforce in North Carolina.

PRACTITIONERS

Frances Apple, RT(R), FASRT
Radiologic Technologist (Retired)
27 Willow Bridge Rd
Durham, NC 27707
(919) 489-6666
apple003@mc.duke.edu

Cindi Barnes, AAS, RT(R)
Assistant Chief Technologist
Wake Forest University Baptist Medical Center
1242 S Hawthorne Rd
Winston-Salem, NC 27103
(336) 716-4873
ccbarnes@wfubmc.edu

Vicki Burnett, RT(T)
Radiation Therapist
Duke University Medical Center
102 Old Forest Creek Dr
Chapel Hill, NC 27514
(919) 967-0321
vicbrnett@aol.com

Charlotte Knight, BSRT-R
Supervisor, OR/Interventional Radiology
UNC Hospitals
101 Manning Dr
Chapel Hill, NC 27514
cknight@unch.unc.edu

EMPLOYERS

Jeff Cartwright, BS, RT(R)(CT)(MR), ARRT
Radiology Manager
Lenoir Memorial Hospital
100 Airport Rd
Kinston, NC 28501
(252) 522-7097
jcartwright@lenoir.org

Keith Hornberger, BSRT, MBA, DHA, ARRT(R), FACHE
Director of Radiology/Program Director Radiography School
Presbyterian Hospital Novant Health
200 Hawthorne Lane
Charlotte, NC 28223
(704) 384-5107
kdhornberger@novanthealth.org

Debbie Wolfe, RT(R)(N), CNMT
Radiology Manager
UNC Hospitals
101 Manning Dr
Chapel Hill, NC 27599-7600
(919) 966-6644
dwolfe@unch.unc.edu

Eileen McConville, MBA
Director, Workforce and Volunteer Development
New Hanover Health Network
PO Box 9000, 2131 South 17th St
Wilmington, NC 28402-9000
(910) 343-7839
Eileen.McConville@nhhn.org

EDUCATORS

Debbie Durham, MA, RT(MR)(CT)
Coordinator, CT/MR
Forsyth Technical Community College
2100 Silas Creek Parkway
Winston-Salem, NC 27103
(336) 734-7178
ddurham@forsyth.cc.nc.us

Elizabeth Isler, RN, MEd
Associate Vice President, Academic/Student Services
NC Community College System Office
200 West Jones St
Raleigh, NC 27603
(919) 733-7051
islere@ncccs.cc.nc.us

Carolyn Mayo, PhD
Director
North Carolina Health Careers Access Program
CB 8010, 301 Pittsboro St, Ste 351
Chapel Hill, NC 27599-8010
(919) 966-2264
cmayo@email.unc.edu

Joy Renner, MA, RT(R)
Director
Division of Radiologic Science
University of North Carolina at Chapel Hill
CB 7130, Rm 328 Wing E
Chapel Hill, NC 27599-7130
(919) 966-5147
jrenner@med.unc.edu

James Sadler, PhD
Associate Vice President, Academic Planning
UNC Office of the President
910 Raleigh Rd
Chapel Hill, NC 27515
(919) 962-3910
jcs@northcarolina.edu

ASSOCIATIONS AND PROFESSIONAL ORGANIZATIONS

Valrie Hopkins, RT(R)(M)(QM)
President, North Carolina Society of Radiologic Technologists
Clinical Coordinator
Bertrand Breast Center
4535 Jessup Grove Rd
Greensboro, NC 27401
(336) 379-0941
Lcnb1993@aol.com

Ronnie Walker, CNMT, ARRT-N
President-Elect, North Carolina Nuclear Medicine Technologists
Chief Nuclear Medicine Technologist
Lexington Memorial Hospital
250 Hospital Dr, PO Box 1817
Lexington, NC 27293-1817
(336) 248-5161 x4837
rwalker@lmh.cc

PRIMARY STAFF TO PANEL

Susan Dyson, MHA
Research Associate
Sheps Center for Health Services Research
UNC-CH, CB 7590
Chapel Hill, NC 27599-7590
(919) 966-7922
susan_dyson@unc.edu

Erin Fraher, MPP
Director, Health Professions Data System
Sheps Center for Health Services Research
UNC-CH, CB 7590
Chapel Hill, NC 27599-7590
(919) 966-5012
erin_fraher@unc.edu

R Bert Wilkins, MHA
Data Coordinator
Sheps Center for Health Services Research
UNC-CH, CB 7590
Chapel Hill, NC 27599-7590
(919) 966-7112
bwilkins@mail.schsr.unc.edu

COLLABORATORS AND OTHER ATTENDEES

Alan Brown, MSW
Associate Director, NC AHEC Program
UNC-CH, CB 7165
Chapel Hill, NC 27599-7165
(919) 966-0814
Alan_Brown@med.unc.edu

Thomas Ricketts, PhD
Deputy Director
Sheps Center for Health Services Research
UNC-CH, CB 7590
Chapel Hill, NC 27599-7590
(919) 966-7120
tom_ricketts@unc.edu

Andrea Catenaro, BS
Administrative Assistant
Council for Allied Health in North Carolina
UNC-CH, CB 7335 TR48
Chapel Hill, NC 27599-7335
(919) 966-8566
andrea_catenaro@med.unc.edu

David Yoder, PhD
Executive Director
Council for Allied Health in North Carolina
UNC-CH, CB 7335 TR48
Chapel Hill, NC 27599-7335
(919) 966-8566
dyoder@med.unc.edu

North Carolina Radiologic Sciences Workforce Advisory Group

The Advisory Group provided editorial and technical assistance in preparation of the final document

Rosanne Annas, RT(R)
Radiography Program Director
Caldwell Community College
2855 Hickory Blvd
Hudson, NC 28638
(828) 726-2351
rannas@caldwell.edu

Mary Jane Gentry, EdD, RT(R)
Chair, Radiography
Fayetteville Technical Community College
2201 Hull Rd, PO Box 35236
Fayetteville, NC 28303-0236
(910) 678-8303
gentrym@faytechcc.edu

April Apple, RT(R)
Senior Staff Technologist
Radiology Sports Medicine
Duke University Medical Center
Box 3472 Medical Center Dr
Durham, NC 27710
(919) 668-1408
apple03@mc.duke.edu

Elizabeth Shields, BSRT(R)
Director, Radiologic Technology Program
Moses Cone Health System
1200 North Elm St
Greensboro, NC 27401-1020
(336) 832-7628
betsy.shields@mosescone.com

Debra Wilson, MPH, RT(R)
Department Chairperson, Medical Imaging
Asheville-Buncombe Technical Community College
340 Victoria Rd
Asheville, NC 28801
(828) 254-1921 x282
dwilson@abtech.edu

Marti Feathers-Magee, AAS, RCVT
Program Coordinator
Cardiovascular/Vascular Technology
Forsyth Technical Community College
2100 Silas Creek Parkway
Winston-Salem, NC 27103
(336) 734-7189
mmagee@forsyth.cc.nc.us

Robert Thorpe, EdD, RT(R)(MR)
Associate Professor, Div of Radiologic Science
Department of Allied Health
University of North Carolina at Chapel Hill
TR 48, CB 7335
Chapel Hill, NC 27599-7335
(919) 966-5797
bthorpe@med.unc.edu

Panel Staff: Melissa Fruhbeis, Shayla Higginbothom, Katie Gaul, John Shadle and the staff at the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill.

Acknowledgements: The panel members would like to thank the North Carolina Area Health Education Centers, the Cecil G. Sheps Center for Health Services Research, and the Council for Allied Health in North Carolina for their vision for conducting this panel process. This study has been made possible by the financial support of the North Carolina Area Health Education Centers and The Duke Endowment. Booklet design by Christine Shia of the Cecil G. Sheps Center for Health Services Research.

This report would not have been possible without the generous contribution of data, expertise, and advice from Jerry Reid and Debbie Kripotos at the American Registry of Radiologic Technologists; Bhaskar Dawadi at the Nuclear Medicine Technology Certification Board; Greg Morrison, Ceela McElveny, and Lynn May at the American Society of Radiologic Technologists; Joanna Spahr at the Society of Nuclear Medicine; Laurie Shaw at the North Carolina Society of Radiologic Technologists; Tom Elkins and Dollie Strickland at the North Carolina Division of Facility Services; Amy Sawyer and William Johnson at the North Carolina Division of Environmental Health (NCDEH), Radiation Protection Section; Lee Cox at NCDEH, Radioactive Materials Branch; Don Riffle at NCDEH, X-ray Program; Larry Mayes at the University of North Carolina Office of the President; Myron Dunston at the UNC-CH Office of Institutional Research; Keith Brown at the North Carolina Community College System; Joanne Greathouse at the Joint Review Committee on Education in Radiologic Technology; and the individual directors and faculty of accredited radiologic sciences educational programs in North Carolina.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

EXECUTIVE SUMMARY

To estimate the adequacy of North Carolina's allied health workforce, the Cecil G. Sheps Center, in conjunction with the Council for Allied Health in North Carolina and the North Carolina Area Health Education Centers Program (AHEC), developed an innovative Allied Health Workforce Assessment process. The process convenes advisory panels comprised of educators, employers, practitioners, and workforce experts to review the best available statistical and administrative data, discuss existing and emerging policies and construct a consensus statement on the need for, and supply of, select allied health professionals in the state. The radiologic sciences profession is the fourth allied health workforce to be studied through this collaboration and this report details the findings, conclusions, and recommendations of the Technical Panel on the Radiologic Sciences Workforce.

The Technical Panel met on March 13 and April 10, 2003, to discuss the radiologic sciences workforce. For the purposes of this report, the radiologic sciences workforce is defined as practitioners who utilize radiation in imaging or therapy services and includes radiologic technologists, radiation therapists, nuclear medicine technologists, and technologists who operate computed tomography (CT), magnetic resonance (MRI), mammography, positron emission tomography (PET), cardiovascular interventional (CV), and other radiology equipment. The meetings focused on the following key workforce issues:

- *What is the overall balance between supply and need for radiologic sciences practitioners in North Carolina and how likely is it to change in the near future?*
- *How many practitioners are actively practicing in North Carolina and where are they located?*
- *What proportion of the workforce has attained certification through a credentialing body?*
- *Are some areas of North Carolina, or some groups, more prone to labor imbalances such as staffing shortages, recruitment and retention difficulties, or underemployment?*
- *Does the racial/ethnic and gender makeup of the radiologic sciences workforce match that of the population of North Carolina?*
- *Are we producing too few, too many, or the right number of practitioners to meet current and future needs?*
- *Are the numbers, types, and locations of educational programs appropriate to meet the imaging and therapy needs of the population?*

CONCLUSIONS AND RECOMMENDATIONS

Utilizing data obtained from credentialing and professional associations, educational programs, state agencies, and an extensive literature review, the following conclusions and recommendations were developed by the Technical Panel on the Radiologic Sciences Workforce in North Carolina.

1. Workforce Planning

Little collaboration exists between employers and educators to plan workforce strategies at the local or regional level. Workforce issues are not unique to an individual facility or educational site and decisions made by one entity have implications for other facilities and educators within a larger region. Workforce imbalances would be better addressed through coordinated regional efforts by employers and educators.

Recommendation: *Increase and improve communication and collaboration among employers, educators, practitioners, and other key stakeholders in the development of regional educational and workforce planning. To more effectively utilize scarce radiologic sciences resources, the radiologic sciences community could convene county or multi-county planning forums to discuss educational programs, student clinical placement sites, or workplace retention.*

Recommendation**:** *Consider the development of a more formal regional organization with the mission of ensuring access to a well distributed, trained, and educated radiologic sciences workforce through systematic and collaborative planning. Involve educators, employers, practitioners, and other key stakeholders.*

The process of allocating new technology services and equipment across North Carolina through the annual development of the State Medical Facilities Plan (SMFP) is unfamiliar to many in the radiologic sciences profession.

> ***Recommendation:*** *Encourage involvement in the public hearing and comment phases of the development of the SMFP. Educators are in a prime position to offer comments about the workforce implications and availability of personnel needed to operate any new or emerging pieces of radiology equipment across the state.*

> ***Recommendation:*** *Utilize the annual need allocations published in the SMFP to develop plans to educate and prepare the future workforce necessary to operate forthcoming equipment.*

2. Education

Number of Programs:

The number of radiologic technology, radiation therapy, and nuclear medicine technology programs in the state is sufficient to fill the needs if all program spaces are filled and graduation rates improve. The number of specialty programs should be increased; however existing programs continue to operate below capacity. Radiologic sciences educators and employers must begin to prepare the workforce needed to operate the increasing number of positron emission tomography scanners in the state.

> ***Recommendation:*** *Maintain the status quo with respect to the number of radiologic technology, radiation therapy, and nuclear medicine technology programs and spaces. Through regional workforce and educational planning, expand specialty programs to better meet the needs of the state. Develop statewide educational marketing and recruiting policies to ensure existing programs are well-utilized and fill existing enrollment capacity.*

Recruitment:

Careers in radiologic sciences are often overshadowed by other health care professions and students are not always informed about the range of career opportunities. Students and applicants are often unaware of the true working climate of a radiologic sciences practitioner (ie. physical demands, exposure to bodily fluids, etc). Many employers and students are not aware of the campus-based and distance learning offerings in radiologic sciences.

> ***Recommendation:*** *Expose and educate students and guidance counselors about opportunities in radiologic sciences. Establish an educational handbook describing locations and types of programs in North Carolina.*

> ***Recommendation:*** *Require curriculum orientation and clinical shadowing before entrance into programs and facilitate communication among practitioners and potential students. In addition, educate applicants about the positive and negative aspects of a radiologic sciences career.*

Retention:

Students unable to complete academic programs often withdraw because of financial hardships or difficulties in balancing school, work, and/or families.

> ***Recommendation:*** *Seek financial resources through employers, foundations, and other sources necessary to offer tuition assistance, scholarships, stipends, or employment opportunities to remove financial barriers for students. Provide tutorial assistance and mentors to enrolled students to address academic challenges or school/work/family issues.*

Faculty Shortages:

Without an adequate supply of trained faculty, schools will be unable to produce the number of radiologic sciences practitioners needed to provide imaging and therapy services to the population. Educational directors and faculty are older than the average practitioner. Practitioners can earn higher salaries in clinical settings than in educational settings. Proposed accreditation standards requiring advanced degrees will likely contribute further to faculty shortages because some educators will not obtain the necessary qualifications, and will instead retire or return to clinical practice.

> ***Recommendation:*** *Develop incentives for practitioners to enter into education and continue to provide incentives for educators to remain in the field. Explore supplemental funding or partnerships to subsidize faculty salaries.*

__Recommendation:__ Provide incentives for faculty and directors to initiate and complete advanced education through distance learning opportunities, tuition assistance, paid time off, flexible scheduling, or other rewards.

Rural Areas/Counties Without Access to On-Campus Programs:

Parts of North Carolina, particularly the eastern and western counties, do not have an accredited educational program or a collaborative arrangement with an existing program. This is particularly true for specialty programs. It is unlikely that these areas have the resources to support a full program. In addition, students from rural areas are unlikely to move or travel considerable distance, to attend a program in another region.

__Recommendation:__ Increase the use of distance learning, encourage collaboration with existing programs, and develop clinical training sites and preceptors in areas where distribution problems exist.

__Recommendation:__ Recruit students from rural areas to increase the distribution of trained individuals practicing in those areas. Offer scholarships and/or employment contracts to individuals who will move, or return to rural areas, after completion of an educational program.

Clinical Sites:

Some programs are unable to expand class size because of a lack of clinical sites, yet not all potential clinical sites are being utilized. Educators are often unaware of facilities that have available capacity to host students.

__Recommendation:__ Conduct an assessment of all clinical sites (utilized, underutilized, and unutilized) to determine the conditions needed to increase utilization of existing sites or develop new clinical sites. Develop a report inventorying facilities able to serve as clinical sites for radiologic sciences students.

3. Employers

Retention:

To improve retention and encourage staff to remain in the field, employers must increase recognition of radiologic sciences staff. Incentives, bonuses, and other recognition should be paid equally to new and existing staff. Long-term staff are more likely to supervise new employees or serve as student preceptors. Existing staff can dramatically influence new employees' or students' perceptions of the profession and the employer.

__Recommendation:__ Improve incentives and benefits to encourage loyalty and retention. Improve retention perks for longer-term employees, beyond the traditional retention bonuses that are given to staff within one to five years of hiring. Encourage staff to serve as clinical preceptors or mentors to radiologic sciences students.

Few employers have instituted career ladders for the radiologic technology workforce and practitioners often see cross-training as the only means to achieve career growth, salary increases, or promotion. Cross-training may alleviate short-term vacancies in other areas, but only serves to maintain or exacerbate vacancies within radiologic technology as a whole.

__Recommendation:__ Develop career ladders within radiologic sciences, specifically within radiologic technology, by promoting education, leadership development, and advanced training. To encourage education and learning, offer tuition assistance, reimbursement of professional fees or dues, or support attendance at professional meetings.

Educational involvement:

Many employers would benefit from participating in the educational planning of the radiologic sciences workforce.

__Recommendation:__ Encourage employers to communicate and collaborate with nearby educational programs by contributing ideas related to program curriculum, application process, scholarships or other financial assistance, post-graduation employment opportunities, or sponsorship of existing employees.

4. Diversity

The racial, ethnic, and gender diversity of the radiologic sciences workforce does not match that of North Carolina's population. The current student body in radiologic sciences programs is slightly more diverse than that of the workforce, but is still not reflective of the population.

> ***Recommendation:*** *Continue to expand recruitment and retention efforts in education and employment settings to increase the presence of underrepresented minorities and men. To acheive this, collaborate with organizations such as the North Carolina Health Careers Access Program (NC HCAP) and the NC AHEC Program.*

The United States and North Carolina are becoming increasingly diverse and will require health care practitioners who have the ability to provide care in a language other than English.

> ***Recommendation:*** *Increase the recruitment of individuals able to provide health care services in a language other than English. Encourage and provide language training opportunities to existing radiologic sciences professionals.*

The lack of an adequate data source to enumerate race, ethnicity, and language abilities of the workforce impedes continuous monitoring and prevents analysis or evaluation of initiatives aimed at increasing the diversity in the workforce.

> ***Recommendation:*** *Require the reporting and collection of race, ethnicity, and language ability, among other demographic information, in the certification and/or registration process with the credentialing bodies. Encourage or require the reporting and collection of similar information with the professional associations.*

5. Workforce Surveillance

Lack of licensure, certification, or registration of the radiologic sciences workforce presents challenges in assessing supply and demand. The absence of a uniform state database including credentialed and non-credentialed practitioners hinders decision-making related to issues of supply and demand, the need for future educational programs, retention of the North Carolina educated workforce, and the contributions of radiologic sciences practitioners in health care delivery.

> ***Recommendation:*** *Develop a complete database inclusive of all radiologic sciences practitioners in North Carolina. Investigate the feasibility of establishing an entity, or coordinating with an existing entity, to register the credentialed and non-credentialed workforce. Consider a mechanism similar to, or in conjunction with, the registration of radiology equipment in North Carolina. Until registration is achieved, develop procedures to share data among organizations to monitor the supply and distribution of the workforce.*

> ***Recommendation:*** *Obtain agreement between all credentialing and professional organizations on elements needed in a minimum data set to be collected in the certification, registration, or membership application.*

I. BACKGROUND OF THE STUDY

This report details the findings of the Technical Panel on the Radiologic Sciences Workforce, which is the fourth allied health workforce study conducted in North Carolina under the joint collaboration of the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill (Sheps Center), the North Carolina Area Health Education Centers (NC AHEC) Program, and the Council for Allied Health in North Carolina. The purpose of the studies is to review the best available statistical and administrative data, to discuss existing and emerging policies, and to construct a consensus statement on the need for, and supply of, allied health professionals in selected disciplines in North Carolina. The studies utilize the knowledge and expertise of an expert panel comprised of representatives from various stakeholder groups including practitioners from the allied health professions, as well as employers, educators, and workforce planning experts. Previous reports have been published on physical therapy (May 2000), speech-language pathology (June 2001), and health information management (October 2002).

Scope of Work of the Technical Panel on the Radiologic Sciences Workforce

The Technical Panel on the Radiologic Sciences Workforce, a group consisting of educators, practitioners, employers, and workforce experts, met on March 13 and April 10, 2003, to assess the employment prospects for radiologic sciences personnel in North Carolina. Panel deliberations focused on the following key workforce issues:

- *What is the overall balance between need and supply of the radiologic sciences workforce, and how is it likely to change, given current trends?*
- *How many radiologic sciences practitioners are actively practicing in North Carolina? Where are they located?*
- *What proportion of the workforce has not attained certification through a credentialing entity?*
- *Are some areas of the state or some population groups more prone to certain kinds of labor imbalances such as staffing shortages, recruitment and retention difficulties, or underemployment?*
- *Does the racial/ethnic and gender makeup of the radiologic sciences workforce match that of the population of North Carolina?*
- *Are we producing too many, too few, or about the right number of radiologic sciences practitioners in North Carolina to meet current and future requirements?*
- *Are the types of educational training programs and the locations of programs appropriate to meet the radiologic imaging and therapy needs of North Carolina?*

The remainder of this report provides information on the North Carolina radiologic sciences workforce, describes the information and data sources used, examines national trends in radiologic sciences, summarizes the panel's findings and conclusions, and presents the panel's recommendations. The scope of this study is limited to the radiologic sciences workforce, specifically practitioners who utilize radiation in imaging or therapy services and includes radiologic technologists, radiation therapists, nuclear medicine technologists, and technologists who operate computed tomography (CT), magnetic resonance (MRI), mammography, positron emission tomography (PET), cardiovascular interventiional (CV) and other radiology equipment. Other professionals that may work in radiology departments such as ultrasound technologists and medical dosimetrists are not covered in this study.

Data Limitations and Caveats

The best available data to help answer these questions were compiled and analyzed by the Sheps Center. Collecting data for this workforce was difficult for a number of reasons:

- The workforce is not licensed in North Carolina and certification is optional; therefore it is challenging to enumerate all individuals who are actively practicing in the workforce;
- For those who seek certification, there are multiple entities that credential the workforce. The same data were not available from all organizations, and comparability of data sets is problematic due to differences in data methodologies, collection, and definitions;

- Data were collected from two credentialing organizations – the American Registry of Radiologic Technologists (ARRT) and the Nuclear Medicine Technology Certification Board (NMTCB); and three professional associations – the American Society of Radiologic Technologists (ASRT), the Society of Nuclear Medicine-Technologist Section (SNM-TS), and the North Carolina Society of Radiologic Technologists (NCSRT);
- Individuals who do not obtain certification from a credentialing agency and/or do not belong to a professional association listed above are not enumerated in this report;
- Education data were obtained from universities, community colleges, and hospitals offering accredited radiologic sciences programs. Data from other radiologic sciences educational avenues, specifically on-the-job training, were not obtained; and
- Data identifying credential type do not necessarily correspond with employment function. Many practitioners are credentialed in multiple disciplines yet do not actively practice in all disciplines.

Since data could not be obtained to enumerate the entire radiologic sciences workforce actively practicing, figures reported in this study are likely an *underestimate* of the total workforce. However, they provide the most accurate perspective on the workforce in North Carolina from the best available sources.

Terminology

Notes on terminology used in this document:

- The "radiologic sciences workforce" and "radiologic sciences practitioners" will be used as an umbrella term that encompasses the following professionals: radiologic technologists, radiation therapists, nuclear medicine technologists, CT technologists, MRI technologists, CV technologists, bone densitometrists, and mammography technologists.
- "Certified person" will signify a practitioner, as defined above, who has been credentialed by ARRT and/or NMTCB.
- "Member" will signify a person who has active membership with ASRT, SNM-TS, and/or NCSRT.

II. SETTING THE STAGE: THE RADIOLOGIC SCIENCES WORKFORCE

The radiologic sciences workforce is a diverse group of practitioners who perform diagnostic imaging examinations and administer radiation therapy treatments. Radiologic sciences personnel are responsible for accurately positioning patients, assessing and monitoring patients, delivering low doses of radiation during procedures, and ensuring quality images and treatments. Practitioners work closely with physicians, specifically radiologists, radiation oncologists, and nuclear medicine physicians. Radiologic sciences practitioners perform imaging using X-rays, CT, MRI, radiopharmaceuticals, positron emission tomography (PET), nuclear medicine cameras, cardiovascular interventional, and mammography equipment. In addition, some practitioners utilize radiation in the treatment of cancers and other conditions.

The workforce is comprised of three primary disciplines and several specialties. Entrance into the workforce is made through radiologic technology, radiation therapy, or nuclear medicine technology. After obtaining certification in one of these disciplines, practitioners can choose to specialize in another primary discipline or a specialty such as CT, MRI, mammography, CV, bone densitometry, or quality management.

Multiple national organizations credential the radiologic sciences workforce, including ARRT, NMTCB, Cardiovascular Credentialing International, and the Medical Dosimetry Certification Board. However for the purposes of this study, only the workforce credentialed through ARRT and/or NMTCB will be examined.

1. Primary Disciplines in the Radiologic Sciences Workforce

Radiologic Technologists

Radiologic technologists, also called radiographers, use X-rays and other equipment to create images of the internal structure of the body, which are used by physicians to study organs and bones for injury or disease. Radiologic technologists receive their training and education in a variety of settings (on-the job training, hospital programs, community colleges, and universities). Graduates of accredited programs may be eligible for certification through ARRT.[1]

Radiation Therapists

Radiation therapists work under the supervision of radiation oncologists and administer radiation treatment for cancer and other conditions by exposing specific areas of the patient's body to carefully controlled doses of radiation. Therapists may assist in dosimetry procedures and tumor localization. Training is typically obtained in universities, community colleges, or hospitals and graduates of accredited programs are eligible for certification with ARRT.[2]

Nuclear Medicine Technologists

Nuclear medicine technologists are responsible for preparing and administering radiopharmaceuticals, which are chemicals used for diagnostic and therapeutic purposes. Nuclear medicine technologists perform imaging procedures using radiation-detecting instruments such as PET scanners and gamma cameras to demonstrate the distribution of radiopharmaceuticals in the body. Nuclear medicine technologists receive training in community colleges, universities, or hospitals and graduates of accredited programs may be eligible for certification through NMTCB and/or ARRT.[3]

2. Evolution of the Radiologic Sciences Profession[4]

Since the discovery of X-rays by Wilhelm Conrad Roentgen in 1895, the use of radiation as a diagnostic and therapeutic tool has flourished. The growth in the use of X-rays in the early 1900's resulted in a dilemma for physicians. Less time was available for patient contact and treatment because so much time was consumed by the mechanics of operating X-ray equipment. As a result, physicians began delegating the duties of imaging and developing X-ray films to other individuals, typically to an office assistant. Little training or education of technicians occurred and few standardized protective or safety devices existed.

The first professional society for X-ray specialists, the Radiological Society of North America (RSNA) was founded in 1920. Later the American College of Radiology (ACR) was formed, resulting in separation of radiologists and lay individuals. The American Association of Radiological Technicians (the first of several name changes of today's American Society of Radiologic Technologists), first met in 1921, and a registry for technicians followed (ARRT). The Registry later added certification of nuclear medicine technologists in 1963 and radiation therapists in 1964.

The emergence of new technology has influenced every aspect of the profession. In the 1970's, CT offered significant improvement over traditional X-rays. Exposure times shortened, patient dosage was reduced, and computerized systems became commonplace. As the number of hospitals increased, so did the numbers of X-ray equipment and the volume of exams. The introduction of Medicare in 1965 further contributed to demand for radiologic services and personnel by providing health coverage to a previously uninsured population. The rapid explosion of technology prevented radiologists and technologists from becoming experts in every discipline, and professionals began to specialize in radiography, mammography, magnetic resonance imaging, computed tomography, cardiovascular interventional technology, nuclear medicine, radiation therapy, and sonography.

3. Advances in Technology and New Uses for Existing Technology

Digital Radiology/Computed Radiography

Significant developments in digital technology have led more and more radiology programs and hospitals to enhance film/screen radiography with digital imaging and archiving systems. With digital technology, physicians can immediately retrieve and store patient images, thereby reducing the number of images lost or damaged with film handling. Practitioners no longer spend time developing films; these tasks have been replaced with inputting and managing computerized data and images. Digitization of radiology has created a demand for more technologically skilled employees to manage radiology information.

Positron Emission Tomography (PET)

PET is a relatively recent tool primarily used for diagnosing and staging cancer and since 1995, the Center for Medicare and Medicaid Services (CMS) has approved PET coverage for over 22 diseases and conditions.[5] Cardiac procedures perhaps offer the greatest potential for growth in PET; coronary artery disease is the number one cause of death in the US. A decision on the approval of PET to detect and diagnose Alzheimer's disease is expected, and further expansion of Medicare approved conditions for PET is likely.

Interventional Radiology, Endovascular Surgery

Both interventional radiology and endovascular surgery involve the placement of tools and agents in the body or blood vessels under imaging guidance. Imaging disciplines such as X-ray, ultrasound, and CT are used to visualize the body while guiding instruments through blood vessels or other pathways. The minimally invasive procedures can often treat medical problems at earlier stages or before the rise of serious complications. Because the incision needed is very small, there is generally less risk, less pain, and shorter recovery times. Angioplasty, angiograms, embolization, catheter placement, and hemodialysis are just some examples of IR procedures.[6] Aneurysms and narrowing of vessels can be treated with endovascular surgery.[7]

Fusion Imaging

Fusion imaging combines two independent imaging disciplines to produce a diagnostically and clinically superior image. Hybrid equipment combining PET with CT is the most common — PET provides physiological information about an organ's metabolic function; CT provides information about an organ's anatomy.[8] Relatively few pieces of hybrid equipment, either SPECT-CT or PET-CT, are in operation - approximately 150 PET-CTs have been installed worldwide.[9] Radiation therapists also use fusion imaging with intensity modulated radiation therapy (IMRT) to deliver high doses of cancer-killing radiation directly to cancerous tumors while sparing surrounding healthy tissue.

Other Advancements

Molecular imaging is a newly emerging field whereby noninvasive imaging is used to measure or examine biological processes at the cellular or molecular level. The field is likely to lead to better methods for diagnosing and managing diseases. Another trend likely to have significant impact on the radiologic sciences workforce is increased demand for health screening and preventive services requiring imaging capability, such as full body scans, cardiac screening, and virtual colonoscopies.

III. REGULATION OF THE RADIOLOGIC SCIENCES IN NORTH CAROLINA

1. Regulation of the Workforce

Licensure, Certification, and Registration

The regulation (licensure, certification, or registration) of radiologic sciences professionals varies from state to state and across disciplines. North Carolina is one of:

- 17 states that does not regulate radiologic technologists;[10]
- 18 states that does not regulate radiation therapists;[11]
- 24 states that does not regulate nuclear medicine technologists.[12]

Many health care facilities in the state prefer to hire radiologic sciences personnel who are credentialed or registry-eligible, but there is anecdotal evidence of non-credentialed or under-qualified personnel operating radiology equipment.

Mammography Quality Standards Act

The *Mammography Quality Standards Act (MQSA) of 1992*[13] instituted comprehensive federal quality control standards in mammography. Although the American College of Radiology had established voluntary Mammography Accreditation Programs in 1987, breast cancer organizations turned to the federal government to enact legislation. The MQSA built upon the *1990 Omnibus Budget Reconciliation Act* that provided coverage for breast cancer screening for Medicare-eligible women. The legislation withholds reimbursement for screening procedures unless technologists, radiologists, and medical physicists are licensed or certified, and dedicated mammography equipment is used.[14] Other than mammography, the remainder of radiologic sciences disciplines operates under voluntary accreditation standards.

The Consumer Assurance of Radiologic Excellence (CARE) Bill (Proposed)

The *Consumer Assurance of Radiologic Excellence (CARE) Act* (HR 1214, 108th Congress), mandates that every state enact a program of minimum standards for the education and certification of radiologic and nuclear medicine technologists and radiation therapists through licensure, certification, or some other authorization. The federal legislation, endorsed by the Alliance for Quality Medical Imaging and Radiation Therapy,[15] seeks to correct the compliance deficiencies in the Consumer-Patient Radiation Health and Safety Act of 1981 by encouraging states to enact minimal standards for the education and certification of practitioners. If enacted, the CARE Act would tie licensure to Medicaid reimbursement by requiring nuclear medicine and diagnostic imaging or radiation therapy procedures to be performed by licensed individuals who have met federal minimum education and certification standards. At the time this report was published, the CARE bill had been referred to the House Energy and Commerce Committee on Health. The Senate version, S 1197, was introduced on June 5, 2003.

2. Regulation of Radiology Equipment

Radiology Equipment

Although radiologic sciences practitioners are not licensed in North Carolina, radiologic equipment must be licensed every year under Title 15A Chapter 11 of the North Carolina Administrative Code (15 NCAC 11). Licensees must designate an individual responsible for radiation protection who must verify all radiologic sciences personnel have been properly trained to perform their duties and that practitioners have received retraining to maintain proficiency. The determination of qualified personnel is at the discretion of the licensee, however certification in nuclear medicine technology may satisfy the training requirement.[16]

Certificate of Need Regulations

North Carolina is a certificate of need (CON) state, whereby hospital construction, acquisition of new hospital beds, certain capital expenditures, or the purchase of specific technology is subject to approval from the NC Department of Health and Human Services (NC DHHS).[17] The State Health Coordinating Council (SHCC) is responsible for determining need for North Carolina's annual State Medical Facilities Plan (SMFP). X-ray, ultrasound, CT, and mammography equipment are not automatically subject to CON law, however to acquire MRI, PET, linear accelerator, or cardiac catheterization equipment, hospitals must submit an application to the CON section of the NC Division of Facility Services for approval.

IV. FACTORS CONTRIBUTING TO DEMAND FOR RADIOLOGIC SCIENCES SERVICES IN NORTH CAROLINA

Several factors contribute to the need and demand for radiologic sciences services, including population growth, increases in health care services and facilities, increasing consumer demand for imaging, increases in the number of pieces of radiation equipment, and the development of new technology and new uses for existing technology.

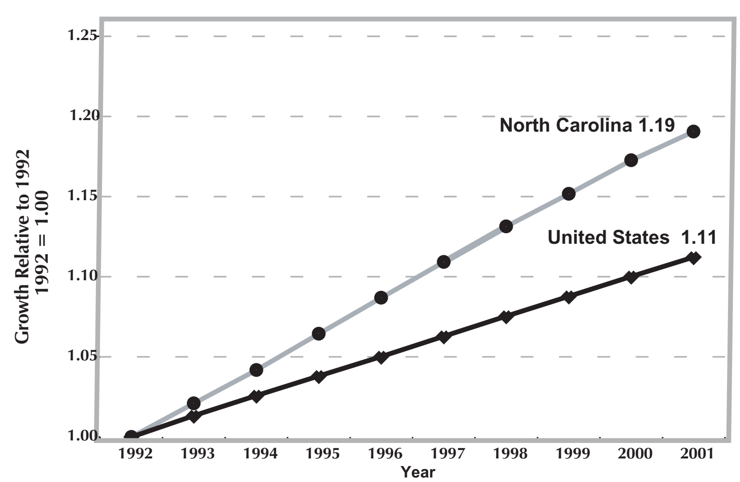
1. Increases in Population and Health Care Utilization

Population increase is one of many factors that have contributed to the growth in health care utilization in North Carolina. Additionally, the elderly use more health care services, including imaging and therapy services.

North Carolina's population has grown nearly 20% from 1992 to 2001, and double the US population growth rate: **(See Figure 1)**

- ✦ The over 65 population, just 12% of the state's total population, has grown 18%.
- ✦ The over 85 population has grown 40%.

Figure 1: Population Growth Relative to 1992, United States and North Carolina, 1992-2001



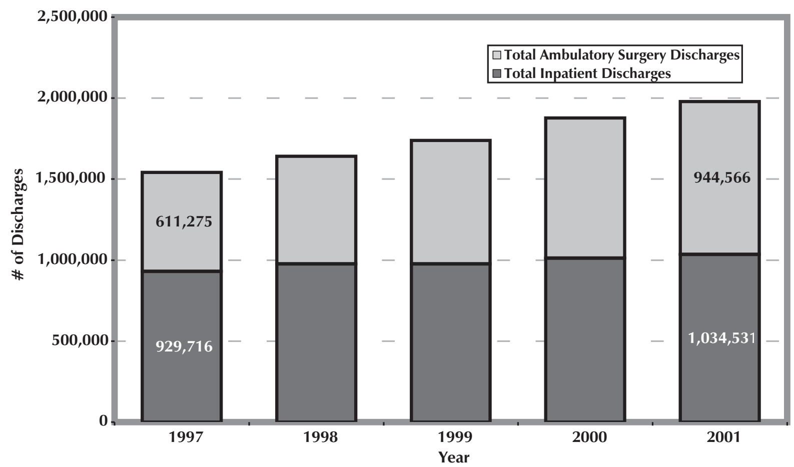
Sources: US Bureau of the Census;
North Carolina Office of State Planning

Discharges from the state's acute care hospitals have increased steadily over the last five years. With the continued trend toward outpatient and ambulatory care, discharges have increased substantially from these settings.

In North Carolina from 1997 to 2001 discharges from:

- Acute care hospitals increased 11%;[18]
- Ambulatory surgery facilities increased 55%. **(See Figure 2)**

Figure 2: Hospital Inpatient and Ambulatory Surgery Discharges, North Carolina, FY 1997-2001



Source: Solucient, Fiscal Years 1997-2001 (October 1, 1996 to September 30, 2001).
Notes: Inpatient discharges include acute, psychiatric, substance abuse, and rehabilitation bed discharges. Does not include discharges from state psychiatric facilities and some rehabilitation facilities.

2. Increases in Radiology Equipment and Procedures

The number of pieces of radiology equipment in the state has consistently increased over the last six years, with the largest growth rate seen in the number of PET scanners. In addition, new equipment projected in the 2003 State Medical Facilities Plan will significantly increase the number of PET scanners and fixed MRIs in use in the state in the coming years, resulting in an increase in the number of radiologic sciences practitioners needed to operate the new equipment. **(See Table 1a and Table 1b)**

Table 1a: Inventory* of Health Care Radiology Equipment in North Carolina, 1996-2002

Year	Cardiac Cath - Fixed	MRI - Fixed	PET - Fixed	Linear Accelerators
1996	84	67	3	75
1997	82	73	3	78
1998	85	81	3	80
1999	87	96	3	80
2000	94	105	4	83
2001	95	114	6	86
2002	111	131	8	90
% change 1996-2002	32%	96%	167%	20%
Projected Need 2003**	7	18	9	1

Sources: Division of Facility Services: State Medical Facilities Plans 1994-2003; NC Division of Environmental Health, Radiation Protection Branch.
* Inventory may not reflect operational inventory. Includes inventory for which CON has been issued or pending development and inventory pending review or appeal.
** Projected need from 2003 SMFP. Approval of additional equipment must go through CON process.

Table 1b: Inventory* of Health Care Radiology Equipment in North Carolina, 2002

Equipment	2002 Total Count
X-ray (i)	3,531
Mammography (ii)	450
CT (ii)	289
Bone Densitometry (ii)	399
Nuclear Medicine (iii)	227
Cardiac Cath - Fixed	111
Cardiac Cath - Mobile	12
MRI - Fixed	131
MRI - Mobile	40
PET - Fixed	8
Linear Accelerator	90

Sources: Division of Facility Services; State Medical Facilities Plans 1994-2003; NC Division of Environmental Health, Radiation Protection Branch.
Notes:
* Inventory may not reflect operational inventory. Includes inventory for which CON has been issued or pending development and inventory pending reveiw or appeal.
(i) X-ray equipment defined as C-arm, fluoroscopic, general, mobile, mobile/fluoro, angiography, radio/fluoro, radiographic, radiographic/fluoro, simulator, or therapeutic.
(ii) Counts may include non-operational registered equipment.
(iii) Counts include RADMAT licenses for hospital based medical practices and private nuclear medicine facilities and may include non-operational registered equipment.

Table 2: Radiology Procedures in North Carolina, 1995-2001

Procedures	1995	1996	1997	1998	1999	2000	2001	% change 1995-2001
Cardiac Cath - Fixed	55,044	57,366	60,128	64,376	66,301	68,253	73,603	34%
Cardiac Cath- Mobile	3,449	3,477	3,672	3,140	3,432	5,065	4,779	39%
MRI - Fixed	159,474	163,919	199,329	245,473	280,064	330,000	395,569	148%
MRI - Mobile	26,057	36,334	47,479	58,179	59,617	74,981	92,860	256%
PET - Fixed	799	1,171	1,798	2,415	3,683	4,717	5,840	631%
Linear Accelerators	377,064	495,361	550,697	589,401	587,269	512,578	558,311	48%

Source: State Medical Facilities Plans, 1996-2003.
Notes: Data unavailable for X-ray, CT, and Mammography.

Increases in the number of pieces of radiology equipment in North Carolina have corresponded with dramatic increases in the number of inpatient and outpatient procedures since 1995.[19] **(See Table 2)**

3. Distribution of Radiology Equipment

Data obtained from the NC Division of Environmental Health (Radiation Protection Branch), the NC Division of Facility Services, and the 2003 State Medical Facilities Plan on the counts of fixed radiology equipment in the state were plotted by county.

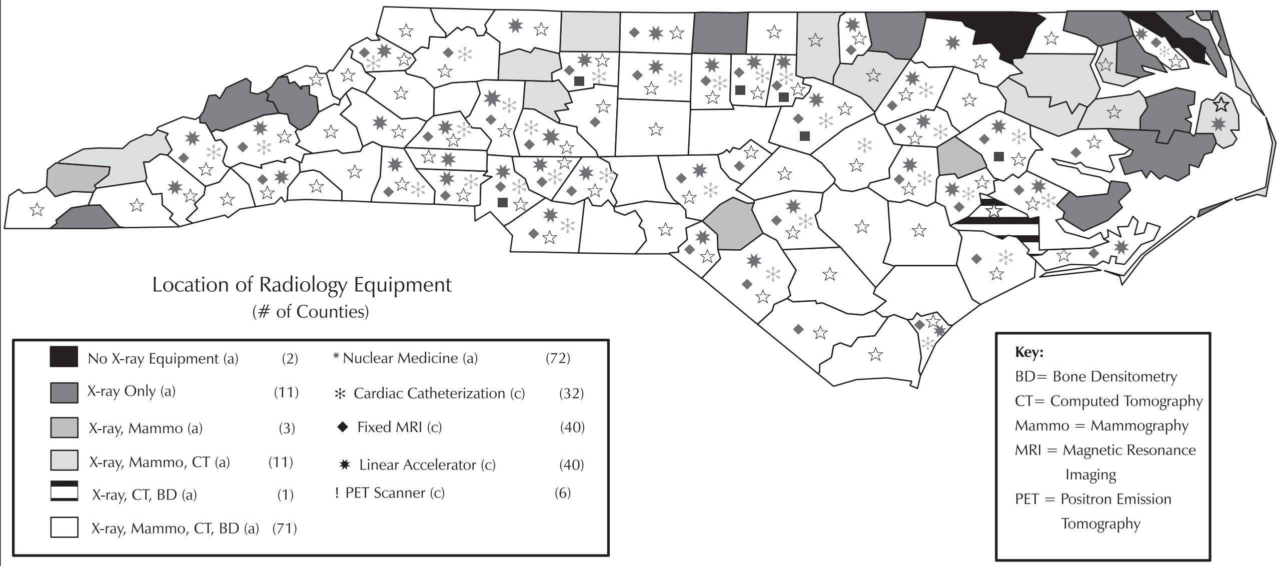
Counts were obtained for fixed X-ray, CT, mammography, bone densitometry, nuclear medicine, MRI, PET, linear accelerator, and cardiac catheterization equipment in health care settings (excludes chiropractor, dental, podiatry, education, industrial, service provider, veterinary, and industrial radiology equipment). X-ray equipment, the basic building block of radiology services, is located in most counties. On the other hand, PET scanners, which are much more costly and require CON approval, are located in relatively few counties – those with a large hospital or academic medical center.

Figure 3 illustrates the distribution of **fixed** radiology equipment. Residents of counties that do not have fixed radiology equipment may be served by mobile equipment or may travel to neighboring counties for imaging or therapy services. A number of **mobile** providers serve counties that do not have a fixed piece of radiology equipment.

The distribution of equipment shows that urban counties and those with a large hospital or academic medical center have the most types of radiology equipment. Pitt, Wake, Durham, Orange, Forsyth, and Mecklenburg Counties have (or are approved to have) all types of fixed radiology equipment listed above. The counties with the fewest types of equipment are those in the northeastern and western parts of the state, which generally have fewer health care providers and facilities. Nearly every county in North Carolina has a fixed piece of X-ray equipment, with the exception of Camden and Northampton, neither of which has an acute care hospital. However, these counties may be served by a mobile provider. Eleven counties in North Carolina house only fixed X-ray equipment.

(See Figure 3, over)

Figure 3: Fixed Health Care Radiology Equipment by County, North Carolina, 2002
(Does not account for counties served by mobile radiology equipment)



Notes:

1) Counts include equipment located in health care facilities (excludes chiropractor, dental, podiatry, educational, service providers, veterinary, and industrial radiology equipment).
2) X-ray equipment defined as C-arm, fluoroscopic, general, mobile, mobile/fluoro, angiography, radio/fluoro, radiographic, radiographic/fluoro, simulator, and therapeutic categories.
3) Map does not reflect counties served by mobile radiology equipment: Mobile MRI (N=40); Mobile Cardiac Catheterization (N=12); Mobile X-ray, CT and/or Mammo (N=121).
4) Counts do not include 2002 SMFP Need Determinations for: MRI (N=13).
5) Counts do not include 2003 SMFP Need Determinations for: MRI (N=18); PET (N=9); Cardiac Catheterization (N=9); Linear Accelerators (N=1).
6) Counts may not reflect operational counts of equipment, such as those for which a CON has been issued and is pending development, or equipment pending CON review or appeal.
7) Additional linear accelerators exempt from CON may be in use in the state (b).
8) Nuclear medicine equipment counts include RADMAT licenses for hospital-based medical practices and private nuclear medicine facilities (excludes PET and Linear Accelerators).
9) Mammography equipment operated in Jones county is registered under ownership in Craven county.

Sources: a) NC Division of Environmental Health, Radiation Protection Branch; b) NC Division of Facility Services; c) 2003 State Medical Facilities Plan
Produced by the North Carolina Health Professions Data System, 2003, Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

4. Employment Trends of the Radiologic Sciences Workforce

The State Occupational Projections, developed by the Bureau of Labor Statistics, US Department of Labor and the Employment Security Commission (ESC) of North Carolina, forecast that all three professions will experience steady growth between 1998 and 2008, and by 2008, there will be:[20]

30.2% increase in radiologic technologists from 4,800 to 6,250;

- 22.2% increase in radiation therapists from 450 to 550;
- 28.6% increase in nuclear medicine technologists from 350 to 450.
-

5. Health Workforce Surveys

In 2002, the North Carolina Hospital Association (NCHA) replicated a study similar to studies conducted by the American Hospital Association. The NCHA Workforce Study collected information on vacancy rates and average placement times for many health professions, including a category referred to in the report as "radiology techs."[21] Of the 16 professions included, the highest full-time vacancy rates were for radiology techs, far ahead of vacancy rates for registered nurses and operating room techs. The study found radiology techs had the second highest average placement time (107-113 days to fill open positions), slightly behind placement times for certified registered nurse anesthetists (147-158 days). Vacancy rates differed by Area Health Education Centers (AHEC) region, with the highest radiology tech rates seen in the eastern regions of the state.

V. THE RADIOLOGIC SCIENCES WORKFORCE IN NORTH CAROLINA

The following section will describe the radiologic sciences organizations that either certify (e.g. ARRT or NMTCB) or offer membership (eg., ASRT, NCSRT or SNM-TJ) to North Carolina practitioners. Data on the North Carolina workforce obtained from these organizations were merged, and results of the analysis will be discussed.

1. Data Sources

American Registry of Radiologic Technologists (ARRT)

ARRT is the largest credentialing organization for radiologic sciences practitioners and certifies practitioners in three primary disciplines (radiography, radiation therapy, and nuclear medicine technology) and 10 specialties (cardiovascular interventional technology, mammography, computed tomography, magnetic resonance imaging, quality management, sonography, vascular sonography, cardiac interventional technology, vascular interventional technology, and bone densitometry). Eligibility for examination in the primary disciplines requires graduation from an accredited educational program. ARRT recognizes programs accredited through the Joint Review Committee on Education in Radiologic Technology (JRCERT), Joint Review Committee on Educational Programs in Nuclear Medicine Technology (JRCNMT), and six regional accrediting agencies.

- ✦ North Carolina radiologic sciences practitioners certified with ARRT increased 24% from 5,807 practitioners in 1994, to 7,189 in 2001.[22] The increase is partly due to the additional certifications offered since 1994.
- ✦ New credentials granted to North Carolina practitioners declined 23% from 1994 to 2001, possibly a result of declining numbers of graduates or signifying that fewer graduates are opting for initial certification.

Nuclear Medicine Technology Certification Board (NMTCB)

NMTCB was founded in 1977 and offers two credentials: Certified Nuclear Medicine Technologist (CNMT) and the recently developed Certified Nuclear Cardiology Technologist (NCT). Technologists taking the certification exam must be graduates of an accredited program or meet alternate-eligibility requirements (estimated at 3% of total individuals sitting for the exam).[23]

American Society of Radiologic Technologists (ASRT)

ASRT was founded in 1920 and is the largest radiologic sciences professional organization in the world, with over 100,000 members.[24] Membership is available to ARRT-certified practitioners and radiologic sciences students, and the society provides its membership with educational opportunities, promotes radiologic technology as a career, and monitors state and federal regulation affecting the profession.

North Carolina Society of Radiologic Technologists (NCSRT)

NCSRT, an affiliate of ASRT, was founded in 1939 and provides educational and professional support to its membership. Membership is available to ARRT-registered practitioners, students, corporations, and others with an interest in radiologic technology. As of July 2002, NCSRT had 1,446 members, consisting of active members (78.2%), students and advanced students (16.7%), and retired, commercial, life, and honorary members (5.1%).[25]

Society of Nuclear Medicine Technologist Section (SNM-TS)

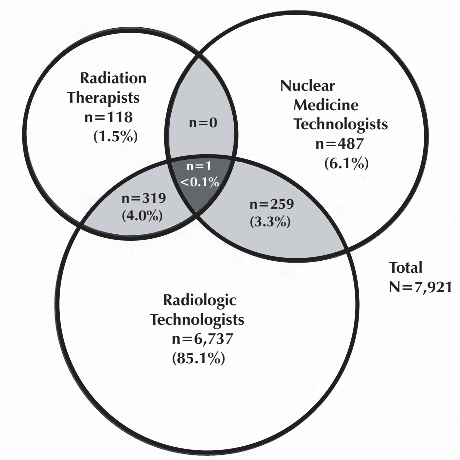
SNM-TS is a subsection of the Society of Nuclear Medicine, a professional society dedicated to nuclear medicine. Nuclear medicine technologists, a subset of the total membership, account for 50% of the total membership in the Society. The North Carolina membership in SNM-TS has declined 31% over the last two years from 140 technologists in 2001 to 96 in 2002.[26]

2. Results of Data Merged From Credentialing and Professional Organizations

Data on the credentialed workforce were collected from ARRT and NMTCB[27] and were merged with membership data from ASRT and NCSRT[28] to obtain a more accurate picture of the total credentialed radiologic sciences workforce in North Carolina. The final analysis file consists of 7,921 active practitioners. This data set excludes radiologic sciences practitioners who do not have a credential from ARRT or NMTCB and therefore may underestimate the true numbers of the active workforce.

(See Appendix A for results of data merge and additional methodology.)

Figure 4: Radiologic Sciences Practitioners by Current Primary Discipline, North Carolina, 2002



Note: Total number of radiologic sciences practitioners currently certified in primary discipline from ARRT and/or NMTCB.
Source: Merged data files from ARRT, NMTCB, ASRT, and NCSRT.

Current Primary Certifications[29]

- ✦ Practitioners with a current certification only in radiologic technology (85.1%);
- ✦ Practitioners with a current certification only in nuclear medicine technology (6.1%);
- ✦ Practitioners with a current certification only in radiation therapy (1.5%);
- ✦ Practitioners with dual certifications in radiologic technology and radiation therapy (4.0%);
- ✦ Practitioners with dual certifications in nuclear medicine technology and radiologic technology (3.3%);
- ✦ 1 individual is currently certified in all three primary disciplines.

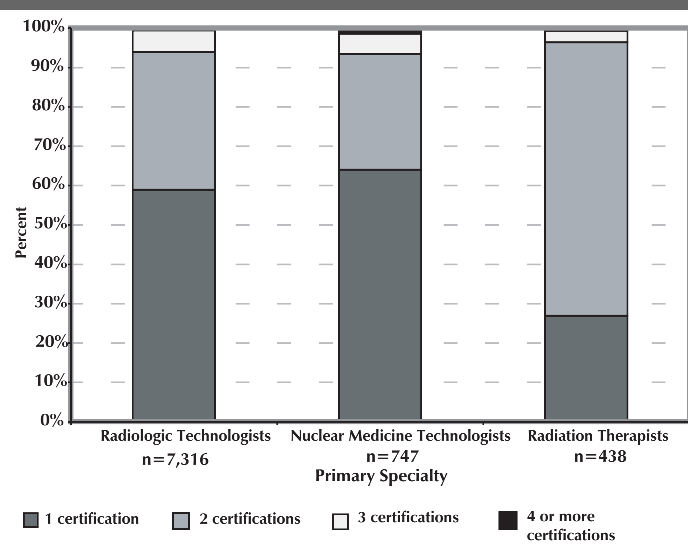
(**See Figure 4)**

Most individuals with a primary certification in radiologic technology (58.9%) or nuclear medicine technology (64.0%) have only one certification. In contrast, the majority of radiation therapists (69.4%) are certified in two primary disciplines.

Over a third (35.1%) of radiologic technologists, and just fewer than 30 percent (29.3%) of nuclear medicine technologists, are certified in two primary disciplines. Individuals with multiple certifications may not be actively working in those disciplines, but have the potential to provide services in those disciplines.

(**See Figure 5)**

Figure 5: Radiologic Sciences Practitioners by Primary Discipline and Number of Certifications, North Carolina, 2002



Notes: Individuals holding multiple certifications are included in percentages for multiple disciplines. Total count of active individuals is 7,921.

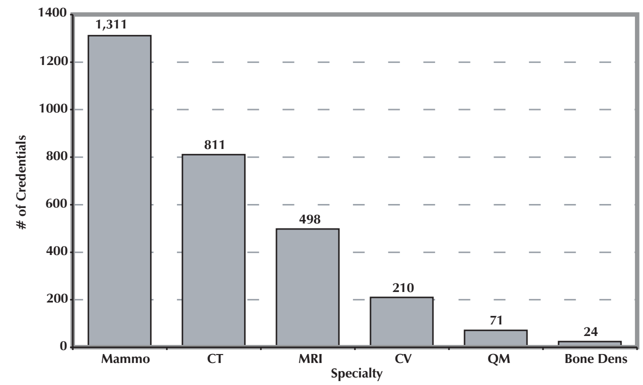
Source: Merged files from ARRT, NMTCB, ASRT, and NCSRT.

Current Specialty Certifications

Of the currently maintained specialty credentials, mammography certifications are the most common followed by CT, MRI, and CV.[30] Relatively few practitioners in North Carolina hold a credential in quality management or bone densitometry, which are both relatively new credentials offered through ARRT.

(See Figure 6)

Figure 6: Number of Radiologic Sciences Specialty Credentials Held, North Carolina, 2002



Source: Merged files from ARRT, NMTCB, ASRT, and NCSRT. Total count of active individuals is 7,921.

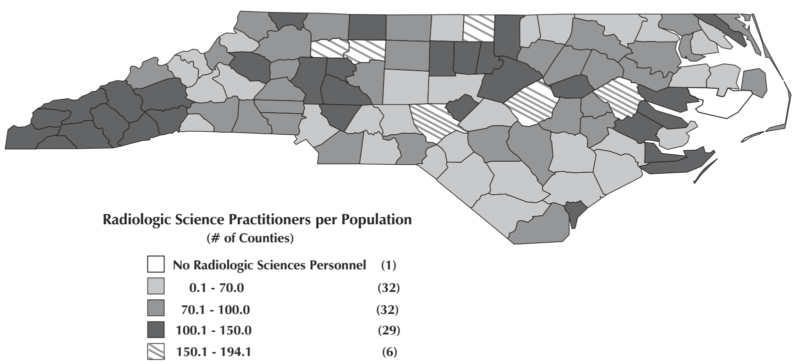
Distribution

Addresses were analyzed at the county level based on the practitioner's primary certifications. Individuals with multiple primary certifications are included in maps for each primary discipline certification held by the individual. Practitioner address may be a home address or work address; therefore, these data may not reflect the true distribution of where the credentialed radiologic sciences workforce provides services. Radiologic sciences practitioners must practice under the supervision of a physician and therefore, supply and distribution is dependent on supply and distribution of physicians.

Not surprisingly, there are more practitioners in the urban counties of the state. No certified practitioners indicated an address in Hyde County. Radiology equipment in this county may be operated by certified individuals who list an address in another county or by individuals who are not certified with ARRT and/or NMTCB.

(See Figure 7)

Figure 7: Radiologic Sciences Practitioners per 100,000 Population by County, North Carolina, 2002 (includes radiologic technologists, radiation therapists, and nuclear medicine technologists)



Source: Merged data files from ARRT, NMTCB, ASRT, and NCSRT. N=7,921. North Carolina Office of State Planning, 2001.

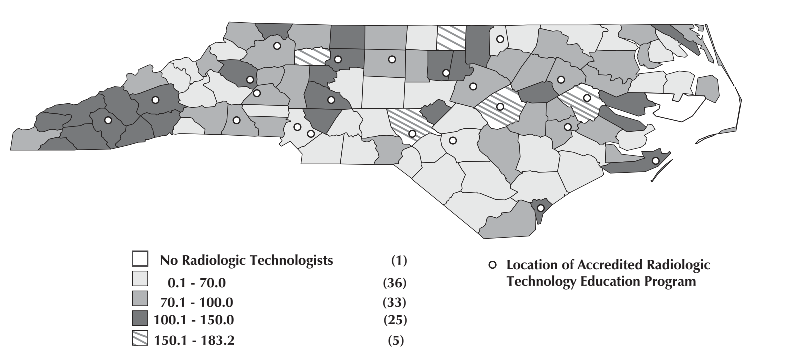
Produced by: North Carolina Health Professions Data System, 2003. Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

Note: Radiologic science practitioners includes those individuals certified as radiation therapists, radiologic technologists and/or nuclear medicine technologists from ARRT and/or NMTCB. May not capture all radiologic science practitioners working in North Carolina. Address used may be home, business, or other address.

Individuals with certification in radiologic technology are the most numerous and well distributed of the primary disciplines, with only one county lacking a credentialed radiologic technologist. Nearly two-thirds (62) of North Carolina's counties have 26 or more credentialed radiologic technologists. It also appears that radiologic technologists are more likely located near radiologic technology education programs or major hospitals.

(See Figure 8)

Figure 8: Radiologic Technologists per 100,000 Population by County, North Carolina, 2002



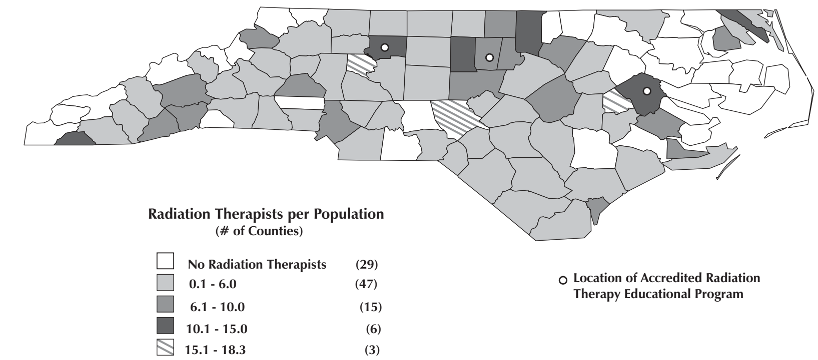
Source: Merged data files from ARRT, NMTCB, ASRT and NCSRT. N=7,316 individuals certified as radiologic technologists. North Carolina Office of State Planning, 2001.

Produced by: North Carolina Health Professions Data System, 2003. Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

Note: Includes only those individuals certified in radiography from ARRT and may not caputure all radiologic technologists practicing in North Carolina. Some individuals are included in maps for multiple modalities. Address used may be home, business or other address. Program location indicates location of program accredited through the Joint Review Committee on Education in Radiologic Technology and/or Southern Association of Colleges and Schools.

Practitioners with a current certification in radiation therapy are clustered around urban areas, and 29 counties do not have a certified radiation therapist. These counties are grouped in the northeastern and western areas of the state. Thirty-four counties have only one to two certified radiation therapists. **(See Figure 9)**

Figure 9: Radiation Therapists per 100,000 Population by County, North Carolina, 2002



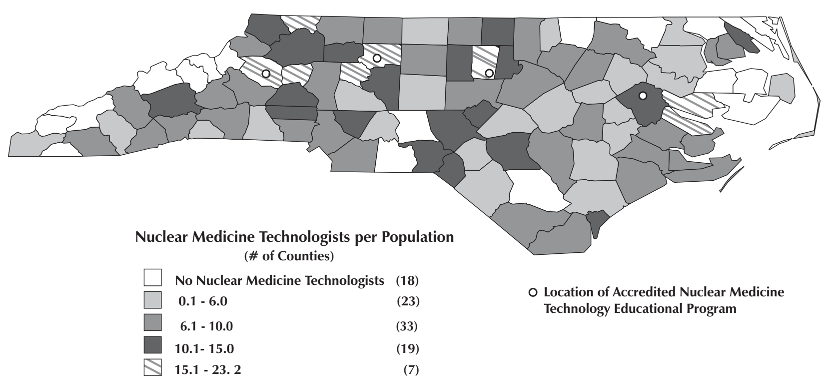
Source: Merged data files from ARRT, NMTCB, ASRT, and NCSRT. N=438 individuals certified as radiation therapists. North Carolina Office of State Planning, 2001.

Produced by: North Carolina Health Professions Data System, 2003. Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

Note: Includes only those individuals certified as radiation therapists by ARRT and may not capture all radiation therapists practicing in North Carolina. Some individuals are included in maps for multiple modalities. Address used may be home, business or other address. Program location indicates location of programs accredited through the Joint Review Committee on Education in Radiologic Technology.

Certified nuclear medicine technologists are found in all but 18 counties in North Carolina and are more likely to be located in the urban counties of the state around the Triangle, the Triad, Charlotte, Asheville, Greenville, and Wilmington.
(**See Figure 10)**

Figure 10: Nuclear Medicine Technologists per 100,000 Population by County, North Carolina, 2002



Source: Merged files from ARRT, NMTCB, ASRT, NCSRT. N=747 individuals certified as nuclear medicine technologists. North Carolina Office of State Planning, 2001.

Produced by: North Carolina Health Professions Data System, 2003. Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

Note: Includes only those individuals certified in nuclear medicine technology from ARRT and/or NMTCB and may not capture all nuclear medicine technologists practicing in North Carolina. Some individuals are included in maps for multiple modalities. Address used may be home, business or other address. Program location indicates location of programs accredited through the Joint Review Committee on Educational Programs in Nuclear Medicine Technology.

Job Title

Of those practitioners indicating a job title, the majority of certified radiologic sciences practitioners, regardless of primary discipline, are employed as staff or senior technologists:

- ✦ 75% of radiologic technologists;
- ✦ 64% of radiation therapists;
- ✦ 61% of nuclear medicine technologists.

The second most common job title for radiologic technologists was supervisory/assistant chief technologist (7%); chief technologist for nuclear medicine technologists (15%); and unspecified for radiation therapists (17%) suggesting that this group is more likely to work under less conventional job classifications. All three groups have very small percentages working as educators. Less than two percent of radiologic technologists (1.8%, 121) and radiation therapists (1.5%, 6) were either faculty instructors or education program directors, while nuclear medicine technologists had a slightly higher proportion of individuals employed in education (2.5%, 9). Job title was missing for 16.1% of practitioners.

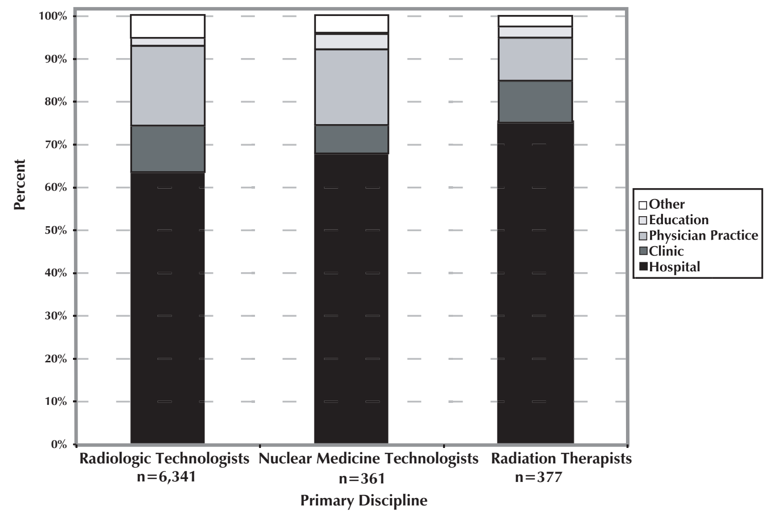
For individuals working in smaller facilities where the radiologic sciences workforce is composed of a few practitioners, job title may not accurately reflect the functions of the staff that may be performing duties of multiple positions (ie. staff tech, chief tech, manager, etc).

Workplace

The majority of certified radiologic sciences practitioners in North Carolina work in hospitals:

- ✦ 63.5% of radiologic technologists;
- ✦ 67.9% of nuclear medicine technologists;
- ✦ 75.1% of radiation therapists;
- ✦ Practitioners are next most likely to work in physician practices and clinics. **(See Figure 11)**

Figure 11: Radiologic Sciences Practitioners by Primary Discipline and Workplace, North Carolina, 2002



Note: Some individuals are included in percentages for multiple disciplines.
Workplace data were missing for 975 individuals with radiography, 386 with nuclear medicine technology, and 61 with radiation therapy as a primary discipline. Other includes data for Retired/Unemployed, Student, and other "unspecified."

Gender

- ✦ 80% of the certified workforce is female;
- ✦ Nuclear medicine technologists have a higher percentage of male workers (33%).

Education

Most certified radiologic sciences practitioners hold an associate's degree (53%) as the highest level of educational attainment, followed by a high school diploma (17%), and bachelor's (14%) degree. The statewide percentages are heavily weighted by the educational characteristics of the radiologic technologists who make up the overwhelming majority of the individuals in this analysis. **(See Table 3)**

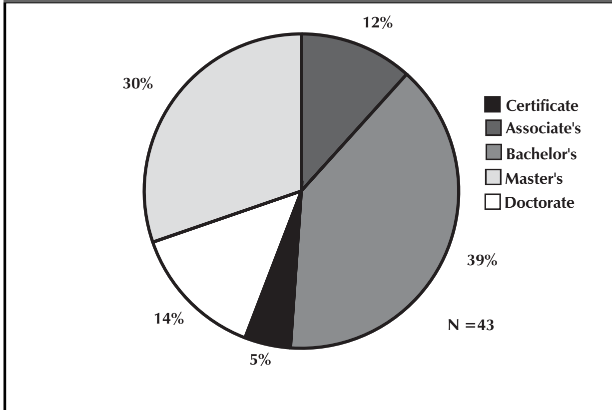
Table 3: Radiologic Sciences Practitioners by Primary Discipline and Education, North Carolina, 2002

Education	Radiologic Technologists	Percent	Radiation Therapists	Percent	Nuclear Medicine Technologists	Percent
High School	1,192	17.3%	19	4.6%	27	7.1%
Certificate	891	12.9%	58	13.9%	65	17.2%
Associate's	3,699	53.7%	216	51.9%	175	46.2%
Bachelor's	918	13.3%	101	24.3%	96	25.3%
Master's	135	2.0%	20	4.8%	10	2.6%
Doctorate	24	0.3%	2	0.5%	3	0.8%
Other (unspecified)	26	0.4%	0	0.0%	3	0.8%
Total w/out Missing	6,885	100.0%	416	100.0%	379	100.0%

Source: Merged data files from ARRT, NMTCB, ASRT, and NCSRT. Total count of active individuals is 7,921.
Notes: Some individuals are included in totals for multiple disciplines. Educational data were missing for 431 individuals with radiologic tehcnology, 368 with nuclear medicine technology and 22 with radiation therapy as a primary discipline.

The Joint Review Committee on Education in Radiologic Technology (JRCERT), the accrediting organization for programs in radiologic technology and radiation therapy, recently adopted new educational standards for programs.[31] By 2009 program directors of JRCERT-accredited radiologic sciences programs must hold a master's degree, while full-time clinical coordinators must have a bachelor's degree. JRCERT implemented this change because it believed it would promote excellence in education and enhance quality and safety of patient care through the accreditation of educational programs.[32] The proposed standards will have a significant impact on program directors in North Carolina. If the requirements went into effect immediately, over half (56%) of the 43 program directors would not fulfill this requirement. Program directors holding a bachelor's degree (17, 39%), associate's degree (5, 12%), or certificate (2, 5%) would need to obtain a master's degree in order for their programs to maintain JRCERT accreditation.
(See Figure 12)

Figure 12: Educational Attainment of Radiologic Sciences Program Directors, North Carolina, 2002

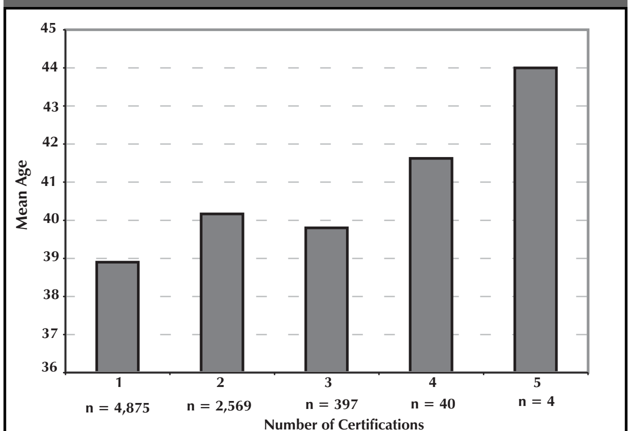


Source: Merged files from ARRT, NMTCB, ASRT, and NCSRT.
N=43 individuals indicating job title of program director.

Age

- ✦ The average age of a certified radiologic sciences practitioner in North Carolina is 39 years.
- ✦ 75% of the workforce is under 46 years; 90% is under 53 years.
- ✦ Individuals with multiple certifications are, on average, older than individuals with one certification. **(See Figure 13)**

Figure 13: Radiologic Sciences Practitioners by Age and Number of Certifications, North Carolina, 2002



Notes: Age data were missing for 36 individuals. Total count of active individuals is 7,921.
Source: Merged files from ARRT, NMTCB, ASRT, and NCSRT.

"Graying of faculty" is a term often heard when discussing the status of current allied health faculty. While the average age of the radiologic sciences workforce is 39 years, radiologic sciences faculty/ instructors and program directors are three years older and six years older than average (42 years, 45 years, respectively).

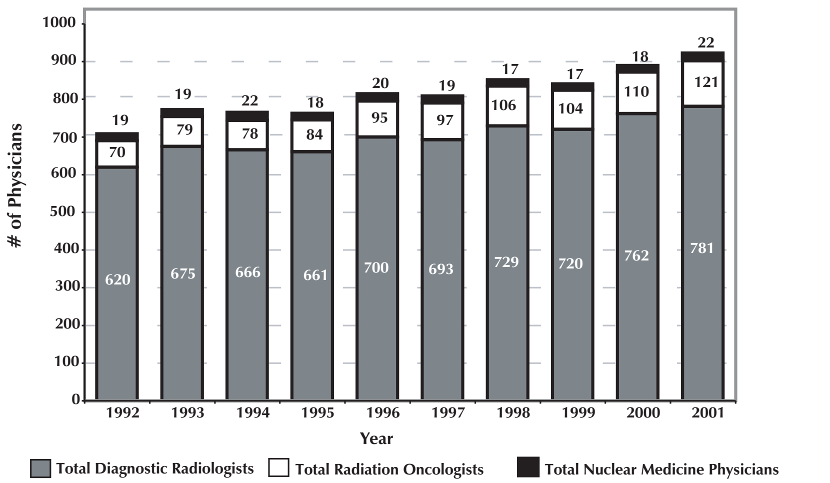
Race

Reliable data on the racial and ethnic diversity of the radiologic sciences workforce in North Carolina were not available. Of the four data sets used in this analysis, only ASRT provided race or ethnicity data. However, 93.7% of ASRT records were missing this field, and therefore race/ethnicity information was only available for 251 practitioners. It is therefore not possible to make conclusions on the composition of this workforce compared with the general population in North Carolina.

VI. THE RADIOLOGY PHYSICIAN WORKFORCE IN NORTH CAROLINA

The radiologic sciences workforce must practice under the supervision of physicians. Like radiologic sciences practitioners, reports about radiologist shortages are growing. Seasoned radiologists are retiring early, and residency programs that were scaled back in the early 1990s in anticipation of managed care are producing fewer radiology graduates.[33]

Figure 14: Total Radiologists, Radiation Oncologists, and Nuclear Medicine Physicians, North Carolina, 1992-2001



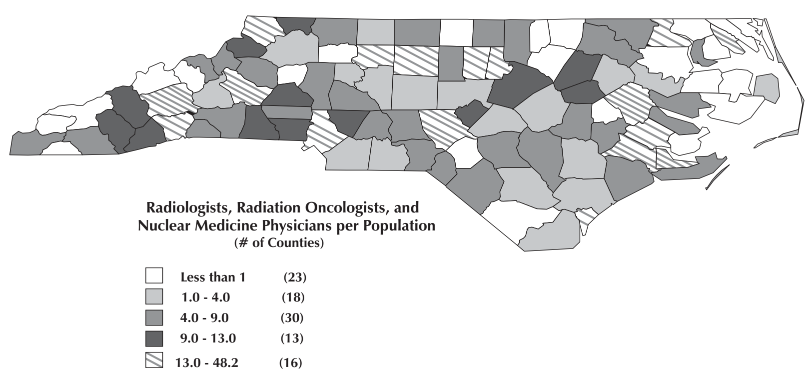
Diagnostic radiologists include the specialties of radiology, diagnostic radiology, pediatric radiology, neuro-radiology and musculoskeletal radiology. Radiation oncologists include the specialties of radiation oncology and therapeutic radiology. Nuclear medicine physicians include the specialties of nuclear medicine and nuclear radiology.

Source: North Carolina Health Professions Data System, 2003.

To compare the supply and distribution of radiologic sciences practitioners to physicians, physician data obtained from the North Carolina Health Professions Data System were divided into similar categories: diagnostic radiology,[34] radiation oncology,[35] and nuclear medicine.[36]

The total number of radiology and nuclear medicine physicians in North Carolina has increased 31.3% from 709 physicians in 1992, to 924 physicians in 2001. The largest growth in these specialties has been in the number of oncologists, which increased 72.9% from 1992 to 2001, compared with a 26% increase in the number of radiologists and a fairly constant supply of nuclear medicine physicians over the same time period. During this time period, these specialties made up between 5.1% and 6.1% of the total physician workforce. **(See Figure 14)**

Figure 15: Radiologists, Radiation Oncologists, and Nuclear Medicine Physicians per 100,000 Population by County, North Carolina, 2001



Source: North Carolina Health Professions Data System, 2003.
North Carolina Office of State Planning.

Produced by: North Carolina Health Professions Data System, 2003.
Cecil G. Sheps Center for Health Services Research,
The University of North Carolina at Chapel Hill.

Notes: Includes the specialties of radiology, diagnostic radiology, pediatric radiology, neuro-radiology, musculoskeletal radiology, radiation oncology, therapeutic radiology, nuclear medicine, and nuclear radiology. Counties reflect primary practice locations only. Physicians were mapped according to primary specialty.

These physicians were mapped according to primary practice location. Radiology and nuclear medicine physicians are largely clustered in the state's urban areas and around regions with tertiary medical centers. There are 23 counties with no physicians with primary practice locations in these specialties. **(See Figure 15)** Diagnostic radiologists are more numerous and more evenly distributed across the state than radiation oncologists. Mirroring the trends in distribution of certified radiologic sciences practitioners, the northeastern and westernmost counties of the state have the least of any of these types of physicians even when controlling for population size.

VII. EDUCATION OF THE RADIOLOGIC SCIENCES WORKFORCE IN NORTH CAROLINA

A key issue for workforce planning in North Carolina relates to the extent to which policies under the control of the state can affect the size, composition, and distribution of the health care workforce. The primary impact state policy makers can have on these factors is through support for educational institutions. The next section will describe the various educational paths to enter the radiologic sciences workforce, followed by an analysis of the educational data obtained from individual programs, the UNC Office of the President, UNC Office of Institutional Research, and the North Carolina Community College System.

1. On-the-Job Training

Because North Carolina lacks state licensure or regulations for the minimum educational credential needed to enter the radiologic sciences workforce, some practitioners have obtained training and experience through on-the-job training. These individuals likely do not hold a credential from either ARRT or NMTCB. Specialty training often occurs in on-site training programs.

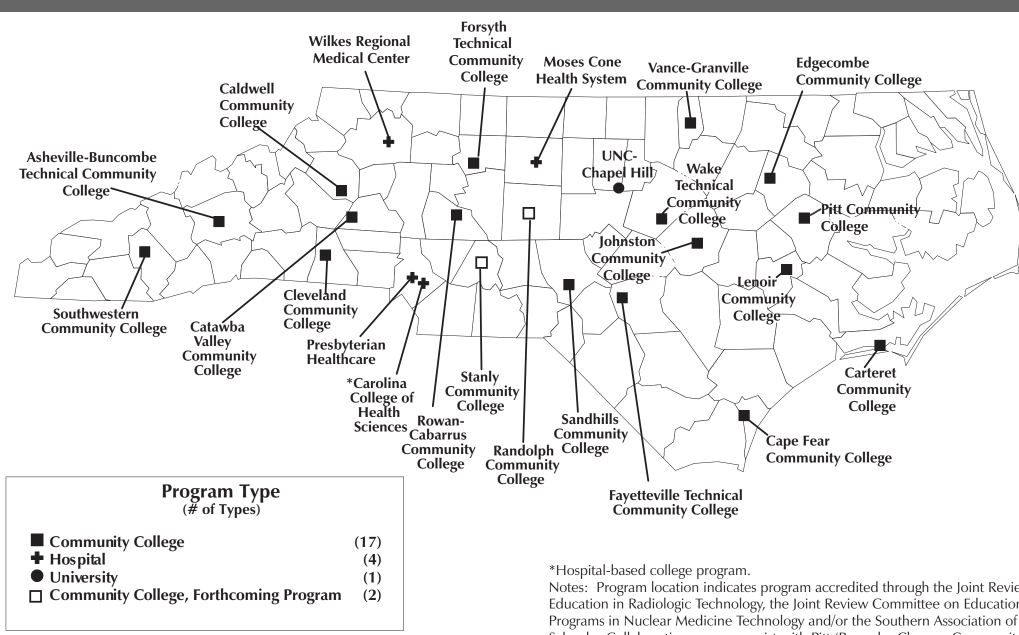
2. Primary Disciplines

Radiologic Technologists

Multiple means exist to become a radiologic technologist in North Carolina. Entrance into the profession can occur after completion of a four-year degree in radiologic sciences from a university, a two-year associate's degree in radiologic technology from a community college, or a certificate in radiologic technology from a hospital or university program.

The University of North Carolina at Chapel Hill (UNC-CH) offers a Bachelor of Science in Radiologic Science (Medical Imaging) – a multi-disciplinary program including radiologic technology. Seventeen community colleges and the Carolinas College of Health Sciences offer associate's degrees in radiologic technology. Three hospitals offer accredited radiologic technology programs: Wilkes Regional Medical Center, Moses Cone Health System, and Presbyterian Health Care. In addition, UNC-Chapel Hill began a certificate radiologic technology program in the fall of 2002. **(See Figures 16 and 17)**

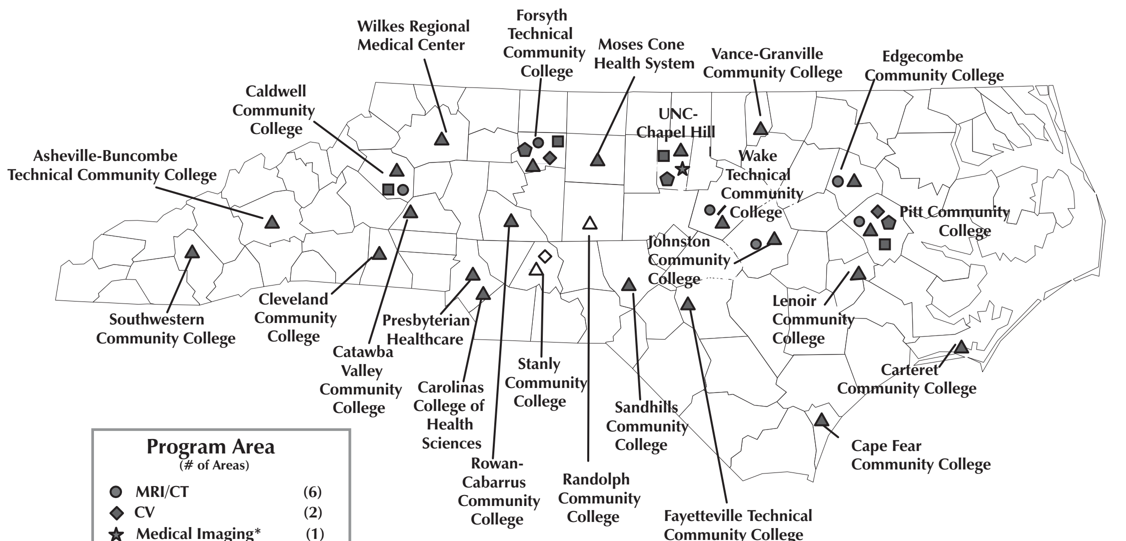
Figure 16: Accredited Radiologic Sciences Educational Programs: Program Types, North Carolina, 2002



Produced by: North Carolina Rural Health Research and Policy Analysis Center, Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

*Hospital-based college program.
Notes: Program location indicates program accredited through the Joint Review Committee on Education in Radiologic Technology, the Joint Review Committee on Educational Programs in Nuclear Medicine Technology and/or the Southern Association of Colleges and Schools. Collaborative programs exist with Pitt (Roanoke-Chowan Community College) and Cape Fear (Brunswick Community College, James Sprunt Community College, Southeastern Community College).
Sources: The American Registry of Radiologic Technologists; The North Carolina Community College System; The University of North Carolina System, 2002.

Figure 17: Accredited Radiologic Sciences Educational Programs: Program Areas, North Carolina, 2002



*Medical Imaging includes radiologic technology and additional areas of study in CT, MRI, mammography and/or CV.

Notes: Program location indicates program accredited through the Joint Review Committee on Education in Radiologic Technology, the Joint Review Committee on Educational Programs in Nuclear Medicine Technology and/or the Southern Association of Colleges and Schools. Collaborative programs exist with Pitt (Roanoke-Chowan Community College) and Cape Fear (Brunswick Community College, James Sprunt Community College, Southeastern Community College).

Sources: The American Registry of Radiologic Technologists; The North Carolina Community College System; The University of North Carolina System, 2002.

Produced by: North Carolina Rural Health Research and Policy Analysis Center, Cecil G. Sheps Center for Health Services Research, The University of North Carolina at Chapel Hill.

Two additional community colleges have been granted approval to start radiologic technology programs: Randolph Community College and Stanly Community College.[37] While the placement of radiologic technology programs is widespread across the state, there are some regions without easy access to a program, particularly in the eastern counties. As seen in the distribution of the radiologic sciences workforce, the eastern portions of the state also have fewer numbers of programs. Distance learning and web-based education are not nearly as prevalent in radiologic sciences as in other educational areas, largely due to significant clinical training requirements. However, some programs have been successful in instituting some web-based components into their programs.

Radiation Therapists

The path to become a radiation therapist in North Carolina usually begins with completion of a four-year baccalaureate degree or a two-year associate's degree. Since 2000, UNC-CH has offered a Bachelor of Science in Radiologic Science (Radiation Therapy) the state's only baccalaureate degree program. However, this program has not enrolled students every year. Prior to 2000, a certificate program in radiation therapy was offered through UNC Hospitals. The one-year hospital-based program in radiation therapy at UNC Hospitals will restart in 2004 and will likely replace the existing BS program.[38] An associate's degree program in radiation therapy is offered at Forsyth Technical Community College; Pitt Community College and Forsyth offer diploma programs.

Nuclear Medicine Technologists

To become a nuclear medicine technologist, completion of an associate's degree or a certificate program is the general requirement. Associate's degree programs in nuclear medicine technology are offered at Caldwell Community College and Technical Institute, Forsyth Technical Community College, and Pitt Community College; UNC Hospitals offers a certificate program.

3. Specialties

Education for additional radiologic sciences specialties is usually offered at community colleges or through individual hospital training programs. The BS in Radiologic Science (Medical Imaging) offered at UNC-CH includes a curriculum in radiologic technology plus additional specialties in CT, MRI, mammography, and/or CV. To obtain certification from ARRT in a specialty, the practitioner must already be credentialed in one of the primary certifications of radiologic technology, radiation therapy, or nuclear medicine technology and pass an examination.

MRI/CT Technologists

Several community colleges offer certificate or diploma programs in MRI/CT. Currently MRI and CT education is offered at Caldwell Community College and Technical Institute, Edgecombe Community College, Forsyth Community College, Johnston Community College, Pitt Community College, and Wake Technical Community College. Students graduating from UNC-CH with a Bachelor of Science in Radiologic Science (Medical Imaging) may elect to specialize in MRI and/or CT. In addition, individual hospitals may offer on-the-job training in these specialties.

Four of the six community college programs and the one imaging program are located in the eastern half of the state; the remaining two college programs are located in western North Carolina. There is wide variability in the utilization of the individual programs, which may be related to geographic location or program factors such as age of program, effectiveness, graduate placement success, recruitment initiatives, and distance learning opportunities, among others. In some areas, competition from on-the-job hospital training in MRI or CT may affect program enrollment. The programs that have been operating in the state for over 10 years (Forsyth and Edgecombe) have been successful in filling most, if not all available enrollment spaces. These two programs have expanded the success with on-campus programs to the development of distance learning options and collaborations with neighboring colleges. The relatively new programs have had more difficulty in enrolling students into all available spaces, and some have not been offered due to insufficient numbers of students. The under-utilization of these programs may be due to lack of knowledge of their existence by potential students or employers or because students may prefer to enroll in established programs.

Cardiovascular/Vascular Interventional Technologists

Certificate, diploma, or joint programs in cardiovascular/vascular interventional technology (CV) in North Carolina are offered at Forsyth and Pitt. Stanly Community College has been granted approval to open a cardiovascular interventional technology program.[39] Students in the BS in Radiologic Science (Medical Imaging) may elect to specialize in CV. Individual hospitals often offer in-house training programs. CV programs are beginning to separate the curriculum into cardiac technology and vascular technology.[40]

Mammography, Bone Densitometry, Quality Management Specialties

In North Carolina, there are no formal educational programs offering mammography, bone densitometry, or quality management. Education and training in these areas is typically conducted at the worksite, under the guidance of a qualified instructor. To apply for certification from ARRT, the practitioner must be certified as a radiologic technologist, must undergo training specific to the specialty, and successfully complete the examination. Students in the BS in Radiologic Science (Medical Imaging) may elect to specialize in mammography.

Positron Emission Tomography (PET) Training

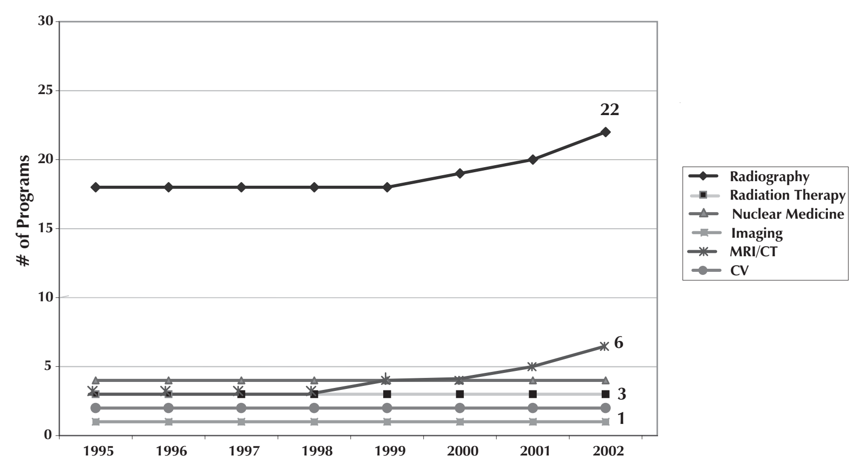
There are no designated positron emission tomography training programs in North Carolina. Existing operators are likely credentialed in nuclear medicine technology, but operation of PET requires additional training that may be offered on-site by employers or from PET vendors. Carolinas Medical Center/Carolinas College of Health Sciences is in the preliminary stages of developing a six-month PET certificate course that will be offered to experienced radiologic sciences practitioners registered in CT or nuclear medicine technology. The course will likely include a fusion imaging component to address the technological advancements in hybrid equipment (PET/CT).[41]

In November 2002, program directors of accredited radiologic sciences programs in North Carolina were surveyed about past and future enrollment, attrition, in-state retention of graduates, and other key workforce issues. Responses were received from all universities, community colleges, and hospitals offering accredited programs in radiologic technology, radiation therapy, nuclear medicine, medical imaging, CT, MRI, and CV (N=22 sites, 100% response rate).[42] In addition, aggregate data were received from the North Carolina Community College System, UNC Office of the President, and UNC Office of Institutional Research.

The number of accredited radiologic sciences programs across North Carolina remained stable from 1995 to 1998. Beginning in 1999, the total number of programs has increased each year, with the most significant growth in the number of MRI/CT and radiologic technology programs. Two new radiologic technology programs will open in 2003 at Randolph Community College and Stanly Community College; one new CV program will open at Stanly. **(See Figure 18)**

In addition, some hospitals and health systems have opened, or expressed an interest in opening, in-house programs. It is not known whether those hospitals have obtained, or are eligible to obtain, accreditation from JRCERT or JRCNMT.

Figure 18: Accredited North Carolina Radiologic Sciences Programs, 1995-2002



Source: Individual Programs, North Carolina Community College 2003 Educational Guide.

1. Enrollments

Data on number of available and filled enrollment positions were obtained from individual program directors for the last five years.

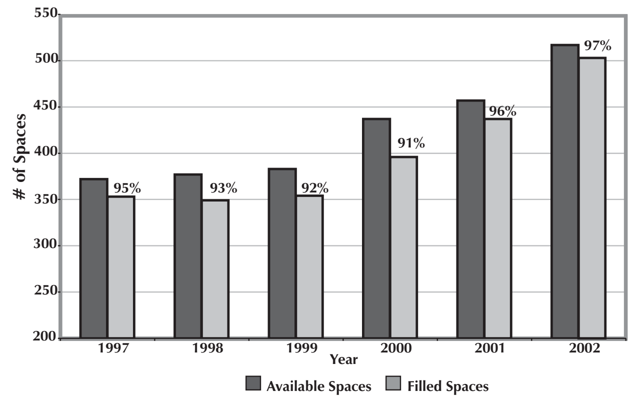
Available Spaces

In recent years, between 88% and 91% of all available enrollment spaces in radiologic sciences across the state have been utilized.

- ✦ Over 91% of radiologic technology program spaces have been filled over the last five years, reaching a high of 97% in 2002. Of the 22 radiologic technology programs operating in 2002:
  - ❏ 18 programs were able to fill 100% of available slots (two programs exceeded capacity)
  - ❏ 2 were able to fill 97% of spaces
  - ❏ 2 were able to fill 72% of spaces.
- ✦ The baccalaureate program in radiologic science (medical imaging) at UNC-CH has seen significant growth in the percent of available spaces being filled and has reached 100% capacity over the last four years.
- ✦ 54% of spaces in 1997 and 95% of spaces in 2002 in nuclear medicine technology programs were filled.
- ✦ Capacity in radiation therapy programs has ranged from 71% in 1997 to 90% in 2001.

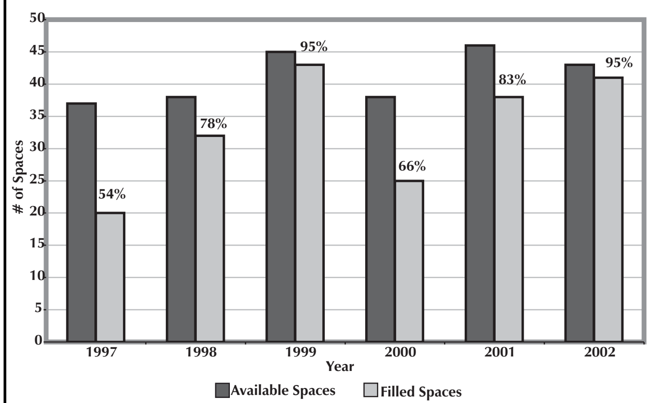
(See Figures 19-21, over)

Figure 19: Enrollment Spaces in Accredited Radiologic Technology Programs, North Carolina, 1997-2002



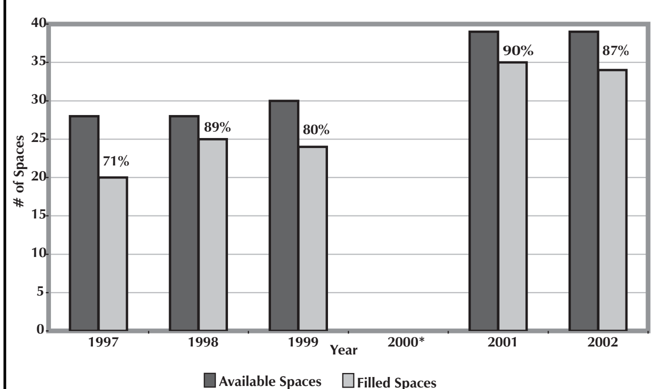
Source: Individual radiologic technology programs in hospital, colleges, and universities. Excludes enrollment in radiologic science (medical imaging) program.

Figure 20: Enrollment Spaces in Accredited Nuclear Medicine Technology Programs, North Carolina, 1997-2002



Source: Individual nuclear medicine technology programs in hospitals, colleges, and universities.

Figure 21: Enrollment Spaces in Accredited Radiation Therapy Programs, North Carolina, 1997-2001



Source: Individual radiation therapy programs in hospitals, colleges, and universities.
*Note: Data not available for 2000.

The specialty programs have seen considerable variation in their ability to fill all available slots, likely due to the availability of some specialty training programs within hospitals. The increase in the number of MRI and CT programs over the last three years has coincided with a decrease in the percentage of available spaces being filled, however this is program-specific. While some programs have not been able to enroll enough students to justify operation of the program, others have substantial waiting lists and are not able to enroll all interested and qualified students.

Reasons for Unfilled Spaces

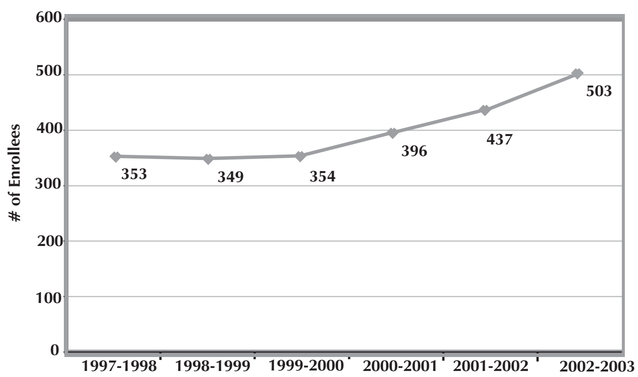
Program directors were asked to comment on the reasons for unfilled spaces, which for the majority of the programs, are few to none. Many programs receive applications well in excess of the number of spaces available and have considerable waiting lists. According to the majority of directors, spaces remain unfilled due to:

- Lack of qualified applicants
- Lack of any applicant pool
- Competition from in-house hospital training programs (for specialties)
- Lack of clinical sites to place students.

Enrollment Trends

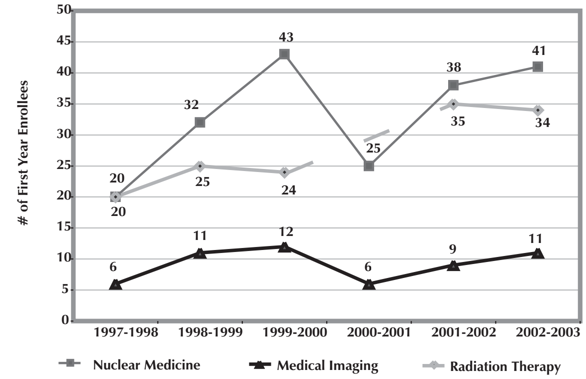
The number of first year class enrollments in accredited radiologic sciences programs across North Carolina has increased 52% since 1997-98, and the increase has been seen across most disciplines. The fluctuations in enrollments of individual programs however vary considerably, from a 38% decrease[43] to a 433% increase.
(See Figures 22-24)

Figure 22: Enrollments in Accredited Radiologic Technology Programs, North Carolina, 1997-2003



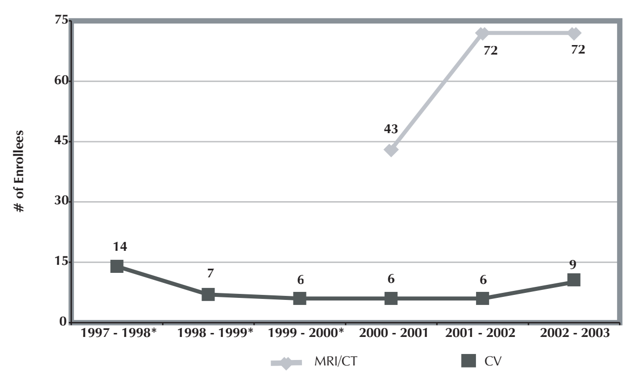
Source: Individual Programs, December 2002. Excludes enrollments in radiologic sciences (medical imaging program).

Figure 23: Enrollments in Accredited Nuclear Medicine Technology, Radiation Therapy, and Medical Imaging Programs North Carolina, 1997-2003



Note: Data not available for radiation therapy in 2000-2001.
Source: Individual programs, December 2002.

Figure 24: Enrollments in Specialty Radiologic Sciences Programs, North Carolina, 1997-2003



Source: Individual Programs, December 2002.
*Data not available for MRI/CT 1997-2000.

Future Spaces

Over half (54%, 24) of current accredited radiologic sciences programs (disciplines or specialties) do not anticipate any program expansion over the next five years; 32% (14) of programs anticipate increasing the number of spaces; 7% (3) will decrease the size of programs, and 7% (3) are unsure. Programs that will expand have waiting lists or have collaborated with local employers to increase the number of students and/or the number of classes each year.[44] The reasons for lack of expansion or for declining class sizes were similar across most programs:

- ✦ Lack of faculty
- ✦ Fewer employers willing or able to serve as clinical sites (ie., short staffed, cannot support student learning, financial limitations)
- ✦ Lack of clinical sites (all sites in area at capacity).

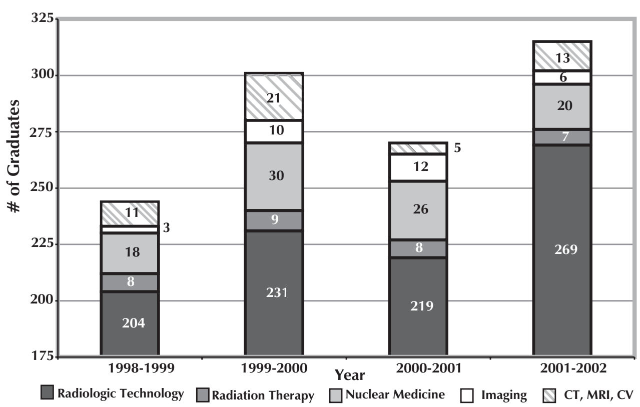
The opening of two additional radiologic technology programs and one additional CV program in the next year will increase the number of available enrollment spaces across the state, but will also require additional, or expansion of existing clinical sites and additional faculty.

2. Graduates

From the period 1998-99 to 2001-02, the number of graduates from accredited bachelor's, associate's, hospital certificate and diploma radiologic sciences programs in North Carolina has increased 29% (excludes college certificate programs). Across all radiologic technology programs, the majority of individual programs showed growth in the number of graduates, but there is a high degree of variation across individual programs (–100% to +118%). Between 1998-99 and 2001-02:

- ✦ Graduates from all radiologic technology programs increased 32%.
- ✦ Graduates from radiation therapy programs decreased 13%, however, this is somewhat attributable to the availability of programs in radiation therapy. The certificate program at UNC-CH ended in 2000 and was replaced by a bachelor's program, which admitted its first class the same year. No students were admitted in fall of 2000, which resulted in no graduates in 2001. The radiation therapy program at UNC Hospitals will restart in 2004.

Figure 25: Graduates from Accredited Radiologic Sciences Programs, North Carolina, 1998-2002*



Source: North Carolina Community College System, UNC Office of the President, Individual Programs.
*Notes: Includes graduates from bachelor's, associate's, diploma, and hospital certificate programs. Excludes graduates from community college certificate programs. 2002 graduates include up to May 2002 and exclude summer 2002 graduates.

- ✦ Graduates from nuclear medicine technology programs increased 11%.
- ✦ Graduates from the baccalaureate program in radiologic science (medical imaging) and the diploma MRI/CT programs have increased 100% and 30% over the last four years, respectively. Practitioners who complete on-the-job hospital training programs are not included in these graduation counts.

(**See Figure 25)**

3. Attrition

Although the majority of programs enroll enough students to fill vacant slots, attrition from programs is another consideration in evaluating the effectiveness of educational programs. Calculating attrition rates from enrollments and graduates is difficult because not all students complete the program in the scheduled time frame. However, looking at the number of enrolled students at the beginning of programs and the number of graduates from the programs reveals that attrition is a concern for many programs.

For example, in 1997, there were 372 spaces available in the state's radiologic technology programs. Of those spaces, 353 were filled with students. If we assume a two-year graduation for these students, these students would graduate in 1999. In 1999, only 204 students graduated from radiologic technology programs. Obviously some students may take more time than the traditional two-year time frame, some students may drop out but return to the program at a later date, but it is reasonable to say that many students are not remaining in the program. Individual programs attrition rates vary considerably.

Attrition data obtained from JRCERT for the last three years show higher attrition rates from accredited radiologic technology programs than radiation therapy programs. Attrition from North Carolina's radiologic technology programs has remained relatively stable: 22.0% (1999-00), 23.0% (2000-01), and 22.2% (2001-02).[45] Attrition in radiation therapy programs has fluctuated, increasing dramatically in the last year: 14.3% (1999-00), 12.8% (2000-01), and 23.1% (2001-02).[46]

Many program directors offered reasons for attrition in radiologic sciences programs including:

- ✦ Factors related to students (academic, financial, and transportation difficulty; failure to adapt to the curriculum; and other personal reasons).
- ✦ Competition with other career interests, particularly ones that offer higher salaries with a shorter educational commitment.

Many directors felt students lacked a realistic perception about careers in radiologic sciences or the preparation needed to complete the curriculum. Improved marketing of the profession and program options is needed to attract qualified and committed students. Additionally, enhanced recruiting, screening, and ongoing support (educational, financial, personal, transportation assistance) of radiologic sciences students could prevent some attrition.

4. Retention

To understand the relationship between the output of North Carolina's accredited educational institutions and new entrants into the radiologic sciences workforce, a "retention index" was calculated. This index was calculated by averaging the estimated percentage of graduates from programs who will remain in-state to practice. These data were obtained from program directors who were asked to estimate the percentage of the last three graduating classes who were employed in the profession in North Carolina. This factor was calculated for the primary certifications (radiologic technology – including medical imaging; radiation therapy; and nuclear medicine technology) because entry into the specialty programs is open to students who have already earned one of these primary certifications. They are already considered to be employed in the workforce and therefore should not be

Table 4: Expected Additions to the Radiologic Sciences Workforce From North Carolina Institutions, 2001-2006

	Graduating Class Size				Projected Graduating Class Size*					Retention Factor**	Expected Additions to NC Workforce					
Educational Program	1999	2000	2001	2002	2003	2004	2005	2006	2007		2001	2002	2003	2004	2005	2006
Radiologic Technology/Medical Imaging***	207	241	231	275	275	275	275	275	275	0.84	195	232	232	232	232	232
Radiation Therapy	8	9	8	7	8	8	8	8	8	0.76	6	5	6	6	6	6
Nuclear Medicine Technology	18	30	26	20	24	24	24	24	24	0.75	20	15	18	18	18	18
Total	233	280	265	302	307	307	307	307	307		221	252	256	256	256	256

Sources: Graduating class size from NC Community College System, UNC Office of the President, and individual hospital programs. Retention factors from program directors.

Notes: * Projected graduating class for radiologic technology based on 2002 graduating class in radiologic technology and medical imaging only. Projected graduating classes for radiation therapy and nuclear medicine technology are based on a constant 4-year average rate and assume constant enrollment patterns for future years. No new nuclear medicine technology or radiation therapy programs are expected at this time. (The radiation therapy program opening at UNC Hospitals will likely replace the existing program at UNC-CH).

** Retention factor based on average estimate of percent of graduates that will practice in North Carolina after graduation. Radiologic technology/medical imaging retention factor based on 3-year average of 20 radiologic technology and 1 medical imaging programs. Radiation therapy retention factor based on 2-year average of 2 programs (2 programs not reporting). Nuclear medicine technology retention factor based on 3-year average of 4 programs.

***Medical Imaging indicates Bachelor of Science in Radiologic Science (Medical Imaging) -- which includes radiologic technology and additional areas of study in MRI, CT, CV and/or mammography.

considered a "new" entrant. The retention index should be interpreted with some caution. While most educational programs collect information on their students post-graduation, it is often incomplete or unreliable. **(See Table 4)** The overall retention factor for radiologic technology (including graduates of the baccalaureate program in radiologic science/medical imaging) students is 0.84 meaning that 84% of graduates from accredited radiologic technology programs can be expected to enter the North Carolina radiologic sciences workforce.[47] For radiation therapy students, the retention rate is 0.76 meaning that 76% of graduates will remain employed in the state.[48] Three quarters of nuclear medicine technology (75%) graduates remain in the state after graduation.[49] The percentage of students remaining in-state after graduation is highly dependent on the percentage of students who are North Carolina residents. Radiation therapy students and nuclear medicine technology students were more likely to be from out-of-state than were radiologic technology students, possibly due to the availability of programs in neighboring and southeastern states.

The annual projected number of new additions to North Carolina's radiologic sciences workforce from the state's accredited programs (excluding specialties) is:

- ✦ 232 radiologic technologists (including graduates from medical imaging program)
- ✦ 6 radiation therapists
- ✦ 18 nuclear medicine technologists.

The radiologic technology/medical imaging figures were based on last year's (2002) graduation rate. Since two new radiologic technology programs opened in 2002 and two new programs are expected to open in 2003, the figure observed in 2002, assuming attrition remains constant, is more likely to be reflective of the size of future graduating classes. The projections for radiation therapy and nuclear medicine technology assume a constant enrollment and use a four-year graduation average. These projections will change with any increase or decrease in the number of programs, changes in the number of available spaces, improved marketing and recruitment efforts, or any other mechanism affecting recruitment, attrition, or retention.

5. Diversity

Race and Ethnicity

Without adequate data on the race and ethnicity of current radiologic science practitioners, it is difficult to compare the diversity of radiologic sciences students to the workforce and to North Carolina's population. Ethnicity and race data were obtained for enrollees in the state's community college and university certificate programs.[50] Data on the diversity of enrolled students were obtained to highlight the proportion of underrepresented minorities that are seeking radiologic sciences education. Because not all enrollees complete the programs, the diversity of graduates will differ from enrollees. Data from community college and university certificate programs were combined because of the relatively low numbers in the university programs. Likewise, because of the low number of students enrolled in the specialty programs, racial and ethnic figures have only been calculated for the primary disciplines of radiologic technology, radiation therapy, and nuclear medicine technology.

Of the three primary disciplines, radiologic technology programs have the highest percentage of underrepresented minority students, and the percentage has improved over the last four years. In 1998-99, 13.6% of radiologic technology students were non-white; by 2001-02, that number had increased to 18.8%. The percentage of radiation therapy students from underrepresented minority groups has ranged from 3.3% in 1998-99 to 9.1% in 1999-00 and 2000-01. The diversity of nuclear medicine technology students has fluctuated over the last four years from a high of 22.9% in 1999-00 to a low of 6.4% in 2001-02. The fluctuation in data indicates that there may be some reporting error on race/ethnicity. Race and ethnicity data are often not accurately recorded, and underrepresented minority students may be included in another racial/ethnic classification or in the "other" category. Figures from the 2000 Census indicate 27.9% of North Carolina's population was non-white or mixed race, indicating that the diversity in the state's radiologic sciences educational programs is less than that of the general population.[51] African American students make up the largest majority of underrepresented minority students, followed by Asian students in a distant second.

A concern for all programs is the lack of persons of Hispanic/Latino origin represented in the student population. With the exception of a small number of Hispanic/Latino students in radiologic technology programs, none of the other radiologic sciences educational programs reported enrollments of students of Hispanic/Latino origin since 1998-99. The Hispanic/Latino population in North Carolina continues to increase, and programs have not been particularly successful in attracting this population to the radiologic sciences. Many health professions, including allied health, are seeing the need and benefits in having a diverse workforce to care for, and communicate with, the increasing Hispanic/Latino population.

Gender

Radiologic sciences students, like the active workforce, are predominantly female. However, the current student body is less diverse than the workforce. Approximately 15% of radiologic students are male; in the actual workforce 20% of practitioners are male. Nuclear medicine technology students, like the nuclear medicine technology workforce, are more likely to be male than students in radiation therapy or radiologic technology. In 2000-01 nearly 27% of nuclear medicine technology students were male; 18% and 13% of students were male in radiation therapy and radiologic technology programs, respectively.

IX. NATIONAL CHANGES IN THE RADIOLOGIC SCIENCES WORKFORCE

Several initiatives and activities currently underway on a national level will affect the radiologic sciences workforce in North Carolina.

1. New Career Paths

Radiologist Assistants

In March 2002 an advisory panel of physician and radiologic sciences representatives including the American College of Radiology, ARRT, ASRT, and other stakeholders met to discuss the development of a new advanced-practice radiologic technologists, called a Radiologist Assistant (RA). The impetus for this meeting arose from challenges facing the radiology community, including increased patient demand, a growing shortage of radiologists and radiologic technologists, and the rapid expansion of new technology. The panel envisioned that the RA would work under the supervision of a radiologist - analogous to the physician/physician assistant model. The RA would be responsible for patient assessment, education, and management, performing fluoroscopy and other procedures, and making initial image observations.[52] The new program may offer relief to current radiologic technologist shortages by raising interest in the field, creating a professionally appealing career path, and relieving time pressures experienced by radiologists facing shortages.[53, 54]

Thirteen radiologist assistant programs will be starting around the nation. The University of North Carolina at Chapel Hill has been awarded a New Program Development Grant for Radiologist Assistant Programs through the ASRT Education and Research Foundation to explore the feasibility of developing a post-baccalaureate radiologist assistant certificate program that will likely evolve to a master's degree.[55]

Radiology Practitioner Assistants

Radiology practitioner assistants (RPAs) already exist in the US, but the Certification Board of Radiology Practitioner Assistants (CBRPA) has certified relatively few (less than 100 nationwide).[56] The qualifications and standards for the RPA differ from the proposed competencies currently under development for the RA. The primary differences will be in the curriculum of study and required degree awarded. RPAs provide primary patient care and participate in case management, under the supervision of a radiologist. Weber State University in Utah offers the only RPA educational program in the United States.[57]

Radiologic Technologist Aides

Some facilities utilize assistive personnel alongside radiologic technologists. RT aides or assistants are entry-level positions that provide support in radiology departments, thereby allowing radiologic technologists to focus on patient care. There is no standardization of skills or competencies, and the scope of duties for RT aides differs across facilities. Some aides assist with transporting patients; others are more involved in patient care and departmental operations. The use of RT aides offers an opportunity for employees to learn more about the field of radiology and may potentially lead to a future applicant pool.

2. Changes in the Education of Radiologic Sciences Personnel

National Trends in Radiologic Sciences Education

Unlike North Carolina, the number of JRCERT accredited radiologic technology and radiation therapy programs has decreased 7% and 26% respectively between 1997 and 2001 in the United States.[58] Enrollments in both radiologic technology and radiation therapy programs have followed similar trends – increases in the last few years after three years of decline.[59] Although improving, the number of graduates from both types of programs have yet to reach 1997 levels.[60] A recent ASRT survey of educational directors revealed that attrition is a concern, finding that radiologic technology programs experienced the highest student attrition rates of all the three primary disciplines. Approximately 22% of radiologic technology students dropped out of programs before graduation, compared with 18% for radiation therapy and 12% for nuclear medicine technology.[61]

Bachelor Degrees as the Entry-Level Education for Radiologic Sciences

Standardizing radiologic sciences educational and training requirements across the country is of interest to ASRT, which advocates a bachelor's degree as the entry level for radiation therapists.[62] The Society of Radiation Oncology Administrators (SROA) opposes the proposal, asserting that the plan will exacerbate the shortage of therapists and negatively impact cancer patient care.[63] A November 2000 ARRT survey of radiation therapists revealed that most respondents believed the degree requirement would lead to higher salaries, more respect from other health care providers, higher self esteem, and greater opportunities for advancement.[64]

Entry-Level Education for Radiologic Technology

Currently no universal standard for minimum education for radiologic technology exists. ASRT advocates an associate's degree as the entry-level educational standard, but in recognition of certificate granting hospital programs, ASRT intends to facilitate a process through which hospital program graduates can earn academic credit and a degree upon graduation.[65] This could have implications for existing hospital certificate programs, including the three currently operating in North Carolina.[66] The bachelor's degree for radiologic technology is promoted by some in the profession as the ideal educational minimum. Hospital administrators and the profession view the move toward the baccalaureate degree differently. The profession sees it as increased professionalism of the workforce. In a survey of hospital radiology administrators, the educational degree of radiologic technologists was not perceived to be related to employment, retention and promotion practices, salary, career orientation, or willingness to cross-train.[67] Managers are more interested in experience and personal attributes than in educational degrees, including flexibility, customer service skills, knowledge of additional specialties, and efficiency. Additionally 84% of administrators reported the same wage for the same job would be offered to technologists, regardless of education, preferring to hire an experienced technologist with a certificate or associate's degree to an inexperienced bachelor's-prepared technologist.

Career Ladder in Radiologic Technology

Career advancement within the radiologic sciences is often limited. The ASRT Education Master Plan seeks to define advanced practice for radiologic technologists, including baccalaureate and graduate degrees in radiologic sciences, and to focus on multi-credentialed individuals.[68] The new radiologist assistant practitioner is also perceived by the profession as a positive step in the development of a radiologic technology career ladder.

Training for New Technology

As the use of fusion imaging increases, concerns have arisen about the education, qualification, and regulation of personnel operating this equipment. In a 2002 consensus conference jointly sponsored by ASRT and SNM-TS, the societies agreed the ideal technologist operating hybrid equipment would be credentialed in both CT and nuclear medicine. However, fewer than 200 technologists across the US have dual certifications in CT and nuclear medicine and because of the shortage of this type of practitioner, personnel operating existing fusion equipment have varying qualifications. For some states with licensure, the regulation of hybrid equipment personnel requires the operator be dually credentialed in nuclear medicine and CT. Given the rarity of this multiple credential, regulations state a technologist credentialed in nuclear medicine and one credentialed in CT must be present, placing further pressure on facilities facing staffing shortages.[69] Many in the profession believe a new type of worker is needed to operate this emerging technology and the ASRT and SNM-TS recommend creating multiple pathways to educate and train radiologic technologists, nuclear medicine technologists, and radiation therapists in operating fusion equipment.

The explosion of interventional radiology has posed challenges for health care employers to ascertain the most appropriate practitioner to assist in these procedures. The debate over whether a trained radiologic technologist (with vascular experience) or a surgical technologist is the most appropriate is ongoing.

Reduction in Length of Radiologic Technology Programs

Although ASRT advocates an increase in the entry-level radiologic technology education, many community college radiologic technology programs are shortening program lengths, largely in response to employer pressure to graduate students more quickly and the difficulty in finding faculty to teach. Radiologic technology programs in North Carolina range from 18 to 24 months in length, not accounting for time needed to complete prerequisites.[70]

X. THE RADIOLOGIC SCIENCES WORKFORCE IN THE UNITED STATES

EMPLOYMENT TRENDS OF THE RADIOLOGIC SCIENCES WORKFORCE IN THE US

The Bureau of Labor Statistics (BLS) of the United States Department of Labor provides information on national trends in the radiologic science workforce, specifically radiation therapists, radiologic technologists, and nuclear medicine technologists. Like North Carolina figures, BLS projects increases in the number of new positions needed as a result of new positions and positions that will need to be filled due to retirement, death, change in career direction, etc. Between 2000 and 2010 there will be:

- 23.1% increase in the number of radiologic technologists from 167,000 to 206,000
- 22.4% increase in the number of nuclear medicine technologists from 18,000 to 22,000
- 22.8% increase in the number of radiation therapists from 16,000 to 19,000.[71]

Health Care Workforce Studies in the US

Similar to the North Carolina Hospital Association Workforce Study, The American Hospital Association's publication, "In Our Hands; How Hospital Leaders Can Build a Thriving Workforce," reported on the shortages in health care professionals in the nation's hospitals.[72] The survey found:

- imaging technicians are facing the highest mean hospital vacancy rate at 15.3%.
- registered nurses, pharmacists, and licensed practical nurses, among others, had smaller vacancy rates than imaging.
- 71% of hospital CEOs were experiencing workforce shortages in radiology/nuclear imaging.

XI. THE IMPLICATIONS OF A SHORTAGE OF RADIOLOGIC SCIENCES PRACTITIONERS

The radiologic sciences profession has experienced several cycles of workforce imbalances. For health care facilities facing a shortage of practitioners, the implications for both staff and patients are numerous. When faced with unfilled vacancies, departments often hire contract staff to fill vacancies, usually at much higher labor costs. Departments try to maximize existing staff through increased hours or extra shifts, often resulting in increased workloads, job dissatisfaction, and stress. Shortages of radiologic technologists can impede patient access to tests or delay turnaround times, which in turn can create delays in treatment plans. Burnout can impair radiologic technologist's ability to produce high quality diagnostic radiographs and decrease the quality of patient care in the hospital environment.[73] Patients may be subjected to repeated studies because of improper positioning or poor technique. Unnecessary duplication can be costly to a health care facility; treatment decisions made from poor quality images can be damaging to patients. For states without licensure for imaging or therapy personnel, non-certified personnel may fill vacancies. The proposed federal CARE bill seeks to ensure that all patients undergoing all types of radiologic procedures have the same assurance of quality as those receiving mammograms under the federal provisions of the Mammography Quality Standards Act.[74]

XII. CONCLUSIONS AND RECOMMENDATIONS

This final section of the report summarizes the panel's findings and reports the panel's recommendations about actions needed to address current and future issues in the radiologic sciences workforce in North Carolina.

1. Workforce Planning

Little collaboration exists between employers and educators to plan workforce strategies at the local or regional level. Because of the cyclical nature of past radiologic sciences shortages and surpluses, short-term decisions have further contributed to excessive workforce imbalances. Workforce issues are not unique to an individual facility or educational site and decisions made by one entity have implications for other facilities and educators within a larger region. Workforce imbalances would be better addressed through coordinated regional efforts by employers and educators.

> ***1.1 Recommendation:*** *Increase and improve communication and collaboration among employers (ie. hospitals, clinics, physician practices, etc), educators (ie. university, community college, hospital), professionals (representing the different disciplines and specialties, both practitioner and physician), and other key stake-holders (ie. NCHA, professional societies and associations, vendors, etc.) in the development of regional educational and workforce planning. To more effectively utilize scarce radiologics sciences resources, consider convening county or multi-county planning forums to discuss educational programs, student clinical placement sites, or workplace retention (e.g. Forsyth Tech Health Care Summit).*

> ***1.2 Recommendation:*** *Consider developing a more formal organization with the sole mission of ensuring access to a well distributed, well trained, and well educated radiologic sciences workforce through systematic and collaborative planning among educators, employers, practitioners, and other key stakeholders. Use the knowledge and expertise of existing regional planning entities such as the Western North Carolina Health Network or Health Care Works! (in the Triangle region).*

The process of allocating new technology services and equipment across North Carolina through the annual development of the North Carolina State Medical Facilities Plan (SMFP) and pursuant to G.S.131E-177 is unfamiliar to many in the radiologic sciences profession. The allocation of technology requiring a CON is projected using designated health service areas. Draft Plans are made available to the public and public hearings are held throughout North Carolina in early summer in which comments and petitions are considered by the State Health Coordinating Council (SHCC).

> ***1.3 Recommendation:*** *Encourage involvement in the public hearing and comment phases of the development of the SMFP. Educators are in a prime position to offer comments to the SHCC about the workforce implications and availability of practitioners needed to operate any new or emerging pieces of radiology equipment across the state.*

> ***1.4 Recommendation:*** *Utilize the annual need allocations published in the SMFP in educational planning. Projected need determinations made in the SMFP are still subject to CON approval and appeal, and there fore equipment does not become operational for years after the SMFP is published. Therefore educational programs, together with employers within a health service area have the opportunity to develop and prepare programs to educate the future workforce necessary to operate forthcoming equipment.*

Technology in the field of radiology is changing quickly. Educators and employers often do not know what technology is on the horizon until products reach the market. This prevents long-term workforce planning for educators and employers.

> ***1.5 Recommendation:*** *Consider the establishment of an entity responsible for assessing future needs and demands in radiology in North Carolina. Seek funding from outside foundations or equipment vendors to support such an entity.*

2. Education

Number of Programs

The number of radiologic technology, radiation therapy, and nuclear medicine technology programs in North Carolina is sufficient to fill the needs of the state if all program spaces are filled and a larger percentage of students complete the programs. The number of specialty programs (MRI, CT, CV) should be increased; however existing programs continue to operate below capacity. Radiologic sciences educators and employers must begin to prepare the workforce needed to operate the increasing number of PET scanners in the state.

> ***2.1 Recommendation:*** *Maintain the status quo with respect to the number of radiologic technology, radiation therapy, and nuclear medicine technology programs and spaces. Through regional workforce and educational planning, expand specialty programs to meet the needs of the state. Develop statewide educational marketing and recruiting policies to ensure existing and forthcoming programs are well-utilized and fill existing enrollment capacity.*

Recruitment

Careers in radiologic sciences are often overshadowed by other health care professions and students in elementary, middle, and high schools are not always informed about the range of career opportunities. Students and applicants are often unaware of the true working climate of a radiologic sciences practitioner (ie., physical demands of lifting patients, exposure to blood and other bodily fluids, relationships with other health care providers, etc.). Many employers and students are not aware of educational offerings in radiologic sciences, both campus-based and distance learning.

> ***2.2 Recommendation:*** *Expose and educate school-aged students, and guidance and career counselors to the opportunities in allied health sciences, including radiologic sciences. Establish a radiologic sciences educational handbook describing locations and types of programs in North Carolina.*

> ***2.3 Recommendation:*** *Require curriculum orientation and clinical shadowing before entrance into programs, facilitate communication between the existing workforce and potential students, and educate applicants about both the positive and negative aspects of choosing a career in radiologic sciences. Ensure these initiatives are HIPAA compliant. Disseminate best practices of programs that have developed successful pre-entrance initiatives and programs.*

Retention

Students unable to complete academic programs often withdraw because of financial hardships or difficulties in balancing school, work, and/or families.

> ***2.4 Recommendation:*** *Seek financial resources through employers, foundations, and other sources necessary to offer tuition assistance, scholarships, stipends, or employment opportunities to remove financial barriers for students. Provide tutorial assistance and mentors to enrolled students to address academic challenges or school/work/family issues.*

Faculty Shortages

Without an adequate supply of trained faculty, schools will be unable to produce the number of radiologic sciences practitioners needed to provide necessary health care services to North Carolina's population. Program directors are six years older and faculty three years older than the average radiologic sciences practitioner. Pracitioners can earn higher salaries in clinical settings than in educational settings. Proposed JRCERT accreditation standards requiring advanced degree for clinical instructors and program directors will likely contribute further to faculty shortages because some educators will not obtain the necessary qualifications, and will instead retire or return to clinical practice.

> ***2.5 Recommendation:*** *Develop incentives for practitioners to enter into education, both monetary and non-monetary. Investigate the possibility of developing a specialty credential in clinical education to reward those who choose education as a career. Equally important, continue to provide financial incentives for existing educators to remain in the field. Explore supplemental funding or develop partnerships to subsidize faculty salaries.*

> ***2.6 Recommendation:*** *Provide incentives for current faculty and directors to obtain advanced education through distance learning opportunities, tuition assistance or reimbursement, paid time off or flexible scheduling, or other rewards.*

Rural Areas/Counties Without Access to On-Campus Programs

Parts of North Carolina, particularly the eastern and western counties, do not have an accredited educational program or a collaborative arrangement with an existing program. This is particularly true for specialty programs (MRI, CT, and CV). These areas are not likely to have the resources necessary to support a full program. In addition, students from rural areas are unlikely to move or travel considerable distance in order to attend a program in another region.

> ***2.7 Recommendation:*** *Increase the use of distance learning, encourage collaboration with existing programs, and develop clinical sites and preceptors in areas where distribution problems exist.*

> ***2.8 Recommendation:*** *Recruit students from rural areas to increase the distribution of trained individuals practicing in those areas. Offer scholarships and/or employment contracts to individuals who will move or return to rural areas after completion of an educational program.*

Clinical Sites

Some educational programs are unable to expand class size because of a lack of clinical sites, yet not all potential clinical sites are being utilized. Educators are often unaware of facilities that have available capacity to host students. Programs which fully utilize clinical sites within its service area often experience difficulty in finding new clinical sites outside of their local area.

> ***2.9 Recommendation****: Conduct an assessment of clinical sites that are not being utilized or are underutilized, to determine the conditions needed to increase utilization of existing sites or develop new clinical sites. Develop an annual report inventorying facilities that are able to serve as clinical sites for radiologic sciences students.*

> ***2.10 Recommendation:*** *Community colleges which are fully utilizing clinical sites within their service areas should follow NCCCS procedures to seek permission to develop new clinical sites in other college service areas.*

3. Employers

Retention

To improve retention and encourage staff to remain in the field, employers must increase recognition of the radiologic sciences staff. Long-term staff are more likely to supervise new employees or serve as student preceptors. Existing staff can dramatically influence new employees' or students' perceptions of the profession and the employer. Incentives, bonuses, and other recognition should be paid equally to new and existing staff.

> ***3.1 Recommendation:*** *Improve incentives and benefits to encourage loyalty and retention. Reduce call burden, offer flexible scheduling, or implement staffing pools. Utilize nursing magnet hospital models. Improve retention perks for longer-term employees, beyond the traditional retention bonuses that are given to staff within one to five years of hiring. Encourage staff to serve as clinical preceptors or mentors to radio logic sciences students.*

Few employers have instituted career ladders for the radiologic technology workforce and practitioners often see training in different disciplines or specialties as the only means to achieve career growth, salary increases, or promotion. Cross-training may alleviate short-term vacancies within other areas, but only serves to maintain or exacerbate vacancies within radiologic technology as a whole.

> ***3.2 Recommendation:*** *Develop career ladders within radiologic sciences, specifically within radiologic technology, by promoting education, leadership development, and advanced training. Encourage and promote education and lifelong learning by offering tuition assistance or loan repayment for advanced and continuing education, assisting with certification fees or membership dues, and encouraging attendance at state or national professional meetings.*

RT aides or RT assistants, as well as other health care staff who have demonstrated loyalty and interest toward the field of radiology, can often be used as a source for new employees.

> ***3.3 Recommendation:*** *Develop career ladders for RT aides. Consider sponsoring or cost-sharing the education of existing assistive radiology personnel or other health care staff. Encourage individuals to seek formal education in the radiologic sciences in return for continued employment upon completion.*

Educational involvement

Many employers would benefit from the opportunity to participate in the educational planning of the radiologic sciences workforce and can participate in a number of ways: offer financial contribution or scholarships, discuss future needs and plans, provide input into student recruitment or enrollment, provide part-time student employment, and serve as a referral source of potential applicants.

> ***3.4 Recommendation:*** *Encourage employers to communicate and collaborate with nearby educational programs by contributing ideas related to program curriculum, application process, scholarships or other financial assistance, post-graduation employment opportunities, or sponsorship of existing employees.*

4. Diversity

The problem of underrepresentation of minorities in the health professions is a long-standing one and by no means limited to the radiologic sciences workforce. However, the diversity of the radiologic workforce does not match that of North Carolina's current or future population. The current gender makeup of the radiologic sciences workforce is also imbalanced, with a much higher proportion of women in the profession than men. The current student body in radiologic sciences programs is more diverse than that of the workforce, however the racial, ethnic, and gender makeup of students is still not reflective of the state's population

> ***4.1 Recommendation:*** *To achieve parity between the proportion of the population that is from an under-represented racial or ethnic group in the North Carolina population and the proportion in the radiologic sciences workforce, develop and continue to expand recruitment and retention efforts in education and employment settings to increase the presence of underrepresented minorities. Collaborate with organization(s) whose mission is to increase underrepresented minorities in the health professions including North Carolina Health Careers Access Program (NC HCAP) and the NC AHEC Program.*

> ***4.2 Recommendation:*** *Increase and continue to improve early exposure and enrichment opportunities in radiologic sciences to school-aged children and youth from all racial and ethnic backgrounds.*

The United States and North Carolina are becoming increasingly diverse, and a health care workforce, including radiologic sciences, that is both culturally competent and reflective of these changing demographics is needed. With a growing international population in North Carolina, the availability of health care practitioners with the ability to provide care in a language other than English is imperative.

> ***4.3 Recommendation****: Increase the recruitment of individuals able to provide health care services in a language other than English to serve the increasingly multilingual North Carolina population. Encourage and provide language training opportunities to existing radiologic sciences practitioners.*

The lack of an adequate data source to enumerate race, ethnicity, and language abilities of the workforce impedes continuous monitoring and prevents any analysis or evaluation of initiatives aimed at increasing diversity in the workforce or student body.

> ***4.4 Recommendation:*** *Require the reporting and collection of race, ethnicity, and language ability, among other demographic information, in the certification and/or registration process with the credentialing bodies (ARRT and NMTCB). Encourage or require the reporting and collection of similar information with the professional associations (ASRT, SNM, NCSRT, and NCNMT).*

5. Workforce Surveillance

Lack of licensure, mandatory certification, or registration of the radiologic sciences workforce presents challenges in assessing supply and demand of the workforce. There are currently no mechanisms in place to enumerate the workforce not certified by ARRT or NMTCB. The absence of a uniform state database including credentialed and non-credentialed practitioners hinders decision-making related to issues of supply and demand, the need for future educational programs, retention of the North Carolina educated workforce, and the contributions of radiologic sciences practitioners in health care delivery.

> ***5.1 Recommendation****: Develop a complete database inclusive of all radiologic sciences practitioners in North Carolina. Investigate the feasibility of establishing an entity, or coordinating with an existing entity, to register the credentialed and non-credentialed workforce. Consider a mechanism similar to, or in conjunction with, the registration of radiology equipment in North Carolina. Until registration is achieved, develop procedures to share data among organizations to monitor the supply and distribution of radiologic sciences practitioners.*

***5.2 Recommendation**: Obtain agreement between all credentialing and professional organizations on elements needed in a minimum data set to be collected in the certification, registration, or membership application. The minimum data set should include, among other elements: name, unique identifier, gender, race, ethnicity, age/birth date, home address, work address, employment setting, job title, position, activity status (i.e. active, student, retired, etc.), number of practice hours per week, location/name of training program, educational attainment, salary, and credential(s).*

6. Public Relations and Marketing

The public is often unaware or unfamiliar with the contributions of the radiologic sciences workforce to health care.

***6.1 Recommendation**: Increase awareness about radiologic sciences to the general public. Utilize this document, along with other currently available state and national publications and materials to increase knowledge and understanding about the workforce. Additionally, develop materials to highlight the financial contributions of the workforce and its staff to health care administrators and managers.*

***6.2 Recommendation:** Ensure that this report reaches key targets including, but not limited to, health care facilities, educators, elementary and high school counselors, state and national legislators, state and national health care associations and societies, regulatory organizations, media, and other identified dissemination targets.*

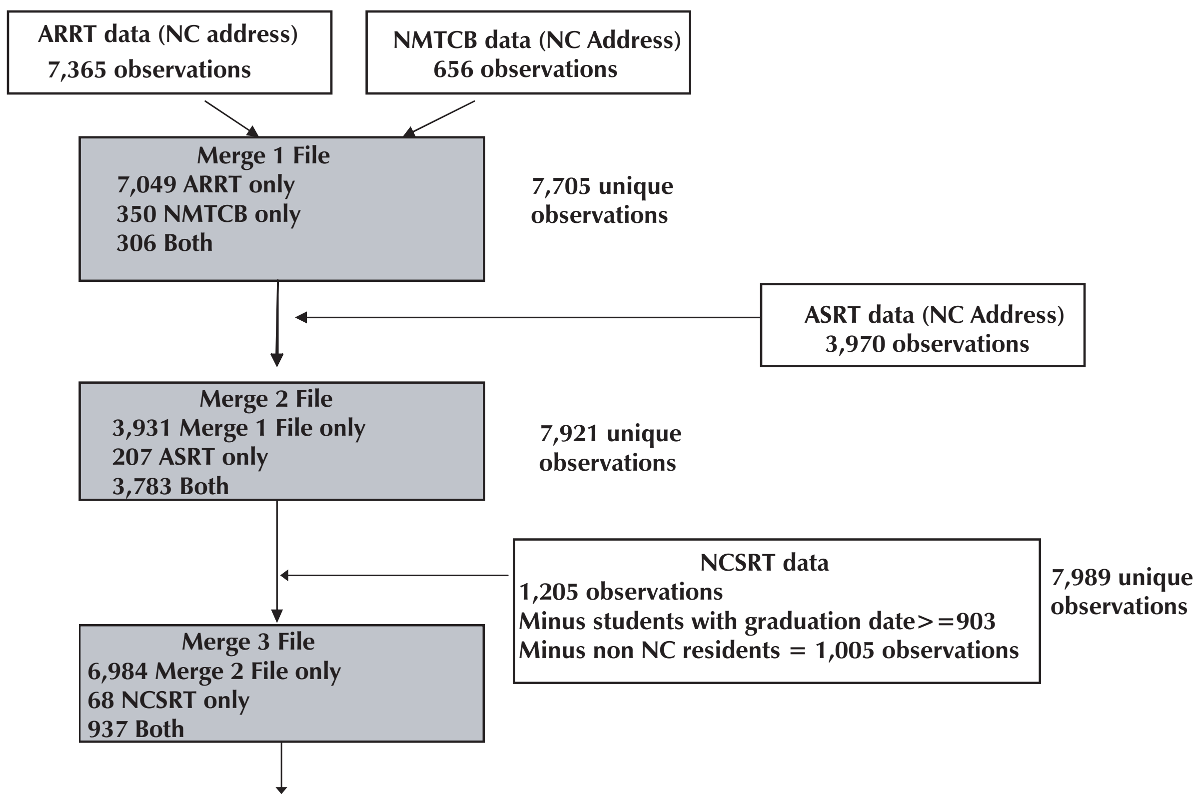
Appendix A. RESULTS OF DATA MERGE FOR RAD SCI FILES

Files Used:

ARRT = American Registry of Radiologic Technologists
NMTCB = Nuclear Medicine Technology Certification Board
ASRT = American Society of Radiologic Technologists
NSRT = North Carolina Society of Radiologic Technologists
SNM-TS = Society of Nuclear Medicine Technologist Section*

*SNM-TS data could not be merged due to lack of identifying variable.

Results:



Total File = 7,989 observations
Cleaning:

- **Delete no primary modality and ASRT only=36**
- **Delete no primary modality and NCSRT only and graduate>=2002=21**
- **Delete if sonography only (ASRT) = 3**
- **Delete if no primary modality and NCSRT only and no information on credential or clinical modality = 8**

Total to be deleted=68
FINAL DATA SET=7,921 PRACTITIONERS

Appendix B. CENSUS 2000 RACIAL AND ETHNIC DATA

Comparisons between Census data and the educational program data are complicated by how they handle Hispanic ethnicity. Hispanic ethnicity is presented as one of the race categories in educational data; in Census figures, it is a classification distinct from race and may include non-white/mixed-race respondents.

NOTES

[1] North Carolina Area Health Education Centers. *North Carolina Health Careers, 2001/2003*. Chapel Hill, NC: North Carolina AHEC., 2001 pp. 80-86.

[2] *Ibid.*

[3] *Ibid.*

[4] Harris E. The Shadowmakers. Albuquerque, NM: American Society of Radiologic Technologists, 1995, pp 4-13, 19-21, 38-43, 110-124.

[5] Coverage includes oncological conditions, myocardial viability, neurological conditions, refractory seizures/epilepsy, metastatic breast cancer, and cardiac perfusion viability. Centers for Medicare and Medicaid Services (CMS). Coverage Issues Manual, Diagnostic Services. http://cms.hhs.gov/manuals/06_cim/ci50.asp#sect_50_36. Accessed February 28, 2003.

[6] McBride G. Medical Breakthroughs: High-Tech 'Surgery.' *Consumer Digest Magazine*. Jan/Feb 1999.

[7] Mayo Clinic. www.mayoclinic.org/endovasclarsurgery-jax. Accessed March 31, 2003.

[8] Qualifications and Regulation of Fusion Imaging Techs. Professional Forum, *Radiology Today*, October 14, 2002.

[9] Fusion Imaging: A New Type of Technologist for a New Type of Technology. *Statements from the PET-CT Consensus Conference*. New Orleans, LA. July 31, 2002.

[10] Radiologic technologists: Licensure (AZ, AR, CT, DE, HI, LA, ME, MA, MT, NE, NJ, NY, OH, OR, RI, UT, VT, VA, WV, and WY); Certification (CA, FL, IL, IN, IA, KY, MD, MN, NM, SC, TN, TX, and WA); Registration (MS); No Regulation (AL, AK, CO, GA, ID, KS, MI, MO, NV, NH, NC, ND, OK, PA, SD, DC, and WI), American Society of Radiologic Technologists (www.asrt.org), and individual state regulatory agencies and/or state statutes.

[11] Radiation therapists: Licensure (AZ, AR, CT, DE, HI, LA, ME, MA, MT, NE, NJ, NY, OH, OR, RI, UT, VT, WV, and WY); Certification (CA, FL, IL, IN, IA, KY, MD, MN, NM, SC, TN, TX, and WA); Registration (MS); No Regulation (AL, AK, CO, GA, ID, KS, MI, MO, NV, NH, NC, ND, OK, PA, SD, VA, DC, and WI), American Society of Radiologic Technologists (www.asrt.org), and individual state regulatory agencies and/or state statutes.

[12] Nuclear medicine technologists: Licensure (AR, CT, DE, HI, LA, ME, MA, NJ, OH, RI, UT, VT, and WY); Certification (CA, FL, IL, IN, IA, KY, MD, MN, NM, SC, TN, TX, and WA); Registration (MS); No Regulation (AL, AK, AZ, CO, GA, ID, KS, MI, MO, MT, NE, NV, NH, NY, NC, ND, OK, OR, PA, SD, VA, DC, WV, and WI), American Society of Radiologic Technologists (www.asrt.org), and individual state regulatory agencies and/or state statutes.

[13] *Mammography Quality Standards Act of 1992* (Public Law 102-539). http://www.fda.gov/cdrh/mammography/mqsa-act.html Accessed February 21, 2003.

[14] Harris E. The Shadowmakers. Albuquerque, NM: American Society of Radiologic Technologists, 1995.

[15] The Alliance for Quality Medical Imaging and Radiation Therapy is comprised of representatives from the American Association of Physicists in Medicine, ARRT, ASRT, the Association of Educators in Radiologic Sciences, the Association of Vascular and Interventional Radiographers, Joint Review Committee on Education in Radiologic Technology, Joint Review Committee on Educational Programs in Nuclear Medicine Technology, NMTCB, Section for Magnetic Resonance Technologists of ISMRM, Society of Nuclear Medicine-Technology Section, and Society for Radiation Oncology Administrators.

[16] NCAC Title 15A, Chapter 11, Sec 318, Paragraph e: "Certification in nuclear medicine technology by the American Registry of Radiologic Technologists or in nuclear medical technology by the Registry of Medical Technologists of the American Society of Clinical Pathologists or the Society of Nuclear Medicine shall be deemed to satisfy the training requirements in Subparagraphs (d)(1) and (2) of this Rule." The Society of Nuclear Medicine does not certify individuals, however the regulation is stated as above.

[17] G.S. 131E, Article 9, §175-190 and 10 NCAC Subchapter 3R.

[18] North Carolina Hospital Discharge Database and North Carolina Ambulatory Surgery Database, Solucient, Fiscal Years 1997-2001 (October 1, 1996 to September 30, 2001).

[19] State Medical Facilities Plans 1997-2003. Procedures as reported on Hospital Annual Licensure Renewals to the Division of Facility Services.

[20] http://almis.dws.state.ut.us/occ/projections.asp Accessed May 21, 2003.

[21] "The North Carolina Hospital Association Workforce Study." North Carolina Hospital Association, September 2002. No definition of radiology tech provided in survey and may have been interpreted differently by employers.

[22] American Registry of Radiologic Technologists, 2002.

[23] *NMTCB News*, Certification of Nuclear Medicine Technologists by Nuclear Medicine Technologists. Vol.16, No.2, Fall, 2002.

[24] www.asrt.org/asrt.htm Accessed January 30, 2003.

[25] North Carolina Society of Radiologic Technologists, June 21, 2002.

[26] Society of Nuclear Medicine, 2002.

[27] Data from the Medical Dosimetry Certification Board were not available.

[28] SNM-TS data were not merged due to the lack of individual identifiable information necessary to merge with other data.

[29] Current certification defined as certifications currently maintained.

[30] ARRT has since split the cardiovascular certification into a cardiac interventional technology and a vascular interventional technology certification, 2003.

[31] Sanchez T. Degree Requirements. *ASRT Scanner*, Vol. 33, No. 11 August 2001.

[32] JRCERT Extends Deadline for Advanced Degree Requirements (2001). *ASRT News Briefs*, November 9, 2001.

[33] Greene J. A Developing Crisis. *Hospitals and Health Networks*, Vol.75, No. 10, p. 52. October 2001.

[34] Diagnostic radiology includes physicians in the following specialties: Radiology, Diagnostic Radiology, Pediatric Radiology, Neuro-Radiology and Musculoskeletal Radiology.

[35] Radiation oncology includes physicians in the following specialties: Radiation Oncology and Therapeutic Radiology.

[36] Nuclear medicine includes physicians in the following specialties: Nuclear Medicine and Nuclear Radiology.

[37] North Carolina Community College System 2003 Educational Guide.

[38] Personal communication with Joy Renner, MA, RT(R), UNC-CH, January 28, 2003 and Debbie Wolfe, RT(R)(N), CNMT, UNC Hospitals, April 22, 2003.

[39] Personal communication with Elizabeth Isler, MEd, North Carolina Community College System, April 30, 2003.

[40] Personal communication with Marti Feathers-Magee, RCVT, Forsyth Technical Community College, May 20, 2003.

[41] Personal communication with Jeff Aho, Carolinas HealthCare System and Susan Stricker, Carolinas College of Health Sciences, May 21, 2003.

[42] 100% response rate from educational programs (university N=1, community college N=22, hospital N=4), however not all programs collected or had available longitudinal data.

[43] The program has undergone considerable change over the last few years, which has affected the number of enrolled students and graduates.

[44] Programs offering 2 classes per year include: Forsyth's MRI program.

[45] North Carolina radiologic technology programs (N=20) as reported in individual annual reports. Joint Review Committee on Education in Radiologic Technology, April 2003.

[46] North Carolina radiation therapy programs (N=3) as reported in individual annual reports. Joint Review Committee on Education in Radiologic Technology, April 2003.

[47] Retention index based on 20 radiologic technology programs and 1 medical imaging program.

[48] Retention index based on 1 program, 3 programs did not report.

[49] Retention index based on 4 programs.

[50] Excludes hospital programs (N=4) and university baccalaureate programs (N=2).

[51] See Appendix B for additional notation on Census racial and ethnic data.

[52] The Radiologic Assistant: Improving Patient Care While Providing Work Force Solutions. *Consensus Statements from the Advanced Practice Advisory Panel*. March 9-10, 2002, Washington, DC.

[53] Harvey D. Radiologist Assistant Education Programs: Opening Doors, Closing Gaps. *Radiology Today*, Vol. 3, No. 21, p. 20. October 14, 2002.

[54] ACR E-News. Radiologist Assistants. May 16, 2003.

[55] Personal communication with Joy Renner, MA RT(R), UNC-CH, January 28, 2003.

[56] The Radiologic Assistant: Improving Patient Care While Providing Work Force Solutions. *Consensus Statements from the Advanced Practice Advisory Panel*. March 9-10, 2002, Washington, DC.

[57] http://www.cbrpa.org. Accessed February 24, 2003.

[58] JRCERT Annual Report 2001.

[59] *Ibid.*

[60] *Ibid*.

[61] Anderson R, McElveny C. Image of Enrollment: ASRT Survey Indicates an Increase, *ASRT Scanner*. February 2002, Vol. 34, No.5, p. 37.

[62] Randal J. *Journal of the National Cancer Institute*, Vol. 92, No.3 , February 2, 2000.

[63] Tripuranemi P. For 4-Year Degree, School's Out. *Advance for Imaging and Radiation Therapy Professionals*, November 6, 2000. www.advancer-forirt.com/pastarticles/nov6_00cover.html Accessed January 6, 2003.

[64] Radiation Therapists See Career Advantage. *ASRT News Brief*, May 21, 2001.

[65] ASRT Education Master Plan, Phase I: Identifying the Issues. February 2000.

[66] North Carolina's three hospital-based radiography certificate programs are located at Moses Cone Health System, Presbyterian Healthcare, and Wilkes Regional Medical Center. Carolinas College of Health Sciences, a hospital-based program has received accreditation from the Southern Association of Colleges and Schools and offers an associate degree.

[67] Cruise K, Cruise J. Radiology Administrators' Opinions of Education. *Radiologic Technology*, Vol. 72 No. 4. Mar-Apr 2001. p. 315.

[68] ASRT Education Master Plan, Phase I: Identifying the Issues. February 2000.

[69] Fusion Imaging: A New Type of Technologist for a New Type of Technology. *Statements from the PET-CT Consensus Conference*. New Orleans, LA. July 31, 2002.

[70] North Carolina Radiologic Sciences Workforce Study: Educational Survey, 2002.

[71] Bureau of Labor Statistics. Figures rounded.
http://data.bls.gov/servlet/oep.noeted.servlet.ActionServlet?Action=emprprt&Occ=2920330484&Occ=2911240465&Occ=2920340485&Number=10&Sort=pchg&Base=2000&Proj=2010&EdLevel=&Search=List&Type=Occupation&Phrase=&StartItem=0 Accessed May 21, 2003.

[72] "In Our Hands: How Hospital Leaders Can Build a Thriving Workforce. " The American Hospital Association's Commission on Workforce in Hospitals and Healthcare Systems, 2002. www.aha.org.

[73] Casselden P. The Personality of Radiographers: Empathy Dimensions and the Management of Occupational Problems and Stress. *Radiography*. 1988; 54:77-82

[74] ASRT Government Relations. Consumer Assurance of Radiologic Excellence. www.asrt.org. Accessed March 13, 2003.