MODEL PROJECT INFORMATION SHEET

NATIONAL PROGRAMME OF TRAINING IN MEDICAL PHYSICS

MEXICO - MEX/6/005

SUMMARY

New national regulations, expected to be enacted before the end of 1994, require the participation of a trained medical physicist when radiotherapy services are provided. Mexico has 80 ^{60}Co radiotherapy units and 13 linear accelerators for the treatment of cancerous tumours, in addition to 100 nuclear medicine centres and more than 20,000 diagnostic X-ray units. Since there are at present only 30 or so professional medical physicists in Mexico, most of whom have no formal training in the subject, there is an immediate need for an additional 100-125 medical physicists. No training programmes exist in this field and the Government has therefore decided to establish a National Programme of Training in Medical Physics to be carried out jointly by the National Institute for Nuclear Research and the National Cancer Institute. This model project will assist in establishing and implementing the programme. As a result of the national programme, Mexico and the regions of Central and northern South America will be provided with 10-12 additional medical physicists per year for the foreseeable future.

Project duration: 2 years. Total budget: US $438,200 million.

INTRODUCTION

The use of ionizing radiation in the medical field has increased significantly in Latin America, as it has throughout the world. It has therefore become necessary to increase the number of physicists specializing in the areas of radiotherapy, diagnostic radiology (imaging), and nuclear medicine in order to ensure that the exposure of patients and hospital staff is maintained at the lowest possible level. The diagnostic and therapeutic benefits of radiation technology in such applications as X-rays, imaging of various kinds and radiotherapy are well known and these procedures are widely utilized. As a result, the largest source of exposure to ionizing radiation of the average citizen is

from medical applications of radiation technology. Careful control of exposure in all medical applications by thoroughly trained professionals is therefore especially important.

Mexico has a total of 80 ^{60}Co radiotherapy units and 13 linear accelerators for the treatment of cancerous tumours, in addition to 100 nuclear medicine centres and more than 20,000 diagnostic X-ray units. However, there are at present approximately 10 professionals with formal academic training in medical physics and another 20 who carry out their work on the basis of experience acquired in hospitals. Thus, taking all of these personnel as fully qualified, Mexico has only 30 professional medical physicists for a population of more than 90 million, whereas the requisite number is 900, according to standard practice in developed countries, where there is one medical physicist for every 100,000 persons.

New national regulations, which are expected to be enacted into law before the end of 1994, require the participation of a trained medical physicist when radiotherapy services are provided. Compliance will be controlled by the National Department of Health and the Commission for Nuclear Safety and Safeguards. Thus, even considering the present level of development in radiation technology in Mexico, a very conservative estimate indicates that there is a need for 100-125 additional medical physicists. One reason for this deficit is that there are no established programmes in Mexico through which formal training in medical physics can be obtained. The situation throughout Latin America is comparable to that in Mexico, or even worse.

In response to this problem, Mexico has established a National Programme of Training in Medical Physics. The course is designed for Mexican nationals but up to 30% of the places will be open to persons from other countries in the region. The Agency has been asked to assist in the development and implementation of this programme.

NATIONAL COMMITMENT AND FOUNDATION FOR THE PROGRAMME

The Mexican National Programme of Training in Medical Physics will be carried out jointly by two outstanding institutions, the National Institute for Nuclear Research (ININ) and the National Cancer Institute (INCAN). ININ will be responsible for training in the basic scientific principles of medical physics and in radiological safety and quality assurance. INCAN will be responsible for the clinical aspects of the programme, including radiotherapy treatment planning, diagnostic radiology and nuclear medicine. A formal agreement has been reached between ININ and INCAN on the organization and implementation of the programme, involving common use of the infrastructure of both institutions. The resources of the National Institute of Neurology (INNN) will also be utilized in the programme, as will the Agency experts drawn primarily from the University of Texas M.D. Anderson Cancer Center in Houston, Texas, USA.

The National Institute for Nuclear Research (ININ) is well equipped and staffed for its role in the programme. The Institute has an established secondary standards dosimetry laboratory, which serves as the primary radiation calibration laboratory for Mexico and for neighbouring Latin American countries also. ININ has a Triga Mark II research reactor, two linear accelerators, a ^{60}Co irradiation facility and a variety of laboratories working with radioactive material. Equally important, ININ has an

operational National Nuclear Training Centre with lecture and work rooms, an excellent library, computer training facilities, and radiochemistry, electronics and counting laboratories. The Director of the programme at ININ has extensive experience in medical physics and metrology, including 20 years as the chief medical physicist at INCAN.

The National Cancer Institute (INCAN) is a major cancer treatment facility located in Mexico City and is also especially suitable for teaching medical physicists. The Institute has a well equipped Therapy Department with modern ^{60}Co and linear accelerator treatment facilities of several types. The Diagnostic Radiology Department also has a full complement of X-ray instruments and automated film processing as well as mammography, computerized tomography and ultrasound equipment. The amount of space available is exceptional for such facilities anywhere in the world. Space for study is available, as are laboratory facilities for computer treatment planning, thermoluminescence dosimetry, and manual calculation techniques. The Director of the programme at INCAN is a senior radiotherapist with more than 15 years experience.

The National Institute for Neurology (INNN) is located near INCAN and has adequately equipped diagnostic facilities for computer tomography, angiography, ultrasound and nuclear medicine scans of the brain.

Key personnel at all three institutes as well as national authorities are strongly committed to the programme. Senior and other highly qualified staff from the Commission of Nuclear Safety and Safeguards, including the General Manager for Radiological Protection, will participate as lecturers for topics in radiation protection and nuclear instrumentation.

THE PROPOSED PROGRAMME

During the period 1995-97, the programme will focus on formal training for persons who are at present practising medical physics. Plans are envisaged for an expansion of the programme into an advanced degree course in medical physics which will be certified by a national university. The national programme will thus go forward as a professional certification (diploma) programme, with both Mexican and other Latin American participants, until a formal Master's degree course, in which ININ and INCAN will continue to collaborate, can be proposed and approved and is fully operational. Discussions in this direction are being held with several academic institutions. During the interim period special care will be taken in the selection of national specialists who will later join the faculty of the programme; training is being planned with this in mind.

In view of the shortage of medical physicists in Mexico, individuals currently practising medical physics cannot be released from their work for full time study during the complete programme. The schedule of courses for the first three years of the programme has taken this into account. The programme was prepared with the assistance of Agency experts and is based on the recommendations of the Agency, the Master of Science programme in medical physics recommended by the American Association of Medical Physics, and curricula at various universities in the USA and Europe. Four modules of approximately two months duration have been designed. Students will return

to their hospitals for full time work for periods of approximately three months between each module. During the first course, the programme will be reviewed and modified at the end of each module, if necessary, according to the experience acquired. Modules I and II (Principles of Medical Physics, and Radiological Safety and Quality Assurance) will be taught at ININ. Modules III and IV (Radiotherapy Treatment Planning, and Diagnostic Radiology and Nuclear Medicine) will be taught at INCAN. Topics covered by the four modules are listed below:

Module I - Principles of Medical Physics

Applied Electronics
Medical Physics Instrumentation
Introduction to the Use of Computers
Principles of Atomic and Nuclear Physics
Interaction of Radiation with Matter
Radiation Sources in Medicine
Instrumentation for Radiation Detection
Instrumentation for Dose Determination
Review and Evaluation.

Module II - Radiological Safety and Quality Assurance

Radiobiology
Radiological Safety
Radiation Protection in Radiotherapy and Diagnostic Radiology
Internal Training Programme
Metrology
Protocol of External Beam Calibration
Radiation Beam Characterization
Quality Assurance
Specification of Radiotherapy Units
Review and Evaluation

Module III - Radiotherapy Treatment Planning

Quality Assurance
Acceptance Tests for Radiotherapy Units
Dosimetry of Simple Fields
Dosimetry of Multiple Fields
Dosimetry of Electron Fields
Dosimetry of Irregular Fields
Brachytherapy
Review and Evaluation

Module IV - Diagnostic Radiology and Nuclear Medicine

Radiological Physiology and Anatomy
Physics of the Diagnostic Image
Radionuclides in Medicine and Biology
Image Physics in Nuclear Medicine
Magnetic Resonance Imaging
Control and Administrative Technical Functions of the Hospital Physicist
Advanced Topics in Imaging
Review and Evaluation

Each module will consist of 9-10 weeks training (360-400 teaching hours, including laboratory and clinical practice). All students who complete the programme will be qualified for the following tasks:

Calibrating radiotherapy units, including those using ^{60}Co sources, X-ray units, linear accelerators and brachytherapy facilities;

Planning and performing clinical treatment using computers or manual methods;

Carrying out acceptance testing and commissioning of radiation therapy, diagnostic radiology and nuclear medicine units;

Designing shielding for radiotherapy, diagnostic radiology and nuclear medicine facilities;

Advising clinical and administrative staff on new equipment selection and specification;

Designing and executing quality control programmes for radiotherapy, diagnostic radiology and nuclear medicine procedures;

Managing and designing procedures for brachytherapy in conformity with appropriate standards;

Designing and implementing training courses in clinical and personnel dosimetry and radiation safety;

Optimizing dose calculations to improve dose distribution, and introducing devices for modifying the external beam;

Providing primary maintenance of diagnostic and therapy equipment.

IMPACT

It is estimated that, on average, each therapy unit in Mexico provides treatment to approximately 1200 patients per year, so that more than 100,000 patients receive radiotherapy per year. During the first phase of this project, 50 individuals will have completed formal, high level training in medical physics and will be immediately and directly involved in patient treatment as required by the new national regulations. The project will thus have the immediate effect of ensuring the clinical effectiveness and the safety of the radiotherapy received by about 100,000 people, as well as the safety of the clinical staff at each treatment centre. These benefits will continue to multiply as the careers of the trained specialists advance and more and more physicists are trained.

FINANCES

The budget allocation for the project is US $438,200, distributed as follows:

Year	Experts		Equipment	Fellowships		Scientific Visits		Grp. Trg.	Sub-Contr.	Misc. Comp.	Total
	M/D	US $	US $	M/D	US $	M/D	US $	US $	US $	US $	US $
1995	3/0	37,800	110,000	-	-	4/0	50,400	-	-	-	198,200
1996	3/0	39,600	174,000	-	-	2/0	26,400	-	-	-	240,000
Total	6/0	77,400	284,000	-	-	6/0	76,800	-	-	-	438,200

Source of funding: Footnote a/