SIE 78a

PUBLICATION BY AEC AUTHORIZED ☐

NOTICE OF RESEARCH PROJECT
SCIENCE INFORMATION EXCHANGE
SMITHSONIAN INSTITUTION

U.S. ATOMIC ENERGY COMMISSION

SIE NO. 588

AEC CONTRACT NO. (R) AT-(40-1)-3734

SUPPORTING DIV. OR OFFICE:

NAME & ADDRESS OF CONTRACTOR OR INSTITUTION: (State the division, department, or professional school, medical, graduate or other, with which this project should be identified.)

Division of Nuclear Medicine; Department of Radiology; University of Miami Achool of Medicine; Miami, Florida

TITLE OF PROJECT:

707783

EVALUATION OF THE ABSORBED DOSE FROM THE DIAGNOSTIC USE OF RADIOPHARMACEUTICALS

NAMES, DEPARTMENT, AND OFFICIAL TITLES OF PRINCIPAL INVESTIGATORS AND OTHER PROFESSIONAL SCIENTIFIC PERSONNEL: (not including graduate students) engaged on the project, and fraction of man-year devoted to the project by each person.

Edward M. Smith, Sc.D., Asst. Prof. of Radiology 20 per cent
Sharad R. Amtey, Ph.D., Asst. Prof. of Radiology 60 per cent
Peter J. Kenny, Ph.D. - pending, Asst. Prof. of Radiology 10 per cent
Denny D. Watson, Ph.D., Asst. Prof. of Radiology 10 per cent
William M. Smoak, III., M.D., Asst. Prof. of Radiology 10 per cent
Fuad S. Ashkar, M.D., Instructor in Radioloay and Medicine 5 per cent

NO. OF GRADUATE STUDENTS ON PROJECT: _____ NO. OF GRADUATE STUDENT MAN-YEARS: _____

SUMMARY OF PROPOSED WORK: (200-300 words, omit Confidential Data). Summaries are exchanged with government and private agencies supporting research, are supplied to investigaters upon request, and may be published in AEC documents. Make summaries substantive, giving initially and for each annual revision the following: OBJECTIVE; SCIENTIFIC BACKGROUND FOR STUDY; PROPOSED PROCEDURE; TEST OBJECTS AND AGENTS.

The objective of this research proposal is to develop methods to answer the question "How much activity should I administer to this patient to obtain the answer to a specific clinical question?". In these studies we will critically examine the interrelationship of the radiopharmaceutical, the radionuclides used to label the radiopharmaceutical and the organ visualization instrumentation used for the clinical study in terms of the specifically desired clinical information. Based on the characteristics of the radiopharmaceutical, the radionuclide, the organ imaging system and the patient: a range for the level of administered activity of the radiopharmaceutical can be determined which will allow a specific clinical question to be answered. Based on the administered activity, the absorbed dose will be calculated. The physician can then make the decision to perform the study or not, based on the absorbed dose that the patient will receive if he is to obtain the clinical information to make his diagnosis. The results will be presented as a set of tables similar in concept to the Patterson-Parker Radiotherapy tables.

RESULTS TO DATE:

Tables of absorbed dose for various radiopharmaceuticals used in bone pulmonary and brain imaging have been computed. Preliminary results have been obtained relating the administered activity and/or imaging time to the spatial resolution that can be obtained in bone and pulmonary imaging procedures with a five inch focused collimator.

	PROGRAM CATEGORY NO.
BUDGET	
PRIMARY	
SECONDARY	

Edward M. Smith
Signature of Principal Investigator

DATE: 11/15/70

INVESTIGATOR – DO NOT USE THIS SPACE

1033788

Form AEC-481
(6-67)

AECPR 9 4 51

U. S. ATOMIC ENERGY COMMISSION

CONTRACT AUTHORIZATION

1. DATE: MAR 9 1971

2. AUTHORIZATION NO.: BM-71-387

3.A. TO: S. R. Sapirie, Manager
Oak Ridge Operations Office

3.B. FROM: John R. Totter, Director
Division of Biology and Medicine

4.A. CONTRACTOR (Name, Address, Department, etc.)
Department of Radiology
University of Miami, P. O. Box 875
Biscayne Annex, Miami, Florida 33152

4.B. PRINCIPAL INVESTIGATOR(S)
EDWARD M. SMITH, Sc.D.

5. ☐ NEW CONTRACT ☒ RENEWAL ☐ OTHER

6. TERM OF CONTRACT: 10-15-70 thru 10-14-71

7. CONTRACT NUMBER: AT(40-1)-3734

8. RECOMMENDED TYPE OF CONTRACT:
☐ FIXED PRICE ☐ OTHER
☐ COST REIMBURSEMENT
☒ SPECIAL RESEARCH SUPPORT AGREEMENT (SRSA)

9. EQUIPMENT TITLE TO VEST IN:
☐ AEC
☒ CONTRACTOR

10. SECURITY CLASSIFICATION:
Work to be performed is under category I as defined by AEC Manual Appendix 3401.

11. PROJECT TITLE: "Evaluation of the Absorbed Dose from the Diagnostic Use of Radiopharmaceuticals"

12. HEADQUARTERS TECHNICAL CONTACT
Robert W. Wood

13. FINANCING

A. OPERATING EXPENSES

New AEC Funds	$ 35,930.00
Estimated AEC Balance From Prior Term, if any	$ 0
	$ 35,930.00
Estimated Contractor Contribution, On Proportionate Sharing Basis, if any	$ *
Estimated Project Cost, For Pertinent Budget Period	$

Budget and Reporting Classification: 06 02 08
Allotment Transfer: 06 11 91 (24)

B. PLANT AND CAPITAL EQUIPMENT $
Budget and Reporting Classification:
Allotment Transfer:

14. SPECIAL PROVISIONS AND INSTRUCTIONS:

The technical aspects of the proposed work have been reviewed and are approved. A need currently exists for the results of the research or other work that is to be undertaken. None of the AEC funds shall be used to confer a fellowship.

Please keep us informed as to any problems encountered in your negotiations, as well as the date of execution of this contract and the amount of funds obligated. If the budget as negotiated differs substantially from that in the proposal, please forward a copy of the revised budget to Headquarters.

If not already submitted, a 200-word summary of the proposed work should be forwarded by the contractor as soon as possible after negotiation of the contract.

*Should contractor volunteer to contribute the full amount originally offered, or more, please adjust the cost-sharing percentage accordingly.

15. SCOPE OF WORK

A study of radioactivity distribution throughout the body following administration of selected radioisotopes for use in dosimetry calculations.

C-1891
CONTRACT — $35,930.00
MAR 10 1971

1033789

MAR 3 1971

Dr. Edward M. Smith
Department of Radiology
University of Miami
School of Medicine
Biscayne Annex
P. O. Box 875
Miami, Florida 33152

Dear Dr. Smith:

I am pleased to inform you that the Research Committee of the Division of Biology and Medicine has recommended renewal of your research contract, AT(40-1)-3734, entitled "Evaluation of the Absorbed Dose from the Diagnostic Use of Radiopharmaceuticals" for an additional year but at a level substantially less than that requested. You may expect to be contacted shortly by the Oak Ridge Operations Office regarding the negotiation of the renewal contract.

During the presentation of your renewal proposal to the Research Committee, extensive discussion centered on that portion of the proposed program dealing with optimization of scanning procedures. With the new viewpoint you have presented and your extensive discussion of this area, concern was expressed by the Committee that the initial objectives of the research contract might not be pursued as vigorously as was initially planned. This was particularly the case since we were unable to recommend continuation at the support level requested. In general, the Committee reacted favorably toward the new areas which you outlined but they did feel that the initial objectives and particularly the acquisition of tissue distribution data remain of major interest.

I realize we have already discussed these matters by telephone, but I did want to relay the points raised by the Committee during their

X

USAEC, C. S. SHOUP, CHIEF
RES. CONT. BR.
LAB. AND UNIV. DIV.
OAK RIDGE, TENN.

XX

ORIGINAL SIGNED BY
C. S. SHOUP

C. S. SHOUP, CHIEF

MAY 7 1971

DR. EDWARD M. SMITH, DEPARTMENT OF RADIOLOGY, U. OF MIAMI, P. O. BOX 875 BISCAYNE ANNEX, MIAMI, FLA.

INFO: C. D. ULLMAN, DIRECTOR, RESEARCH ACCOUNTING, U. OF MIAMI, MIAMI, FLA.

REFERENCE OUR MARCH 11, 1971 TELETYPE REQUEST FOR REVISED BUDGET FOR RENEWAL OF CONTRACT NO. AT-(40-1)-3734. IF INTERESTED IN RENEWING CONTRACT, REVISED BUDGET MUST BE SUBMITTED PROMPTLY. OLE:LM 32

Y 2929

CONTRACTS — 3734 (Miami

OFFICE ▶	Adm. Ser. Br.	Res. Cont. Br.				C.A.
SURNAME ▶	MEDLEY:slc	CSShoup				
DATE ▶	5-6-71	5-7-71				

U.S. GOVERNMENT PRINTING OFFICE : 1969— O-364-598

UNIVERSITY OF MIAMI
CORAL GABLES, FLORIDA 33124

RESEARCH ACCOUNTING
P. O. BOX 8153

May 7, 1971

Mr. Lamar Medley
United States Atomic Energy Commission
Oak Ridge Operations
Oak Ridge, Tennessee

Re: Revised Budget AEC AT(40-1)3734
Dr. Edward M. Smith

Dear Mr. Medley:

While I had promised this to you last week, I am now embarrassed that it was making the rounds for signatures.

My apologies for this inordinate delay.

Sincerely,

C. D. Ullman
Research Accountant

CDU/gp

Enclosure OK

CONTRACTS — 3734 (mis.. C.A.
C 3773
MAY 10 1971

1033792

REVISED BUDGET [AEC AT(40-1)3734 10/15/70 - 10/14/71]

1. Salaries and Wages

NAME	POSITION	EFFORT FUNDED	REQUESTED FROM AEC	SUPPORT FROM UNIV. OF MIAMI
(a) E.M. Smith, Sc.D.	Principal Investigator	15%	$ 4,000*	-0-
(b) Sharad Amtey, Ph.D.	Co-investigator	30%	4,800*	-0-
(c) Research Associate		80%	4,000*	-0-
(d) Research Assistant		100%	5,000	-0-
(e) Research Assistant		40%	2,000	-0-
(f) Retirement at 5.5%			990	-0-
	TOTAL SALARIES		$20,790	-0-
2. FICA at 5.1% and group insurance .7%*			653	-0-
3. Expendable Supplies				
Radionuclides and Radiopharmaceuticals			500	-0-
Phantom Material			1,500	-0-
Reference Material			300	
	TOTAL SUPPLIES		$ 2,300	-0-
4. Permanent Equipment				
Radiological Measuring Equipment			-0-	1,014
5. Publication and Communications			750	-0-
6. Domestic Travel			750	-0-
7. Other				
Computer time			2,000	-0-
	TOTAL DIRECT COSTS		$27,243	
8. Indirect Costs @46%. SWR (DCAP)			8,687	876
	TOTAL PROJECT COST		$35,930	$1,890

AEC Funds Requested $35,930 (95%)
U/M Contribution 1 890 (5%)
Total Project Cost $37,820 (100%)

C 3773

MAY 10 1971

Eugene E. Cohen
Vice-Pres. Financial Affairs & Treas.

Edward M. Smith, Sc.D
Principal Investigator

REVISED BUDGET [AEC AT(40-1)3734 10/15/70 - 10/14/71]

1. Salaries and Wages

NAME	POSITION	EFFORT FUNDED	REQUESTED FROM AEC	SUPPORT FROM UNIV. OF MIAMI
(a) E.M. Smith, Sc.D.	Principal Investigator	15%	$ 4,000*	-0-
(b) Sharad Amtey, Ph.D.	Co-investigator	30%	4,800*	-0-
(c) Research Associate		80%	4,000*	-0-
(d) Research Assistant		100%	5,000	-0-
(e) Research Assistant		40%	2,000	-0-
(f) Retirement at 5.5%			990	-0-
		TOTAL SALARIES	$20,790	-0-
2. FICA at 5.1% and group insurance .7%*			653	-0-
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Radionuclides and Radiopharmaceuticals			500	-0-
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Reference Material			300	
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6. Domestic Travel			750	-0-
7. Other				
Computer time			2,000	-0-
		TOTAL DIRECT COSTS	$27,243	
8. Indirect Costs @46%. SWR (DCAP)			8,687	876
		TOTAL PROJECT COST	$35,930	$1,890

AEC Funds Requested $35,930 (95%)
U/M Contribution 1 890 (5%)
Total Project Cost $37,820 (100%)

1033794

Eugene E. Cohen
Vice-Pres. Financial Affairs & Treas.

C 3773
MAY 10 19

Edward M. Smith, Sc.D
Principal Investigator

UNITED STATES
ATOMIC ENERGY COMMISSION
OAK RIDGE OPERATIONS
P.O. BOX E
OAK RIDGE, TENNESSEE 37830

AREA CODE 615
TELEPHONE 483-8611

MAY 27 1971

Ralph Elson, Director, Contract Division

REQUEST FOR CONTRACT ACTION

It is requested that you take the necessary steps to process the following described contract action (CA):

1. Nature of Action Requested:

   [ ] Selection of New Contractor and/or Negotiation of Contract
   Number:
   Contractor:

   [X] Modification of Contract
   Number: AT-(40-1)-3734
   Contractor: University of Miami

2. Nature of Services To Be Covered by Contract: Research

   Title: "Evaluation of the Absorbed Dose from the Diagnostic Use of Radiopharmaceuticals"

3. Type of Contract:

   [X] Support Agreement [ ] Cost Type [ ] Other

4. Amount of AEC Funds To Be Obligated by this CA: $35,930.00

5. AEC Percentage of Est. Total Cost To Be Shown by this CA: 96%

6. Description of Other Changes To Be Covered by this CA:
   Provide for the performance of additional research during the period 10-15-70 - 10-14-71. AEC Support Ceiling will be increased from $35,930 to $71,860. Title to the equipment shall vest in the contractor under authority of the AEC Act of 1954.

7. Authority:
   Form AEC-481 (Cont. Auth.) from J. R. Totter dated March 9, 1971.

Herman M. Roth, Director
Laboratory and University Division

MAY 27 1971

OLE: LM
5-14-71

CONTRACTS - 3734 Miami
C.A.

1033795

R

M

USAEC, C. S. SHOUP, CHIEF
RESEARCH CONTRACTS BRANCH
LAB. AND UNIV. DIV.
OAK RIDGE, TENN.

ORIGINAL SIGNED BY
C. S. SHOUP

C. S. SHOUP, CHIEF

MAR 11 1971

DR. EDWARD M. SMITH, DEPARTMENT OF RADIOLOGY, U. OF MIAMI, P. O. BOX 875, BISCAYNE ANNEX, MIAMI, FLA.

INFO: DR. E. H. MAN, DEAN, RESEARCH COORDINATION, UNIV. OF MIAMI, P. O. BOX 8293 CORAL GABLES, FLA.

MR. C. D. ULLMAN, DIRECTOR, RESEARCH ACCOUNTING, UNIV. OF MIAMI, MIAMI, FLA.

WE HAVE AUTHORIZATION TO EXTEND CONTRACT NO. AT-(40-1)-3734 THROUGH OCTOBER 14, 1971, WITH $35,930 NEW AEC FUNDS. PLEASE SUBMIT ASAP REVISED BUDGET BASED ON APPROVED FINANCING. ALSO, PLEASE SUBMIT EXPENDITURE STATEMENT AND COMPLETED FORM AEC-427 REQUESTED BY OUR LETTERS DATED JUNE 15, 1970, AND JANUARY 6, 1971, WITH REVISED BUDGET. PLEASE HAVE INFORMATION SUBMITTED ENDORSED BY APPROPRIATE ADMINISTRATIVE OFFICIAL OF UNIVERSITY. OLE:LM

RECEIVED
ORO-AEC
TELETYPE SECTION
MAR 11 4 29 PM '71

Y 1526

OFFICE ▶	Adm. Sep. Br.	Res. Cont. Br.	CONTRACTS	-3734 (Amend. No. 2) C.A.
SURNAME ▶	MEDLEY:slc	CSShoup		
DATE ▶	3-11-71	3-11-71		

Form AEC-318 (Rev. 9-53) U.S. GOVERNMENT PRINTING OFFICE : 1969—O-364-598

1033796

UNITED STATES
ATOMIC ENERGY COMMISSION
OAK RIDGE OPERATIONS
P.O. BOX E
OAK RIDGE, TENNESSEE 37830

AREA CODE 615
TELEPHONE 483-8611

January 5, 1971

J. R. Totter, Director, Division of Biology and Medicine, HQ

RENEWAL OF CONTRACT NO. AT-(40-1)- 3734 WITH THE UNIVERSITY OF MIAMI

We are submitting for your review and appropriate action the following information concerning the contract which [redacted] expired on October 14, 1970:

1. Renewal Proposal (4)
2. Progress Report (4)
3. Financial Statement Will be forwarded later
4. 200-Word Summary (3)

We shall appreciate your advising us of your decision so that we may proceed with the necessary contract action at the earliest possible date.

Herman M. Roth

Herman M. Roth, Director
Laboratory and University Division
Oak Ridge Operations

OLE: LM

Enclosures:
As Listed Above

BC: D. S. Zachry, w/2 cys Progress Rpt. & Form AEC-427
C. S. Shoup, w/cy encls.
Alice Brown

Adm. Ser. Br.
MEDLEY:slc
1-5-71

CONTRACT - 3734 (miami)
C.A

1033797

UNIVERSITY OF MIAMI
MIAMI, FLORIDA 33152

Mailing Address
DIVISION OF NUCLEAR MEDICINE
SCHOOL OF MEDICINE
P O BOX 875, BISCAYNE ANNEX

Location:
JACKSON MEMORIAL HOSPITAL

December 11, 1970

Herman M. Roth, Director
Laboratory and University Division
U.S. Atomic Energy Commission
P. O. Box E.
Oak Ridge, Tennessee 37830

Dear Sir:

Enclosed find six copies of the Renewal Research Proposal, seven copies of the Progress Report and four copies of the two hundred word paragraph summary.

I am sorry for the long delay in submitting this research renewal proposal, however, I feel that it was better to wait until we were in the appropriate position to submit this proposal rather than to submit it prematurely. I hope that this will not result in too long a delay in funding becoming available.

Thank you for your patience.

Sincerely yours,

Edward M. Smith

Edward M. Smith, Sc.D.
Assistant Professor of Radiology
Assistant Director Division of Nuclear Medicine

EMS/nl
enc: see above
cc: E.H. Mann, Ph.D.
Dean, Research Coordination
University of Miami

CONTRACTS — 3734 (Miami)
C.A.

RENEWAL RESEARCH PROPOSAL

for the

EVALUATION OF THE ABSORBED DOSE FROM THE DIAGNOSTIC USE OF RADIOPHARMACEUTICALS

Submitted to

U. S. Atomic Energy Commission

Washington, D. C.

Proposed by

Edward M. Smith, Sc. D.

Division of Nuclear Medicine, Department of Radiology

University of Miami School of Medicine, Miami, Florida

November 15, 1970

Authentication

Date

Eugene E. Cohen
Vice President for Financial Affa
and Treasurer, University of Miam

12/10/70
Date

Edward M. Smith, Sc. D.
Asst. Professor in Radiology
University of Miami School of Medicine

The investigations encompassed by this application have been or will be approved by the Committee of Associates of the Investigator(s) in accordance with this institutions assurance on clinical research dated October 24, 1966.

1033799

1. TITLE OF PROJECT: Evaluation of the absorbed dose from the diagnostic use of radiopharmaceuticals

2. INSTITUTION: University of Miami School of Medicine, Department of Radiology, Division of Nuclear Medicine at:

   A. Mount Sinai Hospital, 4200 Alton Road, Miami Beach, Florida 33142

   B. Medical Science Building, University of Miami School of Medicine, P.O. Box 875, Biscayne Annex, Miami, Florida 33152

   C. Jackson Memorial Hospital, 1700 N.W. 10th Avenue, Miami, Florida 33136

3. PROJECT ABSTRACT: The question "How much activity should I administer to this patient, to obtain the answer to a specific clinical question?" has not been studied. In this proposal, we will critically examine the interrelationship of the radiopharmaceutical, the radionuclides used to label the pharmaceutical, and the organ visualization instrumentation used for the clinical study, in terms of the specific clinical information desired. Based on the characteristics of the radiopharmaceutical, the radionuclide, the organ imaging system and the patient, a range in the quantity of administered activity of the radiopharmaceutical can be determined which will allow a specific clinical question to be answered. Based on the administered activity, the absorbed dose can be calculated. Then the physician must make the decision to perform the study or not, based on the absorbed dose that the patient will receive if he is to obtain the clinical information required to make his diagnosis. This project will yield information leading to the systematic answering of these questions.

For a practical solution to this question, a set of tables similar in concept to the Patterson-Parker Radium Therapy Tables will be evolved. These tables will allow the clinician to rapidly determine how much activity he must administer to obtain the information he desires along with the radiation dose the patient will receive. The tables will be based on the response characteristics of general classes of imaging systems with special emphasis on the volume response characteristics and the image display device, the time available for the imaging procedure, the organ studied, the type and location of the lesion,

the tissue distribution characteristics of the pharmaceutical which has been labeled, and the useful photon yield per unit of administered activity.

Studies will be continued to experimentally verify the physical parameters required for absorbed dose calculations, and correlate these results with theoretical values.

4. SCIENTIFIC BACKGROUND: The principal investigator has had a sustained interest in the evaluation of the internal absorbed dose from diagnostic radiopharmaceuticals for approximately eight years, working in both the physical and biological aspects of this problem. During the initial three years of this research contract, the principal investigator has become aware of the need for an answer to the question, which is often asked by his clinical colleagues "How much activity must I give a particular patient to be able to determine if there is a lesion present?" or some ramification of this question. If it was possible to answer the clinician's question, and it was usually not, the next question that arises after stating how much activity must be administered is "What will be the radiation dose?". The physician then feels comfortable in being able to equate the value of getting an answer to a specific clinical question, the relevance of this answer to the management of the patient, and the radiation dose the patient will receive. Thus, I feel that one must arrive at methods of estimating how much activity is to be administered to a patient to obtain specific clinical information, and also be able to tell the physician what the radiation dose will be from this administered activity. If less than the optimal amount of activity is given a patient then the patient will be needlessly irradiated, since the physician will not be able to answer the clinical question that has been posed.

Since the original submission of the research proposal on which this contract is based, the efforts in the field of nuclear medicine directed towards obtaining data on the tissue distribution of various radiopharmaceuticals, and towards the actual calculation of the absorbed dose have increased significantly. This is true, both at the individual laboratory level and the activities of the Medical Internal Radiation Dose Committee, of which the prinicpal investigator is Executive Director. The number of articles appearing in the literature is increasing, but the amount of additional tissue distribution data and estimates of absorbed dose climbs at an even more rapid rate due to the introduction of new radiopharmaceuticals.

The problem of radiation dose is becoming more and more critical because of the desire to give larger quantities of activity, thus increasing the necessity for having more reliable estimates of absorbed dose. From a totally different point of view, increasing

pressure is being brought to bear on the medical profession and governmental agencies to minimize the radiation exposure. This further emphasises the need to minimize the unnecessary exposure of radiation to patients for whom the clinical information required cannot be obtained. However, the corollary, is that if a patient is going to be exposed to radiation to obtain clinical information he should be exposed to the level that will provide this clinical information and not over exposed or under exposed. If he is under-exposed, then most likely the clinical information will be unavailable, and the patient will be needlessly irradiated.

The most effective way to attack this systems problem is to look at the individual components comprising the "Clinical Nuclear Medicine Imaging System" and understand how the various components interact. Figure 1 illustrates the various components of the "Clinical Nuclear Medicine Imaging System". The Summary Progress Report appended to this Research Proposal describes the efforts that our laboratory has directed to this problem and attention is called particularly to publication #4 which describes a first approximation at attempts to arrive at some of these answers.

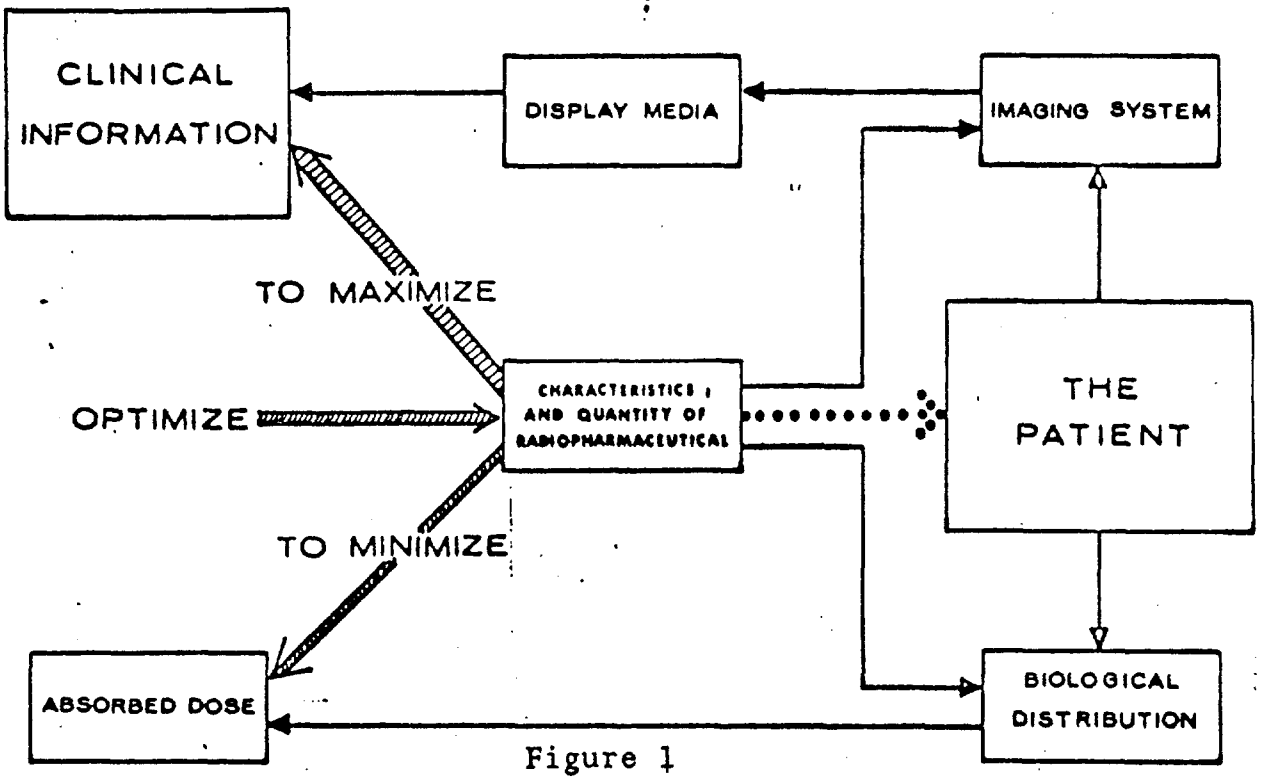

Figure 1

Considerable efforts have been extended by many investigators in trying to arrive at peripheral answers to the overall question asked as the goal of this research proposal. The first systematic approach to this problem was by Beck (1) in 1964 which

considered the overall problem without specifically stating how much activity is required to answer specific clinical questions. He was the first investigator to ponder the question of detection of a defect (in a numerical or quantitative sense) vs. the ability of the physician to actually perceive this abnormality. Many investigators (2-6) have continued along these lines of trying to evaluate how much activity is needed for a specific collimated detection systems to be able to detect an abnormality. However, in all cases the problems associated with the volume response characteristics of the collimated detection systems were not taken completely into account. These investigators relied on factors proportional to source contrast or a similar term "index of detection" and the modulation transfer function (MTF) or the line source response function (LSRF) at the focal plane of the collimator. Unfortunately, this is not the situation in the actual clinical environment, and one is forced to consider the radionuclide that is distributed above and below the plane of interest.

Recently, Sharma (6) and investigators in our own laboratory (please see summary progress report) have attempted to relate the concept of detectability and perceptability that Beck (1,7) brought forth. There is a high degree of agreement between the level of detection, an objective factor based on statistical considerations, and the level of perception, a subjective factor based on training and experience, for fairly gross defects when demonstrated by high quality images. This brings to light the problem of what constitutes a good clinical image for interpretation (perception). Brownell (8), Rossman (9) and Rollo and Schulz (10) have investigated the characteristics of a good clinical image. One of the primary problems in this area is that while it is not difficult to define what constitutes a good clinical image, this may not correspond to what a physician wishes to interpret as a good clinical image. This is fundamentally a problem of training, experience and eliminating previous biases on the best ways of perceiving an image so that possible now presentations may be explored in an unbiased atmosphere.

REFERENCES:

1. Beck, R.N.: Medical Radioisotope Scanning, Vienna, IAEA, 1:35 (1964).

2. Dewey, W.C. and Sinclair, K.W.: International Journal of Applied Radiation and Isotopes, 10:1 (1961).

3. Matthews, C.M.E.: British Journal of Radiology, 37:531 (1964).

4. Matthews, C.M.E. and Kibby, P.: British Journal of Radiology, 41:580 (1968).

5. Mallard, J.R. and Corfield, J.: British Journal of Radiology 42:530 (1969).

6. Sharma, R.R. and Fowler, J.F.: Phys. in Med. and Biol., 15:289 (1970).

7. Beck, R.N. and Harper, P.B.: Fundamental Problems in Scanning, (Gottschalk and Beck, Eds.) Charles C. Thomas, Springfield, Illinois p. 458, 1968.

8. Brownell, G.L.: Fundamental Problems in Scanning, Gottschalk and Beck, Eds.) Charles C. Thomas, Springfield, Illinois p. 339, 1968.

9. Rossman, A.: Fundamental Problems in Scanning, (Gottschalk and Beck, Eds.) Charles C. Thomas, Springfield, Illinois p. 326, 1968.

10. Rollo, F.D. and Schulz, A.G.: J. Nucl. Med. 11:53, (1970).

5. SCIENTIFIC SCOPE:

A. OBJECTIVE:

The overall objective of this research proposal is to arrive at a systematic approach of allowing the physician practicing nuclear medicine to answer the question "How much activity should I administer to this patient, to obtain the answer to a specific clinical question?, and, What will be the radiation dose to this patient?". This is a very ambitious objective for an extremely complex problem. However, if these questions are systematically approached using Figure 1, (please see section 4) as a guide, reasonable estimates in a usable format, such as the Patterson-Parker Tables for Radiation Therapy, can be obtained.

B. RELATIONSHIP OF PROPOSED RESEARCH TO PRESENT KNOWLEDGE AND COMPARABLE WORK IN PROGRESS ELSEWHERE:

As pointed out in the section on Scientific Background, many investigators in various laboratories are working in different aspects of the problem relating the amount of activity required to answer a specific clinical question. Most of our present knowledge relating to this problem has evolved from studies on the instrumentation component, in particular, the detector-collimator combination of the "clinical nuclear medical imaging system" as depicted in Figure 1. Many investigators are working on various phases of this problem; however, to our knowledge no one is attempting to organize the components of this problem in a manner that will provide answers to this very significant questio in the clinical nuclear medicine environment. The tendency in nuclear medicine today is to continue to increase the level of administered activity with the naive hope that this alone will improve the quality of the resulting image, so that the clinician will be able to make a better interpretation. This is obviously not the case, and to achieve improved perceptability of abnormalities in the images obtained in nuclear medicine, we must have a better understanding of the clinical nuclear medical imaging system. This will allow us to know when an increase in activity will yield additional information or when the patient

B. RELATIONSHIP OF PROPOSED RESEARCH TO PRESENT KNOWLEDGE AND COMPARABLE WORK IN PROGRESS ELSEWHERE: (continued)

is just being needlessly irradiated. We have attempted in publication No. 4 (please see attached progress report) to point this problem out, and demonstrate how readily one can increase the administered activity without obtaining additional information.

The most complete analysis of the problem of detectability of lesions which has been made to date is that of Sharma and Fowler [Phys. in Med. and Biol., 15: 298 (1970)] who have derived an analytical expression for the time required to detect abnormalities with a given degree of statistical confidence. All the physical parameters of the problem such as spatial resolution, sensitivity, target to non-target ratio, the location and size of the lesion as well as photon energy are taken into account in this analysis. On the basis of this work, it would be possible to predict what imaging time would be required to detect a spherical nonuniformity in a simple geometric volume of background activity. However, the analysis does not take into account the differing degrees of perceptability for different recording media, and it is difficult to apply the analysis to a realistic clinical situation when the shape of the organ is not a simple geometrical volume. Rollo and Schulz [J. Nucl. Med., 11:53 (1970)] have attempted to simulate the detection problem with the aid of a digital computer by simulating the frequency spectrum of the target organ and modulation transfer function of the detector. This approach, while theoretically elegant, is complex and time consuming.

To our knowledge there has been no attempt to approach the problem by studying the volume response characteristics of the focused collimator for a rectilinear scanner as well as the parallel hole collimator for the Anger camera and convoluting this response function with simple but clinically meaningful radionuclide distributions that would be representitive of clinical situation. This approach, which we are proposing has the advantage of being direct, easy to visualize and easy to verify with simple experimental measurements. It is similar in principle to the computation of tumor dose in radiation therapy using an external beam where one knows the characteristics of the radiation beam, and then convolutes this dose distribution with the location of the tumor in the body of the patient.

The significance of the results that will be derived from this research proposal is that it will allow the physician to optimize the amount of activity given to each of his patients based upon the clinical information that he wished to obtain, and the imaging systems and radiopharmaceuticals that are available to him. The results of our studies should go a long way in improving the efficiency in obtaining clinical information per unit radiation dose the patient receives.

B. RELATIONSHIP OF PROPOSED RESEARCH TO PRESENT KNOWLEDGE AND COMPARABLE WORK IN PROGRESS ELSEWHERE: (continued)

The activities in the field of nuclear medicine with respect to collection of tissue distribution data and computation of the radiation dose from various nuclear medical procedures have significantly increased from the time when the original research proposal was submitted. This has probably been due to the increased pressures of minimizing radiation exposure to the population as well as the desire to be able to give larger quantities of activity in the hope of obtaining better clinical information. The work of the Medical Internal Radiation Dose (MIRD) Committee has continued at a rapid pace, and definitive reports on the radiation dose that patients receive from various radiopharmaceuticals will be appearing the first part of 1971. The MIRD Committee will also be publishing additional data on the physical factors needed to compute dose as well as the nuclear parameters of the radionuclides that are currently being used or will be used in the near future in nuclear medicine.

C. GENERAL PLAN FOR THE WORK:

The descriptive outline presented in this section along with Figure 1 (Section 4) presents the various component aspects of the overall objective, and the manner in which we plan to acquire the necessary information to answer the questions posed by each phase of the problem or the manner in which we will handle the specific component in the initial phase of this study. At this point, we are not completely sure of the approach we will take to answer all of the questions, because the specific approach will, in some cases, depend upon the other areas of the problem. Some of the work described below has already been initiated in our laboratory, and preliminary results are reported in the progress report. It should be emphasized, that we will draw heavily on the work of other investigators who are working on specific facets of the research objective we have put forth (please see Section No. 4 of this proposal).

1. CLINICAL INFORMATION:

a. What is the nature of the clinical information that I need:

1) The objective of the study to be performed is to determine whether or not the organ system is functionally and/or anatomically within normal limits - a screening type procedure.

C. GENERAL PLAN FOR THE WORK: [Clinical Information] (continued).

2) The patient has a definite abnormality - additional information is required - for example:
   i) Is the treatment for pulmonary embolism progressing satisfactorily?
   ii) What ports should I use for radiation therapy?
   iii) Is this a single lesion or are there multiple lesions present?

b. What types of studies and views will be required to obtain the desired clinical information?

1) Dynamic function studies

2) Static images - What views?

c. At what time after the activity is administered will the study be started, and how much time will be required to complete the study?

2. THE PATIENT:

a. The estimated location, depth and size of the suspected lesion.

b. Are there any anatomical or physiological conditions that may alter or limit the imaging procedure?

c. How much time can be devoted to this study with respect to comfort and clinical status of the patient as well as the general patient work load of the nuclear medicine laboratory.

d. Can this patient be optimally positioned so that a more reliable imaging procedure can be performed?

Considerable work has been directed at this point in our laboratory, (Smoak, W.M., Smith, E.M., Kenny, P.J. and Gilson, A.J.: Reduction of physiologic degradation in imaging the liver, To be published in the J. Nucl. Med.), and we are convinced that proper positioning when clinically possible, will improve the image quality. Work has been performed investigating the use of a physiological-monitor-trigger to gate the Anger camera on and off based on patient respiration. These areas will be further investigated with respect to minimizing administered activity while maximizing clinical information.

3. CHARACTERISTICS AND QUANTITY OF RADIOPHARMACEUTICAL:

a. How much activity should I administer to the patient to obtain the necessary clinical information as specified in item 1 of this outline?

C. GENERAL PLAN FOR THE WORK: [Clinical Information] (continued)

b. What are the available radionuclides that may be used to label the pharmaceutical agent that I will use? Tc-99m will be the radionuclide considered in the first phase of the study.

c. What is the specificity of the pharmaceutical agent? Please refer to: Smith, E.M.: Internal Dose Calculations for Tc-99m, J. Nucl. Med., 6:231 (1965).

d. What radiations are emitted during the decay process of the radionuclide and the frequency of these emissions? Please refer to: Dillman, L.T., Radionuclide Decay Schemes and Nuclear Parameters for Use in Radiation Dose Estimation, MIRD Pamphlet No. 4, Supplement No. 2, 10:22 (1969).

4. BIOLOGICAL DISTRIBUTION:

a. What is the tissue distribution and elimination characteristics of the radionuclide that is labeled to the pharmaceutical to be used. Please refer to: Smith, E.M. Internal Dose Calculations for Tc-99m, J. Nucl. Med., 6:231 (1965).

b. What is the specificity of the radiopharmaceutical with respect to the abnormality that is being studied? Technetium-99m as sulfur colloid labels functioning reticuloendothelial tissue and Tc-99m as the pertechnetate ion labels the vascular space during its initial circulation, and then diffuses extravascularly.

c. What is the anticipated distribution of activity in the region to be imaged?

1) Will there be a hot spot in virtually an area of no activity?
2) Will there be a cold spot in an area of high activity
3) Will there be a moderate decrease of activity in a region of high activity?
4) Will there be an increase of activity in a region of moderate activity.

d. Are there methods to enhance the elimination of the radionuclide from specific organs in the body or from the total body?

Studies are underway in this laboratory under the direction of Dr. Ashkar to study whether or not the excretion of various radiopharmaceuticals can be enhanced by the administration of diuretics simultaneously with the radiopharmaceutical. Preliminary results using the diuretic, Lasix (furosemide) has increased the biological elimination of Tc-99m as pertechnetate and I-131 as iodide by greater than 50% without adversely affecting the clinical value of the thyroid imaging study.

C. GENERAL PLAN FOR THE WORK: (continued)

5. IMAGING SYSTEM:

a. Photon energy spectrum of radionuclide. Tc-99m will be used in the initial study.

b. Distribution of radionuclide in region to be imaged. Tissue equivalent phantoms will be made which will approximate the dimensions of the liver and brain. Radioactivity (Tc-99m or a suitable long-lived substitute: C-57 or Ce-141) will be placed in these phantoms to simulate the distribution of activity in both normal and pathological conditions.

c. The volume response function (VRF) of the collimated detector of the imaging system.

By VRF we mean an information matrix which would give the response of the imaging device to the activity located in any unit volume cell under the collimated detector. The VRF of a collimator-detector combination will be determined by measuring the line source response function (LSRF) at various depths in a tissue equivalent phantom for the radionuclide to be studied. The LSRF will be recorded digitally or measured using a densitometer if the display media is to be simultaneously evaluated. It will probably prove to be more efficient to independently apply the digitally obtained LSRF to the film characteristics and condition of film exposure. The VRF will be derived from the LSRF data using a computer program developed in this laboratory by Dr. Amtey. This program also has the capability of convoluting the information matrix, the VRF, with an experimentally measured or simulated radionuclide distribution. The results of these studies will allow us to study the detectability of an abnormal radionuclide distribution.

d. The ability to optimumly orient the detector of the imaging system to the optimal position in which the patient can or should be placed. (Please see item 2d in this outline).

6. DISPLAY MEDIUM:

a. The information capacity of the medium on which the image of the radionuclide distribution is to be presented to the clinician.

1) Analog map presentation
2) Graphical or histogram presentation
3) Numerical or digital presentation.

b. Detectability of an abnormality in the information content of the image versus the perceptibility of the abnormality in the image as portrayed on the display medium. This will be the last, and the most important, part of the experiment

C. GENERAL PLAN FOR THE WORK: Display Medium (continued)

described in part 5c of this outline. The exact experimental design for this part of the study has not been defined, but will probably consist of simulating the convoluted VRF with the actual radionuclide distribution on various display media and comparing the simulated display presentation with the presentation in the same display media obtained in the clinical environment for the identical radionuclide distribution.

7. ABSORBED DOSE:

a. Tissue distribution of a radionuclide labeled to the pharmaceutical.

Activities in this area will be minimal until the six bed metabolic ward at Mt. Sinai becomes operational in mid - 1972. In the mean time, data will be collected when possible and data from the literature and other laboratories will be used when appropriate.

b. Radiations spectrum of the radionuclides used. This data is available or will be available in the MIRD publications.

c. Physical parameters required to compute the absorbed dose.

Studies to be conducted during the next three years will include the effect interfaces (tissue-air, tissue-lung and tissue-bone) have on the energy build-up factor, B_{en}, and the validity of the reciprocity theoreum in bounded hetrogeneous media.

d. Computation of absorbed dose.

8. PRESENTATION OF INFORMATION:

Presentation of the information contained in the above outline in a suitable format that will allow the clinician in the routine practice of nuclear medicine to use this data to allow hir to optimize the quantity of activity administered to patients so as to insure the information that he requires for patient care is acquired while minimizing the absorbed dose to patients

The work to be completed during the first phase of this research proposal (18 to 24 months) will be to present a set of results based on the previous outline for imaging the liver and the brain using a thre inch and a five inch rectilinear scanner and the Anger camera. These organs were chosen for study becausp of the sharp contrast they present in clinical nuclear medicine. In the liver, one is usually look ing for a defect in a sea of activity while in the brain one is

usually looking for an increase in activity with relatively little surrounding activity. The requirements for collimation for these two organ studies present a sharp contrast. In the liver, one is trying to attain maximum resolution since one is trying to observe small differences in high levels of activity in a thick organ. In brain imaging, one is striving for maximum sensitivity since one is looking for a small increase in activity above the normal levels of tissue and blood background. The third contrast in the static imaging of these two organs is that the liver is in motion during the imaging procedure while the brain is stationary.

The radionuclide distribution (please see item 4c in the outline above) in the normal liver is to a first approximation, a smoothly varying level of high activity, in which one is trying to observe a defect which presents itself as a moderate decrease in activity or alternatively a nonhomogeneous, mottled appearing distribution of activity. Another reason for choosing the liver, is that it will allow us to study the significance of patient positioning with respect to decreasing organ motion with an improvement in the spatial resolution, and an increase in the volume of the liver that is in focal volume of the detector, with an improvement in sensitivity. The latter factor could significantly increase the clinical information obtained per unit administered activity, thus reducing the radiation dose per unit of clinical information obtained.

The brain presents the problem of corrolating dynamic studies with static images. Currently we are photon limited with the existing Anger camera for dynamic flow studies. While this is not the case for static images, (please see progress report) one must systematically evaluate how much additional activity is required to successfully answer the clinical questions that are posed: - such as, Is there a reduction of "blood flow" in the carotid arteries?". Based on studies in our laboratory (Smoak, W.M., Watson, D.D. and Smith, E.M.: Clinical value of a computer system for data acquisiti processing and display of cerebral dynamic function studies, to be published in the proceedings of Clinical Dynamic Function Studies with Radionuclides, November 19-21, 1970, Philadelphia, Pa.), we ca detect a 50% or greater reduction in flow (50% reduction in vessel diameter) in a carotid artery studies currently under ideal situations. While there is sufficient activity in the carotid artery, the rapid decrease in activity per unit volume in the intracranial vessels precludes the 50% level of detection. Under less than idea circumstances, i.e., congestive heart failure, pulmonary emphysema, etc., we cannot achieve the 50% detection level, which is the thres hold of clinical significance in carotid occlusive disease, and we cannot begin to approach this level of detection intracranially, because of the reduced photon flux available from these vessels [Join Study of Extracranial Arterial Occlusion - A Cooperative Study. (Parts 1-5) J. Amer. Med. Assoc. 211, March, 1970]. We should striv

to routinely achieve the detectability and perceptability of a 50% reduction in vessel diameter in the carotid region for all clinical situations. To increase the level of administered activity beyond the point where one can detect less than a 50% decrease in vessel diameter, will not yield clinically significant data, because clinical manifestations are not present. Thus, the patient will be needlessly irradiated since no useful information is provided.

Another aspect of brain imaging which has led us to choose the brain as one of our model organs is the interference of Tc-99m activity in the vasculature of the scalp and the skull (Oldendorf, W.: Interference of Scalp and Skull Activity With Brain Isotopic Measurements, Proceedings of the Second Annual Nuclear Medicine Seminar, Charles C. Thomas, Publishers, 1971.) with the optimal visualization of intracranial lesions. Optimal use of our collimators, which requires the knowledge of the volume response characteristics, and the ability to convolute the volume response function of these collimators with the known distribution of blood activity, will enhance the probability of detection of lesions.

The display medium that will be employed in these studies for the rectilinear scanners will be x-ray film, and for the Anger camera, 35mm and 70mm film as well as computer displays. The initial set of studies will be based on Tc-99m administered as the pertechnetate ion for brain imaging and as sulfur colloid for liver imaging.

Based on the data collected from this series of brain and liver studies, it will be possible to make fairly reliable correlations between the detectability of the lesion and the amount of administered activity required for the different instrumentation systems and display media. When this data is accumulated in tabular form, it should be possible to relate the level of administered activity with the ability to detect and perceive the desired information for various clinical situations.

Work will continue towards the objective of our initial research contract, namely collection of tissue distribution data when possible, computation and organization of absorbed dose calculations, and the dissemination of this information as well as investigating the physical parameters required for dose calculations. Specific studies to perform work in the above areas have been enumerated elsewhere in this report.

The primary objective during the first year of this renewal contract will be to develop the format for the questions the clinician will ask and the format for the data that he has available to him to answer his questions.

BIOGRAPHICAL SKETCH

Sharad R. Amtey, Assistant Professor of Radiology

Place of Birth: [redacted] Present Nationality: Indian - U.S. pending

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]	[redacted]	[redacted]	[redacted]

Major Research Interest: Dosimetry and Relationship between administered activity and usable clinical information.

Research and/or Professional Experience:

1. University of Miami School of Medicine, Miami, Florida
   June 1970-present, Assistant Professor of Radiology, Department of Radiology.
2. West Virginia University, West Virginia,
   1969-1970, Assistant Professor, Department of Radiology.
3. Wright-Patterson Air Force Base, Dayton, Ohio,
   1967-1969, Research Physicist, Nuclear Structure Group.
4. Vanderbilt University, Nashville, Tennessee,
   1965-1967, Research Assistant & Teaching Assistant.
5. Vanderbilt University, Nashville, Tennessee,
   1964-1965, Research Assistant
6. Fulbright Grantee from India to U.S.A., 1964.
7. Tata Institute of Fundamental Research, Bombay, India.
   1960-1964, Research Associate
8. St. Fransis de Sale's College, Nagpur, India.
   1958-1960, Lecturer

Publications:

Total of approximately 15 publications.- Please see list of selected publications of professional personnel

1033813

BIOGRAPHICAL SKETCH

Sharad R. Amtey, Assistant Professor of Radiology

Place of Birth: [redacted] Present Nationality: Indian - U.S. pending

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]			

Major Research Interest: Dosimetry and Relationship between administered activity and usable clinical information.

Research and/or Professional Experience:

1. University of Miami School of Medicine, Miami, Florida
   June 1970-present, Assistant Professor of Radiology, Department of Radiology.
2. West Virginia University, West Virginia,
   1969-1970, Assistant Professor, Department of Radiology.
3. Wright-Patterson Air Force Base, Dayton, Ohio,
   1967-1969, Research Physicist, Nuclear Structure Group.
4. Vanderbilt University, Nashville, Tennessee,
   1965-1967, Research Assistant & Teaching Assistant.
5. Vanderbilt University, Nashville, Tennessee,
   1964-1965, Research Assistant
6. Fulbright Grantee from India to U.S.A., 1964.
7. Tata Institute of Fundamental Research, Bombay, India.
   1960-1964, Research Associate
8. St. Fransis de Sale's College, Nagpur, India.
   1958-1960, Lecturer

Publications:

Total of approximately 15 publications.- Please see list of selected publications of professional personnel

1033814

BIOGRAPHICAL SKETCH

Peter J. Kenny, Assistant Professor of Radiology

Place of Birth: [redacted] Present Nationality: U.S.

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]	[redacted]	[redacted]	[redacted]

Major Research Interest: Instrumentation, metabolic studies and radiation measurements

Research and/or Professional Experience:

1. University of Miami School of Medicine; Miami, Florida, 1969-present; Assistant Professor of Radiology
2. Cornell University Medical College Graduate School, New York, New York 1961-1969; Instructor in Biophysics
3. Sloan-Kettering Institute, New York, New York, 1961-1969; Research Associate in Biophysics 1958-1961; Research Assistant in Biophysics
4. University College, Dublin, Ireland 1955-1958; Lecturer in Radiological Physics
5. St. Ann's Hospital, Dublin, Ireland 1957-1958; Physicist
6. Department of Industry and Commerce: Dublin, Ireland 1953-1954; Meteriological Offices
7. Department of Posts and Telegraphs, Dublin, Ireland 1952-1953; Communications Engineer

Publications:

Total of approximately 30 publications - Please see list of selected publications of professional personnel.

1033815

BIOGRAPHICAL SKETCH

Denny Duane Watson, Ph.D., Assistant Professor of Radiology

Place of Birth: [redacted] Present Nationality: U.S.

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]	[redacted]	[redacted]	[redacted]

Major Research Interest: Computer processing of image data and nuclear instrumentation

Research and/or Professional Experience:

1. University of Miami School of Medicine, Miami, Florida
   1970-present, Assistant Professor of Radiology
2. Wright-Patterson AFB, Ohio, Nuclear Structure Group
   1964-1970, General Physics Research Labs., Research Physicist
3. Nuclear Physics Laboratory, University of Kansas
   1959-1964, Research Assistant
4. Douglas Aircraft Company, Culver City, California
   Summer, 1962
5. Los Alamos Scientific Laboratory, Los Alamos, New Mexico
   Summer, 1961

Publications:

Total of approximately 35 publications - Please see list of selected publications of professional personnel.

BIOGRAPHICAL SKETCH

William M. Smoak, III, Assistant Professor of Radiology.

Place of Birth: [redacted] Present Nationality: U.S.

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]			

Major Research Interest: Clinical nuclear medicine and optimization of useful clinical information in an imaging procedure with respect to the administered activity.

Research and/or Professional Experience:

1. University of Miami School of Medicine, Miami, Florida
   1966-present, Associate Director, Division of Nuclear Medicine
   1964-1967, Instructor in Radiology
   1967-present, Assistant Professor of Radiology
2. Jackson Memorial Hospital, Miami, Florida
   1964-present, Attending Radiologist
3. Cedars of Lebanon Hospital, Miami, Florida
   1964-1967, Attending Radiologist
4. Mt. Sinai Hospital, Miami Beach, Florida
   1968-present, Chief, Nuclear Medicine Service

Publications:

Total of approximately 14 publications - Please see list of selected publications of professional personnel.

BIOGRAPHICAL SKETCH

Fuad S. Ashkar, M.D., Instructor in Radiology and Medicine

Place of Birth: [redacted] Present Nationality: U.S. (pending)

Sex: Male

Education:

Institution	Degree	Year	Field
[redacted]			

Major Research Interest: Metabolic Studies

Research and/or Professional Experience:

1. University of Miami School of Medicine, Miami, Florida
   1969 - Present, Instructor in Radiology and Medicine
2. University of Miami School of Medicine, Miami, Florida
   1968-1969, Instructor in Medicine
   1968-1969, Director of Undergraduate Medical Education
   1969-1971, Director of Nuclear Metabolic Section, Division of Nuclear Medicine, Department of Radiology
   1969-1971, House Physician Consultant in Endocrinology

Publications:

Total of approximately 30 publications - Please see list of selected publications of professional personnel.

1033818

SELECTED PUBLICATIONS OF PROFESSIONAL PERSONNEL

1. Smith, E.M.: Properties, Uses, Radiochemical Purity and Calibration of Tc-99m. J. Nuc. Med. 5:871, 1964.

2. Smith, E.M.: Internal Dose Calculations for Tc-99m. J. Nuc. Med. 6:231, 1965.

3. Smith, E.M.: Internal Radiation Absorbed Dose. In the Proceedings of the ORINS Symposium on Radioactive Pharmaceuticals, CONF-6511, Springfield, Virginia, April 1966, pp. 649-669.

4. Smith, E.M.: Radiation Dosimetry. Principles of Nuclear Medicine, edited by H.N. Wagner, Jr., W.B. Saunders Company, Philadelphia, 1968, pp. 742-784.

5. Smith, E.M.: General Considerations in Calculation of the Absorbed Dose of Radiopharmaceuticals Used in Nuclear Medicine, Proceedings of Medical Radionuclides: Radiation Dose and Effects, AEC Symposium Series 20, CONF-691212, Springfield, Virginia, June, 1970, pp.17-32.

6. Smith, E.M., Matthews, H.G., Jr., and Anderson, D.G.: A Multifunction Digital Scintillation Scanning System With a Clinical Example, J. Nuc. Med., 7:793 (1966).

7. Smith, E.M.: Evaluation of a Clinical Whole Body Counter, Physics in Medicine and Biology, 12:115 (1967).

8. Smith, E.M., and Katchis, L.: Digital Research Scanning System, J. Nuc. Med., 9:373 (1968).

9. Corey, K.R., Weber, D., Merlino, M., Greenberg, E., Kenny, P., and Laughlin, J.S.: Calcium Turnover in Man, in Kniseley, Ralph, M. and Tauxe, W. Newlon (eds.). Symposium on Dynamic Clinical Studies with Radioisotopes, Oak Ridge, Tennessee, Oak Ridge Institute of Nuclear Studies, TID 7678, 1964, pp. 519-536.

10. Weber, D.A., Greenberg, E.J., Dimich, A., Kenny, P.J., Rothschild, E.O., Myers, W.P.L., and Laughlin, J.S.: Kinetics of Radionuclides Used for Bone Studies, J. Nuc. Med., 10: 8-17, 1969.

11. Kenny, P.J., Myers, J.J., Lundy, A., Ritter, F., and Laughlin, J.S.: Digital Anger Camera With Electronic Focusing For Positron Emitters, Fundamental Problems in Scanning, Alexander Gottschalk and Robert N. Beck (eds.) Chas. C. Thomas, Springfield, Illinois, 1968, Chap. 16, pp. 226-228.

12. Hennecke, H.J. and Amtey, S.R.: A Computer Program for Shipping Conversion Electron Lines, To be published in Nuclear Instruments and Methods, 1970.

13. Watson, D.D.: A Method for the Analysis of Pulse Height Spectra, Nuclear Instruments and Methods, 43:355 (1966).

14. Marks, A., Chervoney, I., Langford, R., Smith, E.M., Gilson, A.J., and Smoak, W.M.,:"Ventilation-Perfusion Relationship in Humans Measured by Scintillation Scanning", J. Nuc. Med., Vol. 9, No. 8, pp. 450-456, August, 1968.

15. Ashkar, F.S., and Smith, E.M.: The Dynamic Thyroid Study, A Rapid Evaluation of Thyroid Function and Anatomy Using ^{99m}Tc as Pertechnetate. J.A.M.A. (In press).

6. SCIENTIFIC PERSONNEL (continued)

Drs. William M. Smoak, III and Fuad A. Ashkar will be intimately involved in this research contract with respect to posing the clinical questions and providing both subjective as well as objective views on the results of these studies. They will also give guidance on the types of information that are required for specific types of studies as well as estimates of realistic imaging times and other clinical input. In addition, they will be clinically responsible for any patients that will be studied on this project for the purpose of obtaining tissue distribution data on labeled pharmaceuticals.

7. OTHER PERSONNEL: The research technician will devote 90% of his time to this project, and will be responsible for data collection in the various aspects of this research contract under the supervision of Dr. Amtey.

8. OTHER FINANCIAL ASSISTANCE: The principal investigator has research grants from the following Federal agencies, and his involvement in these research projects are as follows:

A. Research Grant No. AM12060, National Institute of Arthritis and Metabolic Disease, H.I.H., "Experimental and Clinical Investigations in Rheumatoid Arthritis". This is a five year grant with the fourth year starting in February 1, 1971 with a requested funding level of $42,800 excluding indirect costs. The principal investigator has 10% of his time committed to this research grant.

B. Research Grant No. EC00029, Bureau of Radiological Health, ECA, U.S.P.H.S., "Radiation Dose from Diagnostic Isotope Procedures". This research grant is in its fifth year, and has been resubmitted for an additional five years of support. The funding level requested for each of the five renewal years is approximately $45,000. This research grant is administered by the Society of Nuclear Medicine, and provides the financial support for the Medical Internal Radiation Dose Committee of the Society. The principal investigator devotes 6 hours per week to these activities.

In addition to U.S. A.E.C. funds and the cited Federal funds, the personnel involved in this project are supported in part from funds derived from the University of Miami School of Medicine, and the Mount Sinai Hospital on Miami Beach.

9. PREMISES, FACILITIES, EQUIPMENT AND MATERIALS TO BE FURNISHED BY THE CONTRACTOR:

The physical locations where this research proposal will be carried out are enumerated in item No. 2 of this research proposal. The space required to carry out these research projects along with large items of capital equipment such as Anger cameras, rectilinear scanners and the Hewlett-Packard 2116B computer at Mount Sinai are provided by the various institutions. The equipment purchased under this contract is still being routinely used, and our intentions are to continue to use this equipment during the fourth and subsequent years of this research contract.

During the -05 year of this research contract the new Cyclotron-Nuclear Medicine facility at Mount Sinai Hospital will become operational. This will provide 25,000 sq. ft. area designated for the operation of the Nuclear Medicine Laboratories as well as the Cyclotron Facility. Of primary importance to the objectives of this research proposal is the 6 bed metabolic ward included in this facility which is totally controlled by Nuclear Medicine as well as the availability of a wide range of imaging devices. In addition, this research proposal will benefit from the extensive radiochemical facilities and the availability of any radionuclides commercially available and many that are not and can be produced on our own four particle, 25MeV proton energy cyclotron in copious quantities.

To facilitate measuring the volume response characteristics of a variety of collimated detectors and studying various radionuclide distributions we have on a 1 to 2 year loan a 3 inch and 5 inch rectilinear scanning system from Abbott Laboratories. This scanning system is valued in excess of $25,000 and will be used extensively on this project.

A major portion of the computational work to be performed in conjunction with this contract will be performed on the GE time share system. We have a terminal in our laboratory which we are currently using to obtain the preliminary data reported in our progress report.

10. BUDGET - First year (Fourth year of contract)

1. Salaries and Wages

NAME	Position	Effort Funded	Requested From AEC	Support From Univ. of Miami
(a) Edward M. Smith, Sc.D.	Principal Investigator	20	$6,510*	-0-
(b) Sharad Amtey, Ph.D.	Co-Investigator	60	9,600*	-0-
(c) Peter J. Kenny, M.S.		10	2,400*	-0-
(d) Denny J. Watson, Ph.D.		10	1,742*	-0-
(e) Research Technician		90	7,500	-0-
(f) Retirement at 5.5%			1,526	
		Total	$29,278	-0-
Employee Benefits				
F.I.C.A. (5.1%)			1,324	-0-
*Group Insurance (0.7%)			$ 142	-0-
			$30,744	-0-
Overhead 46% of S&W* at Mt. Sinai (*includes retirement)			(SEE NOTE 1) $13,468	-0-
2. Supplies				
Radionuclides and Radiopharmaceuticals			$ 1,500	-0-
Thermoluminescent Dosimetry Material			1,000	-0-
Phantom Material			3,000	-0-
Reference Material, etc.			300	-0-
		Total	$ 5,800	-0-
3. Equipment				
Recorder for T.L.D. system and Wang Calculator			-0-	$2,500
4. Publications and Communciations			$ 750	-0-
5. Travel			$ 750	-0-
6. Other				
Computer Time			$ 2,000	-0-
Maintenance to TLD System			-0-	$ 500
Subjects for Study and Travel for Subjects (10 at $125)			$ 1,250	-0-
			$ 3,250	$ 500
	Total Direct Costs		$41,294	$3,000
	Indirect Costs 46% S&W* (*includes retirement)		$13,468	
	TOTAL COSTS		$54,762	$3,000

Note 1 Base: Direct research salaries and wages including vacation, holiday, military, and sick pay and the employer's contribution to the employee's retirement fund, but excluding other directly charged fringe benefits.

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ESTIMATED BUDGET - Second Year (Fifth year of Contract)

	Requested From AEC	Support from Univ. of Miami
Salaries, wages and benefits	$33,203	-0-
Overhead, 46% of S&W plus retirement (SEE NOTE 1)	$14,545	-0-
Supplies	$ 6,000	-0-
Equipment	$ -0-	$ 3,000
Publications	$ 750	-0-
Travel	$ 850	-0-
Other	$ 4,000	$ 750
TOTAL	$59,348	$ 3,750

ESTIMATED BUDGET - Third Year (Sixth Year of Contract)

	Requested From AEC	Support from Univ. of Miami
Salaries, wages and benefits	$35,859	-0-
Overhead, 46% of S&W plus retirement (SEE NOTE 1)	$15,709	-0-
Supplies	$ 6,500	-0-
Equipment	$ -0-	$ 3,000
Publications	$ 750	-0-
Travel	$ 1,000	-0-
Other	$ 4,000	$ 2,000
TOTAL	$63,818	$ 5,000
Total Requested for 3 years	$177,928	$11,750

Note 1 Base: Direct research salaries and wages including vacation, holiday, military, and sick pay and the employer's contribution to the employee's retirement fund, but excluding other directly charged fringe benefits.