

NOTICE OF RESEARCH PROJECT
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PREFIX	NUMBER	CONT.	SUPL
AEC CONTRACT NO. AT-(40-1)-3734			

PUBLICATION BY AEC
HE. BY AUTHORIZED

Division of Biology and Medicine
UNITED STATES ATOMIC ENERGY COMMISSION

SUPPORTING AGENCY: UNITED STATES ATOMIC ENERGY COMMISSION

NAME AND ADDRESS OF INSTITUTION: Please state also 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 School of Medicine; Miami, Florida

707934

TITLE OF PROJECT
EVALUATION OF THE ABSORBED DOSE FROM THE DIAGNOSTIC USE OF RADIO-PHARMACEUTICAL

Give 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, D.Sc.; Asst. Prof. Radiology	25 percent
Albert J. Gilson, M.D.; Assoc. Prof. Radiology	20 "
Louis Katchis, Jr., M.S.E.E.; Research Assoc.	50 "

How many graduate students on project? _____ How many graduate student man-years? 1/2

SUMMARY OF PROPOSED WORK - (200 - 300 words. Omit confidential data.) Summaries are exchanged with government and private agencies supporting research, are supplied to investigators upon request, and may be published in AEC documents. Please make your summary SUBSTANTIVE, giving initially and for each annual revision the following:
OBJECTIVE: scientific BACKGROUND or REASON for study; proposed PROCEDURE; TEST OBJECTS and AGENTS

The evaluation of the absorbed dose received by a patient resulting from a diagnostic procedure employing a radiopharmaceutical is essential if the maximum benefit is to be derived by the patient. Even when the most sensitive and sophisticated instrumentation is used, the quantity of activity administered to the patient limits the quality of the diagnostic information extractable from the study. To obtain the necessary data to calculate the absorbed dose, the tissue distribution of the radionuclide incorporated into the radiopharmaceutical will be studied in vivo, and the activity concentration in tissue specimens and body fluids will be measured. The physical parameters required for absorbed dose calculations will be experimentally determined, and correlated with theoretically calculated values. The results of these investigations will yield a reliable estimate of the absorbed dose received by various body tissues from new radiopharmaceuticals as they are introduced into use, as well as from the routine radiopharmaceuticals in current use.

RESULTS TO DATE

REPOSITORY Oak Ridge Operations
Records Holding area
COLLECTION Documents 1944-1994
BOX No. H-110-9 Bldg. 2714-H
FOLDER Cont 3734 Univ. of Miami
Dr. Edward M. Smith

	PROGRAM CATEGORY NUMBER
BUD.	
PRIMARY	
SECONDARY	

Signature of Edward M. Smith Date 2/2/68
Principal Investigator

INVESTIGATOR - DO NOT USE THIS SPACE

1042080

AEC Research Pact To Miami

A research contract for examination of the effects of new radiopharmaceuticals on various body tissues has been awarded to the University of Miami School of Medicine, is chief investigator under the contract which extends through Oct. 14, 1968.

New radiopharmaceuticals are being developed in the laboratories of medical centers at a rapid rate, and radiopharmaceuticals in current use are already quite extensive.

H. M. Roth, director of the laboratory and university division of the AEC's Oak Ridge Operations, said that under the contract radioactivity distribution in the body will be studied in subjects receiving selected diagnostic radioisotopes.

ACC:AMP

December 10, 1967

University of Miami
Office of Vice President for Financial
Affairs and Treasurer
Post Office Box 8007
Coral Gables, Florida 33124

Attention: Mr. Eugene S. Cohen

Subject: CONTRACT NO. AT-(40-1)-3734

Gentlemen:

Enclosed, for your retention, is one fully signed copy of the subject contract. Also enclosed are sheet entitled "Notice: Use of Equal Employment Opportunity Poster; Standard Form 28 and Compliance Report Forms Under Federal Contract", with indicated enclosures; and pamphlet entitled "Notice to Present and Prospective Contractors on Policies Against Discrimination on the Basis of Sex, Age and Handicap."

This contract will be administered by the Chief, Research Contracts Branch, Laboratory and University Division. A copy of the Statement of Authority and a copy of Assignment of Contract for Administration Form are enclosed for your files.

Will you please advise us when we may expect to receive the completed Notice of Research Project Form requested in our letter of November 29, 1967.

Very truly yours,

Ralph Elson, Director
Contract Division
Oak Ridge Operations

Enclosures:

1. Contract AT-(40-1)-3734
2. Notice re EEO, w/encls
3. Pamphlet
4. Statement of Authority
5. Cy Form OR-169-A

cc: E. S. Shoup

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~~112262~~

DEC 14 1967

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

December 1, 1966

Authentication

12/30/66

Date

Eugene E. Cohen
Eugene E. Cohen
Vice President for Financial Affairs
and Treasurer, University Of Miami

11/30/66

Date

Edward M. Smith, Sc. D.
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.

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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, 1700 NW 10th Avenue, Miami, Florida 33136

3. Project Abstract.

The evaluation of the absorbed dose received by a patient resulting from a diagnostic procedure employing a radiopharmaceutical is essential if the maximum benefit is to be derived by the patient. Even when the most sensitive and sophisticated instrumentation is used, the quantity of activity administered to the patient limits the quality of the diagnostic information extractable from the study. To obtain the necessary data to calculate the absorbed dose, the tissue distribution of the radionuclide incorporated into the radiopharmaceutical will be studied "in vivo", and the activity concentration in tissue specimens and body fluids will be measured. The physical parameters required for absorbed dose calculations will be experimentally determined, and correlated with theoretically calculated values. The results of these investigations will yield a reliable estimate of the absorbed dose received by various body tissues from new radiopharmaceuticals as they are introduced into use, as well as from the routine radiopharmaceuticals in current use. Since detailed data on tissue distribution with respect to time will be obtained, potentially new clinical applications may evolve from these studies.

4. Scientific Background

The principal investigator has had a sustained interest in the evaluation of the internal absorbed dose from diagnostic radiopharmaceuticals for approximately five years, working in both the physical and biological aspects of the problem. From his experience, it appears that if reliable answers are to be obtained efficiently, both aspects of the problem must be attacked simultaneously. For example, consider a radiopharmaceutical which is concentrated by the liver, and excreted primarily in the feces, and one is asked to determine the absorbed dose to the ovaries. To calculate the absorbed dose the appropriate biological data must be collected, as well as the physical and anatomical parameters determined which are necessary to describe the radiation field seen by the ovaries. A rough approximation may be made by the standard methods; however, these tend to be conservative.

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If one wishes to maximize the quantity of activity administered in order to optimize the amount of information available from the study, and maintain a given absorbed dose, one must have the most reliable data available. The aim of this study is not to specify the maximum absorbed dose, but to tell the clinician if he administers "x" millicuries of a radionuclide in a specified chemical form, a given tissue will receive "y" millirads. The clinician must then determine (based on the clinical situation at hand) the absorbed dose (the risk) to which the patient can be exposed, to obtain the necessary diagnostic information (the benefit).

The scientific and medical literature in this area, except for the past few years, has been spotty and haphazard. Only recently have investigators begun to re-evaluate the physical parameters using contemporary computational technics required in these calculations: (Berger, 1966), (Eliett, et al, 1964, 1965), (Loevinger, 1966) and (Smith, et al, 1965). However, the physical parameters for many of these calculations have not been verified experimentally. The ICRU (Cook, 1965) is currently reviewing the anatomical and metabolic data required for absorbed dose calculations. The nuclear parameters such as photon and particle yield per disintegration and energy are actively being evaluated and reported by various groups. The biological data required for absorbed dose calculations is at best almost impossible, with a few exceptions, to obtain from the literature because of the inconsistent manner in which the data is reported. In addition, there is usually incomplete information on the physical and chemical characteristics of the radiopharmaceutical at the time of injection as well as insufficient clinical data on the patients studied. An excellent case in point is ^{203}Hg -Neohydryn. A wealth of data is available in the literature providing tissue distribution data; however, there are significant discrepancies in the data (Smith, 1966) which only after much correspondence plus additional studies have these discrepancies been resolved (McAfee, 1966).

5. Scientific Scope

A. Objectives

- (1) The collection of clinical data yielding information on the tissue distribution with respect to time of the radionuclide incorporated into the radiopharmaceutical under study.
- (2) Experimental verification of the physical parameters such as absorbed fractions and build-up factors required in the absorbed dose calculation.
- (3) The actual calculation and dissemination of the calculated values for the absorbed dose.
- (4) The evaluation of new radionuclide generators at the time they are introduced.

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B. Relationship of proposed research to present knowledge and comparable work in progress elsewhere.

At present there are no full-time projects at any institution devoted specifically to the actual collection of biological data for absorbed dose calculations, and the experimental verification of the physical parameters required in absorbed dose calculations. However, The Society of Nuclear Medicine has an "ad hoc" Committee on Medical Internal Radiation Dose (MIRD). The principal investigator is co-chairman of this committee.

The MIRD Committee does not do the actual laboratory work, but relies on the laboratories of the committee members and other cooperative investigators to supply the committee with the data they have collected. The committee then evaluates this data, which is based on data from at least two laboratories, determines if additional data is needed, and then, when the required data is collected, the absorbed dose calculations are made. The program which I will outline in the following section will provide a sorely needed data in-input for the MIRD Committee.

The work of the MIRD Committee is endless since new radiopharmaceuticals are being developed in the laboratories of medical centers at a rapid rate, and the radiopharmaceuticals in current use are already quite extensive. This proposed project will face a similar situation. The radiopharmaceuticals, in current routine use to be included in this project are those whose use may increase because of improvements in or availability of nuclear medical instrumentation, more sophisticated clinical studies or additional information on the absorbed dose. The radiopharmaceuticals that are in the stage of clinical evaluation will be chosen based on preliminary clinical data regarding the efficacy of the study and the magnitude of potential use of the radiopharmaceutical.

Studies similar in scope to the one proposed in this application, but whose objective is to evaluate the exposure patients receive from diagnostic radiographic procedures are underway in several institutions. These studies, in many instances, are retrospective in nature, where the objective is to answer the question, what exposure did the patient receive from a given study for a given set of exposure conditions. Since the discipline of Nuclear Medicine is young, we should not wait ten or twenty years, and start retrospective studies similar to those currently underway in diagnostic radiology, but institute prospective studies as new radiopharmaceuticals are introduced into the field.

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C. General Plan for the Work

The outline presented in this section will be for the first year of the project. Studies in succeeding years will include additional radiopharmaceuticals (both routine and those under clinical evaluation) and radionuclide generators as they are developed. The experimental verification of the physical parameters will be completed in the second year, and it is hoped that "in vivo" dosimetry studies can be initiated in both humans and animals.

(1) Radiopharmaceuticals to be studied during the first year.

- a. Rose bengal (in routine use for liver scanning and liver function studies).
- b. Iron (in routine use for ferrokinetic studies).
- c. Indium iron oxide (currently being clinically evaluated as a scanning agent for the lungs) (Stern, 1966).
- d. Indium colloid (currently being clinically evaluated as a scanning agent for the liver) (Goodwin, 1966).

All radiopharmaceuticals used in this project will be assayed to determine the exact activity administered to the patient as well as the radionuclidic purity and the radiochemical purity of the radiopharmaceutical.

(2) Radionuclide generator to be evaluated during the first year.

Commercially available indium-113m generators (Kramer, 1966) will be studied with respect to elution efficiency, tin-113 breakthrough, radionuclidic purity of the eluate, presence of column matrix in the eluate, radiation exposure while the generator is eluted, and sterility and pyrogenicity of the eluate. At present these generators are available from New England Nuclear Corporation and Union Carbide Corporation.

(3) Collection of the tissue distribution data.

Patients will be hospitalized in the metabolic ward for a sufficient period of time to provide data on the initial metabolism of the radionuclide incorporated into the radiopharmaceutical, and the rate at which the activity is excreted in the feces and urine. These patients will have a physical examination and history before the study is started. Twenty-four hour urinary and fecal collections will be made as well as serial blood (red

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cells and serum) samples. The total body counter will be used to verify the total body retention of the radionuclide as determined by the excreta collections, and to evaluate the spacial distribution of the radionuclide in the body. The REMCAL phantom will be used as an aid in determining the fraction of the administered dose in the various tissues. A blood sample will be taken when a measurement is made with the total body counter. The patients will be followed on the total body counter as outpatients until less than one per cent of the administered activity is retained or until the decrease in body retention of the radionuclide approaches the decrease in activity that would be due to the physical decay of the radionuclide alone.

When there is significant concentration of a radionuclide in one or more areas of the body, a detailed digital scan will be made over that region using the Dynapix scanning system. Count-rate and spacial information will be evaluated to provide a better estimate of the local tissue concentration. At present a region 1.5 mm by 2.0 mm. can be quantitated.

Biopsy specimen along with a blood sample will be obtained from surgical patients who have received a radiopharmaceutical under study. Tissue specimen will be obtained at autopsy when the radiopharmaceutical has been administered to an individual prior to his demise. Sufficient clinical information on the individual from whom the tissue specimens were obtained must be available for the specimens to be included in the study.

- (4) Experimental determination of the physical parameters required in absorbed dose calculations.

Values for the absorbed fraction will be determined in both infinite and bounded geometries and compared with the calculated values of Ellett, et al. The absorbed fraction will be studied as a function of the photon energy, phantom mass and shape, and radionuclide distribution. Thermoluminescent dosimeters will be used as the radiation detectors in these studies. The absorbed fraction will also be determined for the simulated organs of the REMCAL phantom. The build-up factors of Berger will be studied in a similar fashion.

If the tissue distribution data indicates that a single organ may receive significant absorbed dose due to being irradiated by several nearby organs which have concentrated the radionuclide,

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the irradiation field will be simulated in the REMCAL phantom and the absorbed dose measured using thermoluminescent dosimeters.

(5) Calculation of the absorbed dose.

An upper and lower estimate for the absorbed dose will be calculated based on the data collected in the sections already discussed. When applicable the computer program for absorbed dose calculations developed by Moses Berman and other members of MIRD will be used. The absorbed dose will be calculated for all appropriate organs attempting to give an indication, where possible, of the influence of age, sex, pathological state, etc. on the absorbed dose estimate.

1042088

c. Scientific Personnel

A. Edward M. Smith, Sc. D., Principal Investigator

Education



Professional Experience

- (1) University of Miami School of Medicine, Miami, Florida (1966 to present). Assistant Professor, Department of Radiology, Division of Nuclear Medicine.
- (2) Cornell University Medical College, New York City (1965-1966). Research Associate, Department of Radiology.
- (3) Hospital for Special Surgery, New York City (1965-1966). Associate Scientist; Technical Director, Nuclear Medicine Laboratory; Radiation Safety Officer, Member of Isotope Committee.
- (4) National Institutes of Health, Bethesda, Maryland (1963-1965). Senior Assistant Sanitary Engineer, U. S. P. H. S. (Military Service).
- (5) Catholic University of America, Washington, D. C. (1963-1964). Lecturer. Two semester advanced graduate course entitled, "Radiation Dosimetry and Safety".
- (6) National Institutes of Health Graduate Program, Bethesda, Maryland (1964). Lecturer.
- (7) Johns Hopkins University, Baltimore, Maryland (1960-1963). Research Assistant.
- (8) Los Alamos Scientific Laboratory, Los Alamos, New Mexico, (Summer 1960). Summer Graduate Student.

Publications

- (1) Howley, J. R. and Smith, E. M.: A Method of Assuring the Spectrochemical Purity of I-132 for Medical Use. Health Physics, 10:623 (1964).
- (2) Smith, E. M., Howley, J. M. and Wagner, H. N. Jr.: Determination of Protein-Bound Iodine (PBI) in Human Plasma by Thermal Neutron Activation Analysis, J. Nuc. Med. 5:828 (1964).

Publications (Cont'd)

- (3) Smith, E. M.: Properties, Uses, Radiochemical Purity and Calibration of Tc-99m, J. Nuc. Med., 5:871 (1964).
- (4) Smith, E. M.: Internal Dose Calculations for Tc-99m, J. Nuc. Med., 6:231 (1965).
- (5) Smith, E. M., Harris, C. C., and Rohrer, R. H.: Absorbed Dose Calculations for Radionuclides that Emit Low Energy Photons, J. Nuc. Med. 6:343 (1965).
- (6) Smith, E. M.: Tc-99m Dose Calculations. Appleton-Century-Crofts, New York, pp. 31-95 (1966).
- (7) Smith, E. M.: Current Problems in Absorbed Dose Calculations for Internally Administered Radiopharmaceuticals. Appleton-Century-Crofts, New York, pp. 103-109, (1966).
- (8) Smith, E. M., Harris, C. C., and Rohrer, R. H.: Calculations of Local Energy Deposition Due to Electron Capture and Internal Conversion, J. Nuc. Med. 7:23 (1966).
- (9) Smith, E. M.: Calculating Absorbed Doses from Radiopharmaceuticals, Nucleonics, Jan. 1966.
- (9A) Smith, E. M.: Internal Radiation Absorbed Dose; Radioactive Pharmaceuticals, Conf. 8511, U. S. Department of Commerce, Springfield, Va. 22151, p. 649 (1966).
- (10) Tow, D. E., Wagner, H. N., Jr., Lopez-Majano, Vincent, Smith, E. M. and Migita, Taira: Validity of Measuring Regional Pulmonary Arterial Blood Flow with Macroaggregates of Human Serum Albumin. Am. J. of Roentgenology, Ra. Therapy and Nuc. Med. 90:334 (1966).
- (11) Smith, E. M.: Radiation Dosimetry, Principles of Nuclear Medicine. To be published by Saunders, 1966.
- (12) Smith, E. M.: Internal Radiation Absorbed Dose Calculations, Handbook of Biochemistry and Biophysics, To be published by World Publishing Co., 1966.

Manuscripts in Preparation

- (1) Evaluation of the Optimum Crystal Size for a Clinical Whole Body Counter.
- (2) Design and Evaluation of a Clinical Whole Body Counter.
- (3) Data Acquisition and Control System for a Multifunction Digital Scintillation Scanner.
- (4) A Multifunction Digital Scintillation Scanning System.
- (5) Pattern of Distribution of Sr-85 in Osteoarthritis of the Knee.
- (6) Assay of Radionuclides in the Nuclear Medicine Laboratory.

Manuscripts in Preparation (Cont'd)

- (7) Verification of the Biological Properties of a Radiopharmaceutical (sodium auro-198-thiomalate-myochrysin^R) by Activation Analysis.
- (8) Metabolism and Biological Distribution of Myochrysin in Rats Utilizing Labelled Myochrysin and Activation Analysis.

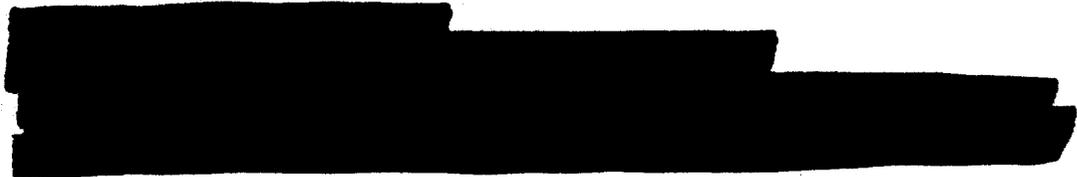
Additional Information

- (1) Co-Chairman, Ad Hoc Committee on Medical Internal Radiation Dose, The Society of Nuclear Medicine.
- (2) Ad Hoc Committee for Survey of Radioisotopes Administered to Man, The Society of Nuclear Medicine.
- (3) Scientific Advisory Board, Handbook of Radioactive Isotopes, The Chemical Rubber Company.
- (4) Radiation Protection Committee, The Society of Nuclear Medicine.

A minimum of 25% of Dr. Smith's time will be devoted to this project.

B. William M. Smoak, III, M. D.

Education



Professional Experience

- (1) University of Miami School of Medicine, Miami, Florida (1964 to present). Instructor, Department of Radiology.
- (2) Jackson Memorial Hospital, Miami, Florida. Associate Director, Division of Nuclear Medicine (1966 to present). Attending Radiologist (1964 to present).
- (3) Cedars of Lebanon Hospital, Miami, Florida (1964 to present). Attending Radiologist

Publications

Viamonte, L., Parks, R. L. and Smoak, W. M., Guided Catheterization of the Bronchial Arteries (A paper presented in three parts), Radiology, 85:295-320 (1966)

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Additional Information

- (1) Medical Licensure
Georgia - 1960
Florida - 1961

- (2) Certification

Certified by the American Board of Radiology (Radiology,
Nuclear Medicine, and Radiation Therapy), 1965.

Dr. Smoak will devote 20% of his time to this project.

C. Physicist - to be employed.

Qualifications

Masters Degree or Bachelors Degree with experience in Nuclear
Medicine. This individual will devote 50% of his time to this
project.

7. Other Personnel

A. Nuclear Medical Technologist. Bachelors Degree or equivalent training
and experience in Nuclear Medicine. This individual will devote 100%
of his time to this project.

B. Medical Secretary. This individual will devote 25% of his time to this
project.

8. Other Financial Assistance

At present, the personnel involved in this project will be supported
by University of Miami or Dade County funds.

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9. Premises, Facilities, Equipment and Materials to be Furnished by the Contractor.

A. Laboratory space for research activities to be conducted.

- (1) Whole body counting laboratory - approximate area 310 sq. ft.
- (2) Dosimetry laboratory - approximate area 150 sq. ft.

Laboratory areas to be shared with clinical nuclear medicine

- (3) Counting laboratory - approximate area 220 sq. ft.
- (4) Dynamic function studies laboratory - approximate area 160 sq. ft.
- (5) Dynapix scanning room - approximate area 210 sq. ft.
- (6) Radiopharmaceutical development, preparation and dispensing laboratory - approximate area 500 sq. ft.

B. Clinical nuclear medicine laboratory

The clinical load in the nuclear medicine laboratory averages 35 procedures per day with a range between 20 to 50 procedures per day. Individuals from this patient population will be administered the radiopharmaceuticals which are to be investigated in this project for diagnostic purposes. Since many of the procedures are performed for screening purposes, this large patient population will provide both normal metabolic data with respect to the organ system being studied as well as data for various pathological conditions.

The nuclear instrumentation which will be made available for use in this project includes the Dynapix scanning system with computer compatible magnetic tape read-out, two rectilinear scanners and several scintillation detector equipped with flat-field collimators connected to single channel pulse height analyzers.

C. Metabolic Ward.

The 14 bed metabolic ward is an independent unit with regard to administration, nursing and other aspects of patient care. The facility is available to all physicians of the University of Miami School of Medicine staff for admission of patients of any age who qualify as research subjects. The Division of Nuclear Medicine will be allocated two beds to be used in conjunction with this project. Routine laboratory determinations are made by the unit's laboratory. All costs for hospitalization are borne by funds supporting the facility.

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D. Computer Center

The computer center at the University of Miami consists of an IBM 7040-1401 computing system. This system will be updated towards the end of 1967 with an IBM 360-50 computing system. Programming assistance is available at the computer center.

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10. Budget

The following section presents a detailed budget estimate for the first year, and the justification and description of each item of equipment listed. An approximate budget is given for the second year.

The travel funds requested in this contract will be used to attend scientific meetings and conferences relating to the objectives of this project.

A. Estimated budget for first year, from February 1, 1967 to January 31, 1968.

	<u>Estimated Requirements</u>
(1) Salaries and wages	
a. Principal Investigator, Edward M. Smith, Sc. D. Assistant Professor of Radiology 25% @ \$1,250/mo.	\$ 3,750
b. William M. Smoak, III, M. D., Instructor in Radiology, 20% of time No salary included, County employee	----
c. Physicist at M. S. level or B. S. with equivalent experience, 50% @ \$700/mo.	4,200
d. Nuclear Medical Technologist at B. S. level or equivalent experience, 100% @ \$550/mo.	6,600
e. Medical Secretary. 25% @ \$400/mo.	<u>1,200</u>
	<u>\$15,750</u>
Social Security @ 4.4% of first \$6,600	\$ 437
Group Life Insurance @ 0.7% of \$3750	26
Retirement @ 7.5% x \$17,750	<u>1181</u>
	1,644
	1322
	<u>12270</u>
(2) Supplies	
a. Radionuclides and radiopharmaceuticals	\$ 2,000
b. Glassware and Chemical supplies	2,000
c. Disposable containers for sample collecting and counting	500
d. Computer and programming time	1,500
e. Electronic maintenance and repair	250
f. Office supplies, reference material, etc.	<u>250</u>
	6,500

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(3) Equipment

a. Total body counter	28,000	
b. Thermoluminescent dosimetry system	5,000	
c. Alderson REMCAL Phantom	2,500	
d. Radionuclide assay equipment	<u>3,000</u>	

38,500

(4) Travel 500

(5) Telephone and other communication costs 200

(6) Publications 300

(7) Indirect costs: 51% of salaries and wages plus
retirement, 0.51 x \$16,939 = 8,639
(A. E. Freerks, Navy Audit Office, Field Box 2691,
West Palm Beach, Florida) 8,639 4,331

Total Project Cost \$72,033

Amount requested of AEC \$72,033

B. Approximate budget for second year from February 1, 1968 to
January 31, 1969.

	<u>Approximate Requirement</u>
(1) Salaries and wages	\$ 25,000
(2) Supplies	10,000
(3) Equipment	---
(4) Travel	500
(5) Telephone and other communication costs	200
(6) Publications	500
(7) Indirect Costs (approximate)	<u>12,500</u>
Total	\$ 48,700

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C. Justification and description of equipment in first year budget.

(1) Total body counter.

The total body counter will be used to determine the total activity retained by the patient as well as the distribution of activity in the body. This cannot be done with sufficient reliability if individual uptake units are used to monitor the various tissues which accumulate activity because of the problems associated with reproducing counting geometry, compensating for body background and assaying the absolute activity contained in a given tissue. Using the total body counter described below, and a suitable phantom (Alderson REMCAL phantom), these problems can be completely eliminated or reduced in magnitude so they can be compensated for.

The total body counter to be constructed will be conceptually similar to the one described by Pircher, et al (Pircher, 1965). It will consist of five collimated detectors above and below the patient. The patient is to be moved at a constant speed between the two sets of crystals. There will be six channels of count information corresponding to various detector combinations, a channel of time information and a channel of spacial information. These data will be recorded on an incremental magnetic tape recorder, and then processed at the Computer Center of the University of Miami. The total body counter will require approximately three months to complete after funds are available. It will be advantageous to have this portion of the project funded as soon as possible. A block diagram of the proposed total body counter is attached.

(2) Thermoluminescent dosimetry system

The thermoluminescent dosimetry system will be used in the experimental verification of the various physical parameters (absorbed fraction and build-up factors) necessary in absorbed dose calculations. It will also be used as an aid along with the REMCAL phantom in the evaluation of the absorbed dose for complex irradiation geometries; for example, the gonads irradiated by the liver, small bowel and total body. In the second year, the system will be used in the planned "in vivo" studies.

(3) Alderson REMCAL phantom

The REMCAL phantom will be used in conjunction with the total body counter to assay the activity in various body tissues. It

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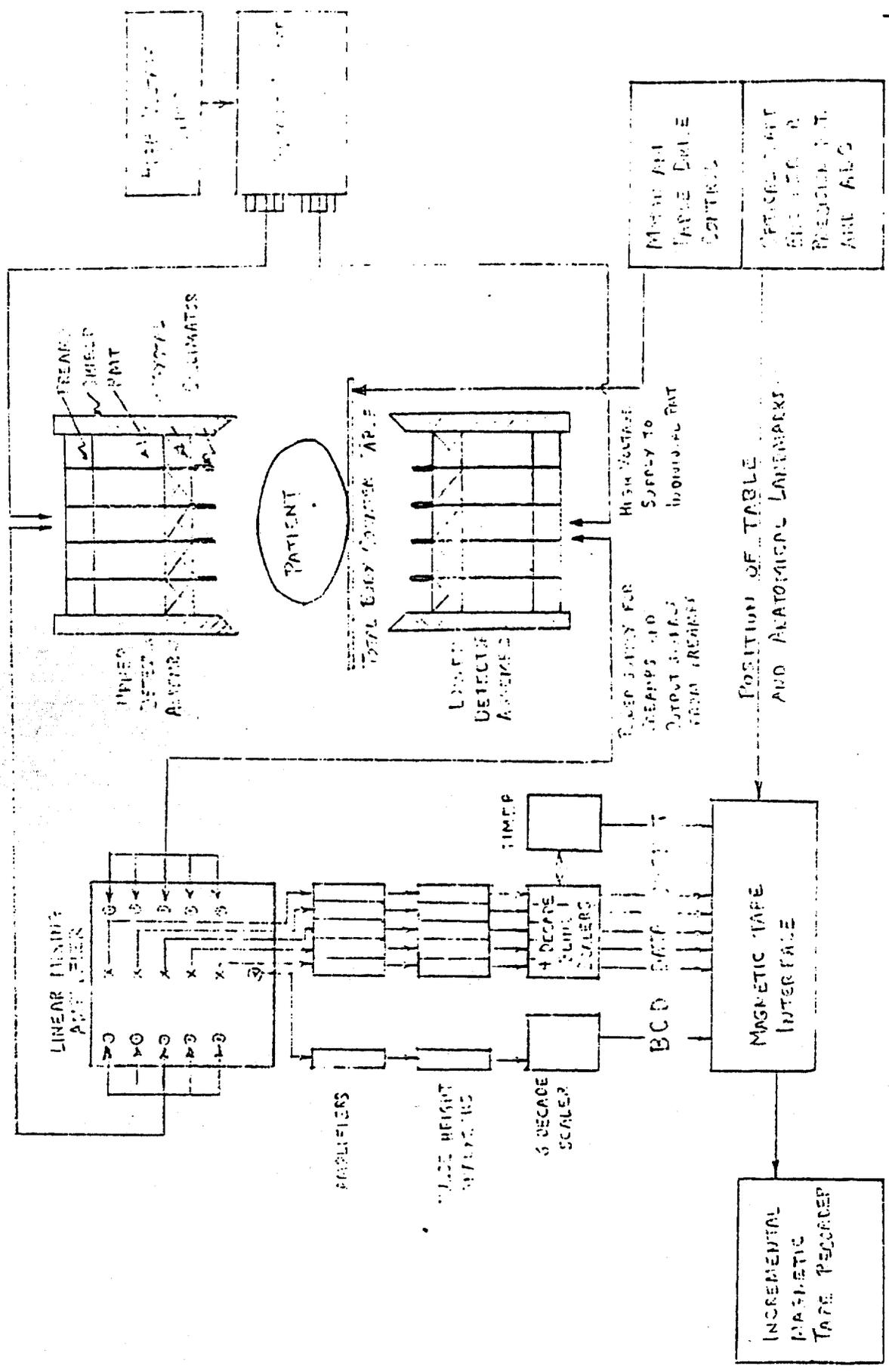
will also be used in conjunction with the thermoluminescent dosimetry system to evaluate complex irradiation geometries.

(4) Radionuclide assay equipment

This equipment will be used to assay the administered activity, counting standards, body fluids, tissue samples and feces. It will consist of a shielded 3" x 3" NaI(Tl) well crystal and a 3" x 3" NaI(Tl) solid crystal mounted in a shielded calibration rig. The detectors will be connected to a single channel pulse height analyzer system.

1042098

BLOCK DIAGRAM OF THE TOTAL BODY SCANNER



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-1*-

REFERENCES

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2. Cook, M. J. and Snyder, W. S.: Estimation of Population Exposure, Health Physics, 11:610 (1965).
3. Ellett, W. H., Callahan, A. B. and Brownell, G. L.: Gamma-ray dosimetry of Internal Emitters - Monte Carlo Calculations of Absorbed Dose from Point Sources, Brit. J. Radiol. 37:45 (1964).
4. Ellett, W. H., Callahan, A. B. and Brownell, G. L.: Gamma-ray Dosimetry of Internal Emitters - Monte Carlo calculations of Absorbed Dose from Uniform Sources, Brit. J. Radiol., 38:541 (1965).
5. Goodwin, D. A., et al: A New Radiopharmaceutical for Liver Scanning, Nucleonics, 24:No. 11, 65 (1966).
6. Kramer, H. H. and Stern, H. S.: Indium-113m as a New Scanning Agent, J. Nuclear Medicine 7:305 (1966).
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