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EARLY PROGRESS OF THE BIOMEDICAL COMPUTING TECHNOLOGY INFORMATION CENTER (BCTIC)[1]

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ABSTRACT

Through five years of effort by the Society of Nuclear Medicine Computer Committee, the Biomedical Computing Technology Information Center (BCTIC) was established by the Division of Biomedical and Environmental Research (DBER) of the U, S. Energy Research and Development Administration (ERDA) at the Oak Ridge National Laboratory in July of 1975. BCTIC forged ahead into the tasks of designing guidelines and procedures, acquisition and packaging of computer codes, data, and interface designs; building a bibliographic data base; and maintaining a directory of the user community. Important contacts were made with societies and individuals involved in biomedical computing; and BCTIC was publicized through news releases, the BCTIC newsletter (bimonthly, since October, 1975), presentations at meetings, and personal contacts.

This paper presents the response BCTIC has received in its initial months, gives a progress report on our developmental phase, and takes a look to the future of BCTIC as a national technology resource in nuclear medicine computing.

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I. BACKGROUND

A. Ancient History

In mid-1970 Betty F. Maskewitz was approached by Francis H. Clark, a physicist at ORNL, and Dr. A. Bertrand Brill, Vanderbilt Medical Center, for advice on how to establish the mechanics for computing technology information exchange within the Nuclear Medicine community. Mrs. Maskewitz was, and still is, the Director of the Radiation Shielding Information Center (RSIC), which for over 15 years has provided a very successful information and computer code exchange service within the nuclear physics community.

This initial contact lead to a close working relationship between the Nuclear Medicine community and Mrs. Maskewitz which has continued to the present time. The first step taken to establish the mechanism for computing technology exchange was the first symposium on the Sharing of Computer Programs and Technology in Nuclear Medicine which was held in Oak Ridge in April, 1971. At this symposium Mrs. Maskewitz challenged the group of atendees as follows:

> This group seems to share many areas of common interest in the use of computers in nuclear medicine. Organize yourselves today into a cohesive unit with an administrative structure. Find yourself a sponsor--a parent organization. Could the Society of Nuclear Medicine (SNM) fill that role? I've learned that its president is one of you and that at least 60% of you are members of it. Meet periodically for a period of sharing, as you've done here, perhaps in conjunction with the SNM meetings. Use the Society's Newsletter and Journal as vehicles for information peculiar to your interests. Promote a climate for exchange and do your programming development with interchangeability in mind. If you believe that you advance the state-of-the-art more by sharing your efforts, then do so. Don't depend on voluntary exchange efforts only. No one has time or money for too much of that. Find a funding agency and an objective middle man, a code center, to coordinate your efforts; and go forward together in pursuit of better tools for use in the very humanitarian technical area in which you work.

This challenge was accepted by Dr. Henry Wagner, the 1971 Society President, and by other participating members. This acceptance resulted in the formation of the SNM Computer Committee with Dr. Brill as Chairman, and the efforts of this Committee during the ensuing years played a major role in the planning of and the petitioning for support of a Computing Technology Information Center.

B. Modern History

After several unsuccessful petitions for support of a Computing Technology Information Center (NSF, NIH, FDA, and ERDA), the Biomedical Computing Technology Information Center (BCTIC) was established in Oak Ridge by the U. S. Energy Research and Development Administration (ERDA). Assurance of such an action was given by Dr. James L. Liverman, Assistant Administrator for Environment and Safety and Director of the Division of Biomedical and Environmental Research of ERDA, in June, 1975. The official confirmation was received in the latter part of August. Since that time the members of the BCTIC organization have been in the process of establishing it within the biomedical field.

II. THE BIOMEDICAL COMPUTING TECHNOLOGY INFORMATION CENTER

A. Organization

The Biomedical Computing Technology Information Center is initially "renting" space and services from the Radiation Shielding Information Center, drawing upon an established information analysis center expertise. Betty F. Maskewitz (ORNL) directs both BCTIC and RSIC activities. Sharing responsibility for the development and viability of the new center are W. J. McClain and R. L. Henne of the Computer Sciences Division (UCCND) who have combined experience and education in biomedical information and computer science, electrical engineering, minicomputer interfacing for medical applications, and information center operation.

A Scientific Advisory Committee assists BCTIC as needed by providing expertise in various related areas. (Appendix I.). Among them are the Chairman of the SNM Computer Committee and the SCM Executive Director. Continuing close cooperation with both professional societies provides additional lines of communication essential to maintaining the quality and viability of BCTIC's technical data base and services.

B. Functions

BCTIC's mission is "to collect, organize, evaluate, and disseminate information in computing technology pertinent to biomedicine in general, and Nuclear Medicine in particular." Specifically, BCTIC functions include:

a. The Clearinghouse - BCTIC collects and packages algorithms, computer programs, data, and interface designs pertinent to clinical and/or research biomedicine. This service permits users to transfer technological advances to others at minimal cost and, in return, to acquire new technology from other sources. Codes and data will be maintained using the 'open code' concept, successfully developed and utilized by RSIC in the radiation transport field, which permits continual updates and revisions as errors and incompatibilities are detected or as programs are extended, modified, or translated into other languages.

b. The Newsletter - BCTIC publishes a periodic Newsletter highlighting important developments in the field, surveying existing biomedical computer installations, noting upcoming meetings and events of interest, and providing a bibliography of recent literature specifically selected by the BCTIC staff as being of interest to its readers.

c. Meetings and Conferences/Proceedings - BCTIC conducts seminars, workshops, and topical meetings on biomedical computing technology and publishes and distributes the proceedings of these and other conferences.

d. Literature Review - BCTIC maintains a storage and retrieval of information system (SAKIS) containing bibliographic citations and abstracts accumulated through review of pertinent books, journals, and reports; and periodically publishes bibliographies and abstracts. As the data base matures, a selective dissemination of information (SDI) service will be offered.

e. Standards - BCTIC personnel actively promote hardware and software standards in biomedical computing.

f. The Workbook of Clinical Resources - BCTIC periodically surveys the biomedical computing community to provide an index of equipment and clinical procedures performed at the various installations. The Workbook enables

prospective users of biomedical computing technology to contact other clinicians and researchers performing similar procedures on similar equipment. The first issue will be published this fiscal year.

C. Present Status

BCTIC's staff has directed its efforts along five major fronts:

1. Publicity
2. Personal Contacts
3. Bibliographic Data Base
4. Nuclear Medicine Workbook
5. Accumulating Code and Data Packages

These efforts have involved one full-time person and two persons working part-time. Efforts in each of these areas are described in the following paragraphs.

1. Publicity

The announcement of BCTIC's organization appeared in the last SNM Computer Committee Newsletter published at Oak Ridge, and it has been supported by the Computer Committee in all of its subsequent notices and Newsletters. Other announcements were published through the normal publicity channels of ORNL. The Center has published the first two of its bimonthly newsletters.

A brochure containing the information shown in Section II-A and -B of this paper was printed and distributed to all persons on the distribution list of the Computer Committee. Members of the staff presented papers at the annual meeting of the Southeastern Chapter of SNM, at the annual meeting of the Society for Computer Medicine, and at the fall meeting of the American Nuclear Society. At all of these meetings brochures were widely distributed.

2. Personal Contacts

Many individuals have submitted response cards attached to the brochures, indicating their interest in the BCTIC operation. As of January 15, 33 persons had stated that they would review literature for articles on computer uses in biology and medicine whose abstracts can be entered into the bibliographic data base being compiled at the present time. Nine had stated that they have computer programs available for submission to our information analysis center.

Visits have been made to New York's Mt. Sinai Hospital, the Billings Hospital of the University of Chicago, the Stanford Medical Center, the Santa Clara Valley Medical Center, and the Vanderbilt Medical Center. Visits to other medical centers and hospitals are planned during the coming months.

The center has received nearly 300 inquiries and contacts by mail and telephone. Requests that could not be filled with the small code inventory presently available are being publicized in the bimonthly newsletter to help these individuals in their quest for help in the application of their computer systems.

3. Bibliographic Data Base

A bibliographic data base on biomedical computer technology is being developed through the information management systems at ORNL. Recent

additions to five major data bases available to the laboratory (Biological Abstracts, etc.) are being searched with varying search profiles to determine the optimum profile required for accessing references to biomedical computing. Whenever the optimum profile for each data base is developed, a retrospective search of the data bases over the past six years will be performed to build the data base for BCTIC. Continuous updating will be accomplished by periodic search of these data bases and through input from persons volunteering to help in this area.

4. Nuclear Medicine Workbook

BCTIC has continued its support of the efforts of the Computer Committee's Workbook Task Group to provide a published document within this fiscal year. The institution resource data is now being entered into the computer in a format usable by the Oak Ridge Computerized Hierarchical Information System (OSCHIS) to provide camera-ready copy of the information in the format desired.

Data from seven manufacturers of computer-based imaging systems are also being entered for that section of the Workbook.

5. Code and Data Packages

In the second bimonthly newsletter BCTIC announced the availability of six computer codes and three medical data packages (Appendix II). We are in the process of personally contacting individuals who have stated that they have technology available for distribution. These code will be tested and packaged as soon as they are received, and announcement of their availability will be made in the following issue of the BCTIC Newsletter. In addition, BCTIC has received requests for programs and routines not now available in its inventory. When a request of this type is received, we will make the need known through the Newsletter.

We will be meeting soon with the Executive Secretary of the Massachusetts General Hospital Utility Multiprogramming Systems (MUMPS) Users Group to determine what technology is available from that organization that could be distributed through BCTIC.

III. RECOMMENDATION

The BCTIC brochure contains as part of its text the following reminder:

> The aim of the Biomedical Computing Technology Information Center is to provide the most up-to-date information possible concerning computer applications in the field. Therefore, we depend upon the cooperation of our users to continually update existing material and add new material to our clearinghouse. We encourage you to put us on your distribution list for all computer-based biomedical research reports, and to contact us if you have codes, interfaces, or modifications you wish to make available.

We realize that our inventory of code and data packages will be small for some time to come, and, for this reason, will not be as effective in meeting our primary objective: that of providing the most up-to-date information possible concerning computer applications in biomedicine. However, we are certain that this situation will be rectified as time goes by.

We have concentrated our efforts within the nuclear medicine community because the concept of BCTIC was developed within the Society's Computer

Committee and the Society has continued to lend support for this activity. We have experienced a very warm reception by the staffs at the Nuclear Medicine facilities visited, and we have been encouraged by the acceptance of the Center's goals by most members of the Society.

Our greatest concern at the present time is how can our limited staff most effectively develop a useful and viable center which contains computer code and data packages that are useful to the nuclear medicine community? To accomplish this, we would make the following recommendations:

A. Utilize each Task Group to insure that computer codes considered to be most effective in the area of its interest and responsibility are entered into MCTIC's library. One Task Group Chairman has provided us with a list of recommended programs - all others could do the same.

B. Let us know how your nuclear medicine facility is utilizing the computer in your normal clinical practice. What are you doing with the computer? Which programs do you consider effective and useful? If the response to this recommendation were great enough, MCTIC could publish a volume of abstracts of computer codes used in daily clinical practice and research as has been done by Canada's Health Computer Information Bureau.[1]

C. Let us know your needs in computer applications, and

D. Let us visit your facility to determine the way that you are using your computer systems.

MCTIC is now in its infancy, but its need has been proven, and we have one and one-half years to show that we can fulfill that need.

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[1] "Health Computer Applications in Canada," Vol. 1, Health Computer Information Bureau, 274 Friel Street, Ottawa, Ont. K1N 6B3

APPENDIX 1

RCTIC Scientific Advisory Committee

John Auxier	Director, Health Physics Division, Oak Ridge National Laboratory (ORNL)
P. R. Bell	Associate Director, MAN Program, Biology Division, ORNL
Nancy A. Betz	Communications Section Head, Computing Applications Department, ORNL Computer Sciences Division
A. B. Brill	Director, Division of Nuclear Medicine and Biophysics, Vanderbilt University Medical Center
J. C. Carlson	Chairman, SNM Computer Committee
R. J. Cloutier	Chairman, Special Training Division, Oak Ridge Associated Universities, and Chairman of the SNM Medical Internal Radiation Dose (MIRD) Committee
J. N. Gitlin	Deputy Director, Division of Radioactive Materials and Nuclear Medicine, Bureau of Radiological Health
M. A. Jenkin	Executive Director, Society for Computer Medicine
A. B. MacIntyre	Staff Assistant, Division of Radioactive Material and Nuclear Medicine, Bureau of Radiological Health (alternate)
J. W. Poston	Head of Medical Physics and Dosimetry Department, Health Physics Division, ORNL
C. E. Price	Head of Information Systems, Computing Applications Department, ORNL Computer Sciences Division
S. S. Stephens	Biological Computing Applications Specialist, Biology Division, ORNL
H. N. Wagner, Jr.	Head of Divisions of Nuclear Medicine and Radiation Health, Johns Hopkins Medical Institutions

APPENDIX II

COMPUTER CODES AND DATA AVAILABLE

Six computer codes and three data packages are now available from the BCTIC collection.

Collection of Code Packages

MED-1/CAMIRD

This Computer Assisted Medical Internal Radiation Dosimetry (CAMIRD) code was contributed by **Paul A. Feller**, Bureau of Radiological Health (BRH), Cincinnati General hospital. It computes absorbed dose to a specified organ in a *standard person* from an internally administered radionuclide according to the Medical Internal Radiation Dose (MIRD) scheme. Sixteen source organ files are included, and one nuclide file is provided as a guide for development of others. It is well documented and includes sample execution. IBM Call-OS FORTRAN (ASCII punched paper tape).

MED-2/AUTOFLUOROSCOPE SERIES

This series of programs used to record, translate, analyze and plot data recorded by an autofluoroscope was contributed by **Robert H. Jones**, Department of Surgery, Duke University Medical Center. Documentation consists of comment cards in each routine. IBM 360; FORTRAN IV (80-column card images on 9-track, 800 1600 bpi magnetic tape).

MED-3/PLOT

This code which provides printed plot on terminal of five dependent variables vs one independent variable was contributed by **J. M. Mozley** and **F. D. Thomas**, Upstate Medical Center, Syracuse, N. Y. It operates in a semi-conversational mode to permit entry of scaling factors and values of variables to be plotted. Sample execution is included. GE MARK II; FORTRAN IV (ASCII punched paper tape).

MED-4/RANDD

A CRT Intensity Modulated Display code was contributed by **Robert O. Smith**, University of Mississippi Medical Center. It produces an intensity- modulated display of 256 x 256 points for displaying a 32 x 32 array of data. One sweep of the display is provided for each push of the RUN button, permitting photography with the oscilloscope camera. It is documented with assembly listing. Hewlett-Packard models 2100, 2114, 2115, and 2116 with SIO system; Assembly language (ASCII punched paper tape).

MED-5/HADAMARD

This fast two-dimensional Hadamard transform code was contributed by **C. Berche** and **Andrew Todd-Pokropek**, Institute Gustave-Roussy, Laboratoire des Isotopes, France. It produces Hadamard or sequential Hadamard transform of a square matrix up to 64 x 64. It is documented by comments. UNIVAC 1107; FORTRAN IV (80-column card images, available on cards, 9-track, 800 1600 bpi magnetic tape, or punched paper tape).

MED-6/MTF PLOTTING ROUTINES

Routines for plotting the Modulation Transfer Function (MTF), developed by **Jon Erickson**, Vanderbilt Medical Center; FORTRAN IV is being currently processed.

MED-7/TILDY

This program to determine cumulated activity ($\tilde{A}$) from the elimination and distribution studies of a radiopharmaceutical was contributed by **Priscilla F. Butler**, **Lawrence T. Fitzgerald**, **Kenneth N. Vanek**, and **Valerie A. Brookeman**, University of Florida, College of Medicine and Veterans Administration Hospital, Gainesville, Florida. It is complete with sample data, sample output, line printer plotting routines, and documentation. IBM 370; FORTRAN IV (80-column card images, 133-column line printer images, available on card [programs and input data only] or 9-track, 800 1600 bpi magnetic tape).

Collection of Medical Data Packages

MDL-1/THYROID DATA

This package, with two files of data, was contributed by **Roger D. Parker**, Johns Hopkins University School of Hygiene and Public Health. The first file was used by S. D. Adelstein, Parker, and H. N. Wagner, Jr. for the study entitled "First Phase in Objective Evaluation of New Diagnostic Tests," published in *Investigative Radiology*, Vol. 5, No. 3, May-June, 1970. The second is not yet the object of a published document, but contains significantly more information. Detailed descriptions of the data formats are included. (Available on ASCII paper tape, 80-column punched cards or 9-track, 800 1600 bpi magnetic tape).

MDL-2/ORNL-5000 Data

Basic data from *A Tabulation of Dose Equivalent per Microcurie Day for Source and Target Organs of an Adult for Various Radionuclides* (ORNL- 5000) contributed by **W. S. Snyder, Mary R. Ford, G. G. Warner, and Sarah B. Watson**, Oak Ridge National Laboratory. Work is in progress on developing codes for selective editing to be included in the data package. Complete set of data available as EBCDIC 133-column line printer images on 9-track 800 bpi magnetic tape.

MDL-3/MIRD Pamphlet 11 Data ("S" Factors)

Basic data from the SNM Mird Committee's Pamphlet 11. Work is in progress on preparing documentation and developing editing codes for the data package. Data available as EBCDIC 133-column line printer images on 9-track, 800 1600 bpi magnetic tape.