Chapter 37

ROLE OF INTERNATIONAL ORGANIZATIONS IN PROMOTING NUCLEAR MEDICINE IN THE DEVELOPING COUNTRIES

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Introduction

When the IAEA was established in 1957 as an autonomous member of the United Nations family, one of its prominent assignments was to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

The inclusion of health reflects an important fact - that medical uses of radiation and radionuclides were among the first and most widespread applications of "atomic energy". Indeed in one developed country, it has been estimated that these applications now contribute, in some measure, to the diagnosis or treatment of one out of every three hospitalized patients. Of even greater significance, is their role in research, helping to clarify the very nature of health and disease.

Today, because of the diversity of its applications - radiation and radionuclides for medical and biological purposes are used in more countries and in more laboratories than any other application of atomic energy. International organizations, mainly the IAEA and the WHO, have played a significant role in the spread of this nuclear technology in developing countries.

There are altogether 112 member states of the Agency, about 71 of them can be classified as developing countries. Out of them, nearly 56 have some kind of nuclear medicine. By that I mean there is some medical use of radioisotopes, be it imaging, radioimmunoassay or the old thyroid uptake! In most of these countries, the personnel working in nuclear medicine has been trained abroad. Training can be as short as few weeks abroad in the form of attendance at one of the four or six week training courses offered by an international organization. Occasionally it is through a fellowship offered by the same organizations. In terms of technology and training, Nuclear Medicine, in its present form, can thus be considered a high technology imported medicine in many of these countries.

The first question that arises is whether nuclear medicine is necessary in all these countries particularly when it is usually at a minuscule level with hardly any impact on the medical practice of that hospital. Is nuclear medicine a luxury or a status symbol? RIA? Some of the radioimmunoassays are obviously useful but if you do very few assays with kits, the whole exercise is not cost effective. Space occupying lesions by imaging? If you do not have neurosurgery, what use is the finding of a space occupying lesion in the brain? Abdominal organs can be scanned effectively with an ultrasound. Nuclear cardiology needs gamma camera-computer complex which is beyond the means of many of the hospitals in the

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developing countries. As far as the radiopharmaceuticals are concerned, the situation is still dismal. Most radiopharmaceuticals are imported from developed countries. Technetium generator needs at least a fortnightly supply. Indium generator is out of fashion and even difficult to obtain.

The Agency conducts many programs to strengthen the indigenous capabilities of developing countries in using radionuclides in the medical field. These programs account for some 10% of the Agency's promotional efforts. Where large amounts of funds are required for establishment of nuclear medicine facilities in a country, it is usually through the Technical Cooperation Program. To do this function effectively in a cost effective way with minimum of failure rate, lots of safeguards are necessary. The first question which faces an Agency is whether a particular hospital or a country qualifies for a large scale assistance for instituting nuclear medicine.

People who say how great is nuclear medicine, how pressing is the need for setting up nuclear medicine in various hospitals, how a tiniest hospital will benefit by its wonders and so on and so forth, are usually nuclear medicine specialists. Nuclear medicine in a developing country sometimes start in a hospital as a status symbol. There is an impossible triangle of: patients, radiopharmaceuticals and the instruments. If you have the radiopharmaceuticals, the instruments do not work; if the instruments are in order, the right kind of radiopharmaceuticals are not available; when both of them are there, the patient is not there. It is usually said for the modern instruments that when they are out of order they require minimum time for repairs because it only involves replacement of a board or an integrated circuit. This is not as easy as it sounds. In a developing country, it may be easy to obtain an instrument costing thousands of dollars through a technical assistance program of an international organization but sometimes extremely difficult to obtain a small sum for spare parts through local foreign exchange resources.

We must recognize that nuclear medicine, being a high technology medicine, demands certain infrastructure for its successful institution in a developing country. It should be in a hospital where specialties like radiology, and clinical pathology are well established, where at least some of the clinical specialties are flourishing. These specialties should have other ancillary investigational facilities, where it is possible to get well defined clinical material referred to the nuclear medicine unit so that you are trying to answer specific rational questions and not trying to get unconfirmable results which do not lead any where as far as the management of the patient is concerned.

To justify nuclear medicine in a developing country we have to see it in a new role. It is not for putting the diagnostic labels, not for differential diagnosis as we have been conditioned to think so far. In a developing country, it should be for differential management. How does it alter the management decision in respect to a particular patient? If management outcomes are restricted, there is no need for an investigation which does not help the management of the patient. If there is no bypass surgery, what use is the thallium perfusion? Although primarily a diagnostic discipline, for its justification and survival in a developing country it should contribute to a sensible differential management.

There are always few apical hospitals in every country. Not many, but one or two are certainly there. Before instituting nuclear medicine, one needs certain basic conditions to be fulfilled. The hospital should have a good stable uninterrupted power supply and reliable air conditioning. This is a condition difficult to satisfy in many of the developing countries. If the culture of preventive maintenance is not there in a hospital, it would be difficult for nuclear medicine to survive. The hospital also should be in a city on the main trunk route of an international airline. Without this, import of radiopharmaceuticals would be impossible. Apart from these, it should have necessary provision for foreign exchange for import of these radiopharmaceuticals and spare parts for the instruments.

It is possible to get technical assistance from the IAEA if you satisfy these conditions. The request for the assistance comes from national atomic energy authority or some such administrative agencies. The Agency's primary function is not the transfer of the equipment but the transfer of technology.

The most crucial part is who is the counterpart at the other end? Who is going to set up nuclear medicine in the recipient country? We need a person who is well versed in one of the branches of medicine, who is a seeker, is keen on diagnostic aspects of medicine and does not want to parade as a healer, is capable of learning a new discipline and can work in harmony with scientists from multiple specialties. Such individuals may not always easily be found: moreover, they cannot be selected on the basis of seniority. The counterpart can be trained, but training abroad can either lead to frustration that back home he has not much, or may need superhuman patience and courage to set up what he learnt abroad.

Research Promotion

One way by which the IAEA assists its member states is by promotion of research. However, research comes after one has instituted nuclear medicine.

A co-ordinated research program is developed around a specific scientific topic and institutes from different countries are invited to work together on an integrated research to achieve the aims of this program. Research contracts or research agreements are awarded on the basis of project proposals submitted by these institutes. The basic role of the IAEA is to define the program of work, secure its financial backing and ensure that the various efforts forming that program are properly co-ordinated. To this end and to ensure proper integration, research meetings are usually held at intervals of 15-18 months. One representative from each participating institute is invited to the meeting. Research contracts or agreements are awarded to research institutes for a period of one year renewable up to a total period of 3-5 years.

Research contracts provide modest financial support for a project on a cost-sharing basis which is usually used for a purchase of small items of equipment and supplies. Priority is normally given to contract proposals from institutes in developing countries. On the other hand, research agreements do not provide financial support and are usually awarded to

institutes in developed countries with expertise in the area of interest. In return, the agreement holder participates in exchange of information and is invited to attend the research co-ordination meetings.

Research contracts are sometimes awarded on other topics than those of co-ordinated projects depending on the availability of funding. However, preference is normally given to proposals that fall within the scope of a co-ordinated research program.

Many clinical nuclear medicine protocols currently accepted in various countries may not be suitable for the developing countries. There is a necessity to simplify the procedures and work with relatively less sophisticated instruments and with easily obtainable radiopharmaceuticals. This process of adaptation of techniques to suit the needs of the laboratories in developing countries is what the Agency programs encourage. The approach recognizes the fact that advanced methods cannot be adopted de novo but need to be adapted to existing realities in developing countries. With this kind of adaptive process in mind, the Agency has set up Co-ordinated Research Programs on subjects specific for the problems prevalent in most of these countries. In addition, simplification of technology would lead to a wider spread of these techniques in more hospitals. Over 100 laboratories are receiving support in the area of health-care at any one time.

The Agency's research program has to be tuned to nuclear medicine's current trends in the world and to the perception of what future role it will be playing in the overall management of patients.

Equipment

Putting instruments in a developing country is a risky business. You work to keep the instrument busy. You work to keep the instrument healthy. Provision of instruments to a developing country is thus a big decision financially. It is easy to initiate a radioimmunoassay facility; financial outlay required is small and manageable. For imaging, scanner is no longer easily available in the world market from an international firm. Gamma camera is too expensive. Without a computer the gamma camera also does not make sense. Both together adds to nearly US $ 300 000 investment with an attendant anxiety whether it would work or not. Even if it is satisfactorily installed, how long will the bliss last?

Finally we work out a compromise between the funds and the demand. However, the funds are always less than the demand and many who deserve and qualify cannot be provided for.

Training courses

For more than a decade, the Agency has organized periodic interregional and regional training courses and study tours in nuclear medicine for participants from developing

countries. They are usually of short duration and can be attended by 20-30 participants depending on the facilities of the host institution. Regional training courses can specially be geared to conditions prevailing in the countries of the regions. At present the practice is to select junior medical doctors for these courses, and provide a basic introductory overview of current clinical nuclear medicine techniques. Participants are provided with theoretical and practical training in the common diagnostic and therapeutic applications of radionuclides, safe handling of radionuclides, general principles of radiopharmacy, analysis, interpretation and quality control of "in vitro" and "in vivo" nuclear medicine procedures, organizational aspects of nuclear medicine service in a hospital, and a general background education in physics related to radiation and radioactivity. In addition, the Agency frequently organizes various short-term training courses and workshops throughout in different parts of the world on special topics in nuclear medicine - for example, quality control of imaging instruments, radioimmunoassays, and maintenance of nuclear medicine equipment.

Training fellowships

The ultimate aim of setting up nuclear medicine facilities in any country is to have a fully trained local person to take up the clinical and technical responsibilities of the nuclear medicine unit. For this purpose, a local person with the requisite academic credentials is sent abroad for comprehensive training to a suitable institution for periods ranging from a few months to a few years. Training a cadre of trained persons is a risky road. They might serve as an initial engine to pull the nuclear medicine train or lead to a group of frustrated people.

The Agency, thus supports the transfer of know-how through granting these training fellowships. However, training in advanced countries - in general - is relatively expensive for developing countries and the level of training programs may not always be entirely suitable for trainees from the developing world who may, in addition, have communication problems and other difficulties which make it hard for them to adapt to the local institution in a developed country. If they do adapt, there is always the danger of failing to return home after training. On the other hand, training in a developed country may provide trainees with the possibility of having valuable contacts in the country concerned.

In this respect, one way to partially overcome some of the problems encountered in training abroad would be, if possible, to establish centres of excellence for training in different regions.

Expert Assistance

One of the most vital aspects of training is on-the-spot instruction in a developing country by a recognized expert. The expert may cover some or all aspects of nuclear medicine. A mission may be of a few months duration or may extend to a whole year. When complex

equipment is supplied to a country, the project usually includes the visit of an expert to train local staff in the operational and technical aspects of the instrument.

The expert provides a new kind of work culture to the whole of the laboratory. The entire staff is exposed to him. Selection of the expert is a rather delicate matter. His guidance is tentative because many a times he comes from a far away glorious country and is not quite aware of the working conditions in a developing country. The developing countries also are at fault. They would not usually accept an expert from another developing country but would always aim at very famous names.

Maintenance of equipment.

Gone are the days of single scintillation probe, a small manual well counter, a rectilinear scanner and a small pocket slide rule to do some of the simple calculations. The present day nuclear medicine is all big machines: gamma camera - that too rotating if you can afford it, dedicated computer, automatic gamma counter for multiple samples hooked to a data processing system and a host of radiopharmaceuticals. Anyone who plans to set up nuclear medicine in a comprehensive way in a hospital will have to plan on an investment of at least half a million dollars in capital funds and $ 50 000 - $ 100 000 annually in running expenses. Thank God that in spite of all these high sounding numbers, amongst most of the imaging disciplines nuclear medicine is still considered as relatively inexpensive and cost-effective.

Doctors and patients both are tuned to this high cost, high technology medicine. The problem arises when these machines do not work, cannot be repaired and then the total investment in them is considered as dead loss. We all know in international organizations that sometimes more than 50% of the equipment in a hospital of the developing countries are defunct, out of order or producing results which are less than optimum. This situation is intolerable and should not exist.

For want of a proper site preparation prior to the installation of equipment, many of the costly equipment have withered away in the customs shed or in the hospital warehouse. Dust and humidity have worked as deadly enemies of the instruments which have no immunity against their attack. In developing countries, it may be possible to get capital funds in a large bounty but rather difficult to get a spare part which may not be costing more than few dollars.

Not one but many international organizations are interested in solving this problem of equipment maintenance and repair. All of them consider this problem as a top priority. If you have a plan to resolve this problem, money is there a plenty to implement the plan. What we are short of is ideas, workable pragmatic proposals and innovative thinking. I feel that the greatest task facing us is to generate ideas and to promote creative thinking.

It is not that we do not realize what are the problems. What eludes us is the way to solve them. For years we have been promoting a programme of preventive maintenance.

As medical doctors, we realize that an ounce of preventive maintenance is better than kilograms of cure. Prevention starts right from the purchase of the equipment. How to decide which is the simplest and the most easily maintainable?

The necessity of proper environment for the working of the instrument is well recognized. Comfortable temperature, low humidity, dust-free rooms, stable power supply - everyone knows that these are essential, but for some reason or other, these simple precepts of maintenance are the most neglected elements in the developing countries.

Hospital based equipment should have minimum of downtime. For this, it is necessary that we have a stock of spare parts or we have a reserve fund in foreign exchange from where necessary spares can be ordered almost by a telegram. We all recognize the need for spare parts but most of the time it is the most difficult single component of maintenance. There are customs regulations, import licenses, permissions and sanctions, but why this maze of rules and regulations to strangulate the working of an equipment?

It is customary to lament the lack of trained personnel for maintenance. At the same time, it is also recognized that the modern electronic equipment is a proprietary item and can be serviced best by the manufacturing company itself. Many of these companies are notorious, in developing countries, to promise the sky at the time of the purchase but show total disdain for all maintenance needs after the warranty period or even before that.

Regular quality control of instruments is well emphasized by all nuclear medicine specialists. I do not want to belittle the importance of quality control, but quality control without the means of correcting the performance of the equipment, is meaningless. All quality control programs should be backed by good maintenance programs. We need to have the proper skills to handle the medical, radiopharmaceutical, computer as well as the other complex engineering aspects of equipment. This can only be accomplished by proper training and the choice of dedicated persons. The IAEA is deeply involved in solving the problems of maintenance and quality control of nuclear medicine equipment.

Dissemination of information.

This is another prominent mechanism of the IAEA to assist its Member States. This is usually accomplished through meetings of various formats, designed for exchange of ideas between scientists from various countries. Each year, the IAEA organizes a number of symposia and seminars at which specialists from both developed and developing countries review their progress and present their latest findings on a specific subject. Almost all of such meetings are organized in cooperation with our sister organization, the WHO.

In 1985, the IAEA had organized an international symposium on "Nuclear medicine in developing countries". Another symposium on "Dynamic functional studies in nuclear medicine" and a seminar on "Training in nuclear medicine in developing countries" were held

in 1988. In 1990, a seminar was held on the "Application of nuclear techniques in the early diagnosis of cancer in developing countries". In 1991, the IAEA is organizing an international symposium on "Radioimmunoassay and related procedures: perspective in developing countries" at its headquarters in Vienna.

In addition, the Agency convenes smaller meetings to examine particular topics in-depth to plan future programs or to review results achieved in research activities. Information of these different meetings, including proceedings of symposia are being published and distributed. Last year, the Agency published as a technical document an "Atlas of Liver Imaging" which was most helpful to practitioners in developing countries serving a rather vital educational need of these countries. Publication of this Handbook is also an effort on the part of the Agency in the same direction.

Trends and new directions.

Three decades ago, nuclear medicine started as a tracer investigation for the function and flow. The advent of scanners and the development of new radiopharmaceuticals localizing in various organs directed the attention of nuclear medicine physicians to imaging of various organs. For years, apart from radiology, nuclear medicine was the only technique available for such imaging. Now that no longer holds true. Various competing imaging modalities are available, such as ultrasound, computerized tomography, and magnetic resonance imaging. Each one has its own virtues and limitations. A hospital administrator is faced with alternatives. What kind of imaging services should be established in his hospital? A physician also is faced with a similar dilemma as to what is the most appropriate investigation for which he should refer the patient.

There is a gradual awakening of an awareness that the primary role of nuclear medicine is not to seek anatomical defects or search for structural abnormalities. Its main forte is the study of function with respect to time or, in other words, to study a radiopharmaceutical's changing distribution in the body during a certain time period. This kind of study yields important information about the function of various organs. Nuclear medicine's future is intimately tied up with development in the field of radiopharmaceuticals. In all other imaging modalities, one needs only the instrument and the patient. In nuclear medicine, one also needs a suitable radiopharmaceutical. It is possible to develop a wide variety of new radiopharmaceuticals each tracing one or another function of the body. This helps to enhance the versatility of nuclear medicine. This realization has led to special attention to the study of cardiovascular, renal and cerebral functions, where in the last few years nuclear medicine has brought about a dramatic surge of new data. So far, such data has been obtained with the use to special instruments such as PET and cyclotron-produced radiopharmaceuticals. Now it appears that new cerebral and myocardial radiopharmaceuticals labelled with $^{99}Tc^{m}$ have started becoming available in the developing countries, and that it would be possible to do "in vivo" functional brain and heart studies with conventional gamma cameras.

Another new direction - also related to radiopharmaceuticals - is the development of specific monoclonal antibodies labelled with an appropriate radionuclide and targeted towards an antigenic site either for imaging or for therapeutic purposes. In addition, tumour markers for diagnosis and management of cancer patients and the detection of antigens and antibodies in infectious diseases are two of the most potentially fertile areas in this respect. The new inexpensive personal computer based analysis, display and storage systems make it possible to carry out practically any kind of program desired. The Agency is aware of all these new applications and is seriously promoting their uses in its developing member states.

These new trends in nuclear medicine also generate an impression that the frontiers of nuclear medicine are advancing. Nuclear medicine's glory will be on the functional studies based on positrons and cyclotrons or on new yet expensive radiopharmaceuticals. The gulf between what the developing countries can do and what we can provide them and what is current in the world is widening. The IAEA has to support the on-going process of evolution and facilitate the wheels of progress.

Nuclear medicine is an integral part of health care structure of all countries especially industrialized ones. However, the third world as a whole is slowly working up to the realization that science and technology are what distinguishes the third from the first. The field of nuclear medicine, like other technologically advanced medical specialties has undergone considerable changes. These changes have come about as a result of the technological developments in instrumentation including computers, and the availability of new radiopharmaceuticals. It is therefore expected that the role of nuclear techniques in medicine will continue to make important contributions towards the identification, treatment and management of diseases in the years to come. Just as yesterday's research is today's practice; today's research is tomorrow's practice.

In the field of nuclear medicine, the interests of international organizations such as the IAEA and the WHO overlap. Many Agency activities in nuclear medicine are done in cooperation with the WHO and many future activities of these two bodies will have to be in close collaboration when they relate to nuclear medicine.

As I stated at the beginning of this presentation, one objective of the IAEA is "in accelerating and enlarging the contribution of atomic energy to peace, health and prosperity"; promotion of nuclear medicine is one step forward in this direction.

What I have tried to describe to you is the ways and means by which the IAEA helps the developing countries in the promotion of nuclear medicine. I have spent more time on describing where the Agency's assistance get bogged down with innumerable uncertainties and anxieties. It is still a small wonder that we succeed somewhere, sometime. My basic philosophy has always remained that it is always better to light even one candle than to curse the darkness.