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Nuclear medicine in Latin America

A review of its development, impact, and potential

by Dr Eduardo Touya

Nuclear medicine in Latin America has reached a remarkable level of development — 42 years after the first medical applications of radioisotopes were carried out in the region. What is the present situation and what are the future prospects in terms of nuclear medicine's role and practical impact on the promotion, preservation, and restoration of health in Latin America?

Nuclear medicine and health care

Medicine in developing regions has characteristic features depending essentially on organizational structures that are not always capable of coping with the health needs of the majority of the population. Economic constraints on health budgets mean that there is often a simplistic confrontation between the concepts of primary medical care and more "sophisticated" medicine entailing highly developed technology and consequently involving great expense in terms of unit cost.

Everyone has a right to health and society has a duty to provide health care to all its members on an equal basis. In actual fact, opportunities for enjoying health in developing regions differ within the population and as a general rule depend on each person's social and economic background. A health programme nowadays should aim at stepping up those activities that help to promote the health of all members of the community on an equal basis and in the shortest possible time.

In Latin America, there is a diversity of health policies and a wide spectrum of needs that have not been satisfied. The programmes are inadequately planned and implemented and do not ensure equal opportunities of health for the whole population. Typical of the economic situation in Latin American countries is a serious accumulation of difficulties that include familiar problems of foreign trade protection and cancellation of foreign debt, which is becoming impossibly heavy in terms of interest payments alone.

A major effort is being made to restimulate economies in the region. Although this should include more attention to health programmes, it probably also means postponing better allocation of resources in many areas in accordance with prevailing political and economic considerations.

Levels of health care

Health care is classified in three levels (primary, secondary, and tertiary) to ensure that everyone receives attention and that account is taken of all existing diseases or risks. The health administrator, faced with insurmountable economic constraints, is obliged to allocate available resources to projects of greatest benefit to the health of the largest number of people.

By virtue of the fact that the primary level of care involves basic but simple activities of low unit cost, it must spread like a sheet over the entire population of a given country or a region. It then becomes clear just how vital and urgent it is to have enough resources to be able to extend primary care in a horizontal direction.

The value of secondary and tertiary care should not be underestimated. This care is concerned with restoring the health of a large proportion of the population not in relation to social and economic conditions, but rather in terms of the growing complexity of biological changes caused by various types of disturbances that modify normal bodily functions.

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Increasing primary care means a reduction in the demand for secondary and tertiary care, since by remedying malfunctions at an early stage one can avoid the appearance or development of more complex diseases.

Against the hasty conclusion that developing countries are not in a position to hope for proper levels of tertiary care, one can argue that this level is just as essential as primary care. But an additional factor has to be borne in mind: It is vital that all such activities be strictly and comprehensively balanced in terms of cost and benefit.

Nuclear medicine's role

Nuclear medicine certainly forms part of that set of specialized medical fields that are quickly assessed in terms of their cost versus the manpower employed and the equipment and materials required. The first requirement of any nuclear medicine examination or treatment is that it should be really effective and efficient in attaining its final objective, which is to ensure health.

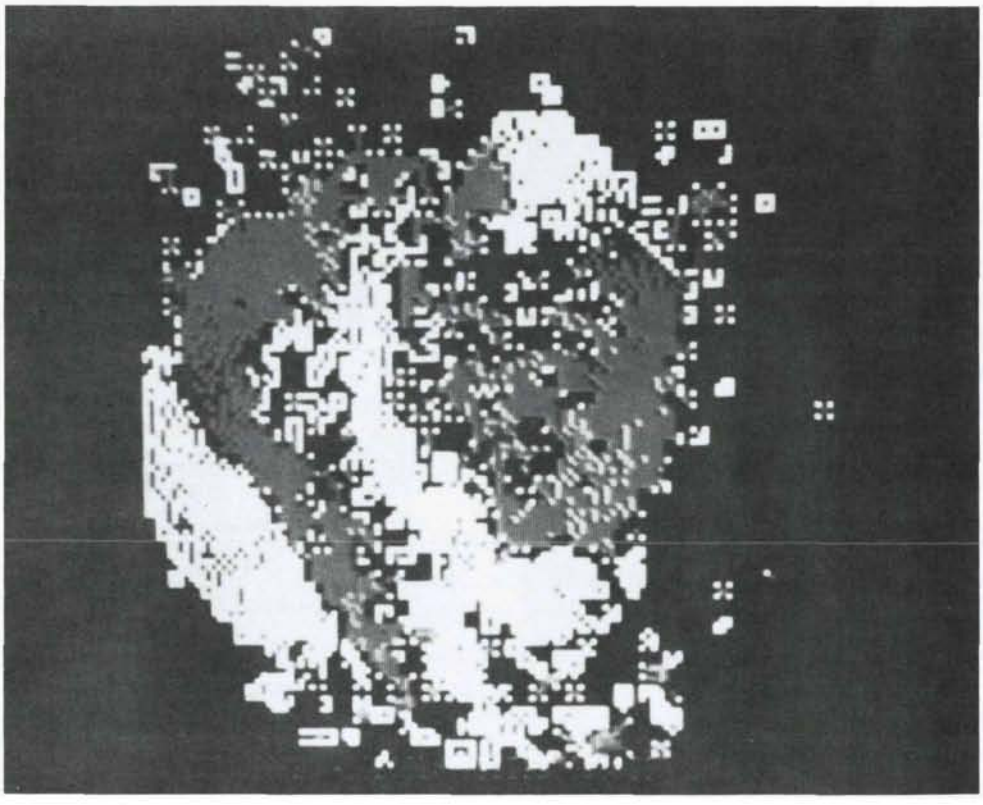
It is true that a large number of nuclear medicine techniques have demonstrated beyond any doubt, from a scientific point of view, that they are very useful for identifying origins or changes during various stages of disease and that they are a valuable basis for therapy to ensure a quicker and fuller recovery. It is also true that previous levels of effectiveness and efficiency should be borne in mind if nuclear medicine evaluation procedures for a given clinical situation are the only means available at low cost in terms of risk-benefit for the patient treated.

How can the continuation of nuclear medicine in developing countries and its further development be justified today against the background of the above ideas?

As far as the classification of the health programme into three levels of care is concerned, nuclear medicine should be visualized in the form of a wedge introduced from the tertiary level into the primary level. This means that two criteria have to be taken into consideration: one is centralization and the other is response to a "critical mass" of requirements. Both these criteria seek to preserve the necessary balance between investment and management. All types of unnecessary duplication of services leading to inadequate operational levels as a result of under-utilization of investment in facilities, equipment, or radioactive material should be avoided.

Impact of nuclear medicine

The impact of nuclear medicine studies on the primary level of medical care is undoubtedly much weaker in comparison to the tertiary level if we consider only the diversity of studies. It is a different matter if we consider the number of patients; here the evaluation has to be changed insofar as nuclear medicine is by nature simple to introduce at the primary level and responds to a highly prevalent pathological condition among the population.



Among other medical applications, radioisotopes are being used in Latin America for diagnosing coronary disease. Shown is an image using a scintillation camera system. (Credit: E. Touya).

One example of this is the determination of thyroid hormone levels; this study can be begun by means of blood samples that can be taken using any basic health equipment. They can then be sent to processing laboratories operating to some extent at the regional level. This type of arrangement can be fully applied in a zone where thyroid disorders are extremely frequent.

Another example is the scheme for a national or regional project aimed at detecting neonatal hypothyroidism at an early stage and thereby avoiding resultant cretinism. This is basically an ethical obligation, but the cost-benefit ratio is also favourable if one compares the cost of maintenance and care of a thyroid cretin with the cost of hormonal assay in all newborn babies.

Nuclear medicine at the level of secondary care should maintain a balance between the pathology of greatest prevalence in the region where the hospital is situated and the resources of manpower and equipment needed for genuinely useful procedures.

In a small country such as Uruguay, the tertiary level exists in practice at very few hospitals; this means that a complete nuclear medicine service, at this level, can play the role of "centralized parent service" at the top of an organization shaped like a pyramid in terms of the complexity of its functions. The tasks of this service will be, first and foremost, teaching, medical care, research and development, and standardization of new diagnostic or therapeutic procedures.

In larger Latin American countries with more territory and bigger populations, units organized at the three levels should be established for effective coverage of requirements. There should be co-ordination between these units and a common programme that subsidizes their major requirements in manpower, equipment availability, and radioactive material.

Any real effort made by countries to decide on effective health policies, programmes, and projects designed for the whole population on an equal basis will lead to the indispensable reorganization of the nuclear medicine field in the region. It will become involved more directly in the process of economic and social development. Its present predominance in private medical care schemes that are limited to a particular sector of the population, defined by its social and economic level and able to afford complete medical attention, will be reduced.

Contributions of nuclear medicine

It is not possible to list in detail all the contributions made by nuclear medicine in the region during the last 40 years, but three major points should be singled out:

● ***The multidisciplinary nature of nuclear energy applications.*** This led to the establishment of work teams composed of people with various kinds of training. Nuclear medicine brought together doctors, chemists, and engineers during the initial years, to which nurses and technicians were added gradually in recognition of the need to improve the organization of the work. Furthermore, the need to incorporate hospital physicists and personnel trained in computer studies was recognized as a result of the growing complexity of nuclear equipment.

The emergence of interfaces permitting integration and communication between professionals is a very positive element. This resulted inevitably from the exigencies of the work and overcame barriers that traditionally still separated departments in the majority of Latin American universities. Despite this development, the process of including the hospital physicist, above all, should be speeded up significantly. This post does not exist in the majority of nuclear medicine services, although such professionals are essential for advising on the purchase of equipment, for carrying out quality control of the instruments, and for ensuring more efficient management of many procedures based on complex mathematical models. These areas are not covered in the more biologically oriented training of doctors.

● ***Radioisotopes.*** They have made it possible to gain reliable knowledge of blood disorders and diseases of the thyroid gland that are highly prevalent in the region, to improve the management of patients during the diagnostic and treatment stages, and to devise preventive measures to cut down the incidence of these diseases and promote health. With regard to diagnostic stages having a pronounced effect on treatment, one should mention the contribution of scintigraphy in cases of hydatidosis and amoebic abscess, as well as Chagas' disease to which a population of 65 000 000 is exposed. It is reckoned that some 28 000 000 people could be infected by *Tripanosoma cruzi*, which is the agent causing this disease.

● ***Diagnostic studies.*** Given the contrasts existing in Latin America, the diseases that are most prevalent in developed countries are also fairly common in Latin America. Mention should therefore be made of nuclear medicine in the study of coronary disease, cancer, and injuries to organs and transplants, particularly kidney transplants.

● ***Radioimmunoassay.*** Apart from studies of the thyroid, radioimmunoassay has made it possible to manage, in a more scientific manner, patients with diseases affecting other internal secretion glands, such as the pituitary, parathyroid, pancreas, suprarenals, and gonads, both in cases of dysfunction and localized neoplasms.

Present needs

In view of the region's current situation, the main requirement, to be given absolute and mandatory priority, is to optimize all utilizable means, starting with economic and financial resources and ending with installed capacities in terms of their operational levels.

Using radioisotopes and related equipment to diagnose thyroid disorders has helped contribute to health care in developing countries, such as Uruguay and, as shown here, Kenya. (Credit: CGEA, CREN-Kenya)

It is essential to improve outputs by insisting on improved quality through more efficient and responsible handling of financial outlays in relation to aims. In this respect, all the efforts to train people are significant, particularly programmes aiming to keep up and improve the knowledge of experts already trained and playing a chief role in nuclear medicine.

Quality assurance of diagnostic and therapeutic procedures will become a reality to the extent that it brings together educational programmes and makes it possible to additionally influence the attitudes and personality characteristics of different professionals and experts of the multi-disciplinary nuclear medicine team. It is equally necessary to increase levels of responsibility. This is so that concern to improve efficiency in the management of the health services becomes natural — keeping in mind measures suited to the procedures, and their value in relation to the environment in which they are used. Two phrases appear to give a stamp of validity to these ideas: "Science in poverty, yes, but poor science, no", and "research and technology appropriate to each individual region".*

It is a duty for Latin America's scientific community to carry out research and to recognize that doing so is the best way to speed up regional economic and social development. The same is applicable to the group of experts working in nuclear medicine. But it is also quite clear that there must be accompanying political decisions at national and regional levels to make these activities possible. Support must be given to the universities as well as to public and private institutions endeavouring to cope with these tasks. Co-ordinated action by national atomic energy commissions, universities, scientific institutions, and scientific societies at national and regional levels would create a better framework for making use of available resources. In this respect the Latin American Association of Societies of Nuclear Biology and Medicine (ALASBIMN) could continue to play a similar role.

International organizations, among them the IAEA and the Pan American Health Organization of the World Health Organization (PAHO/WHO), together with governments and institutions in developed countries providing technical co-operation for the region, should continue to give substantial support to national and regional programmes. However, they should seek to improve them by optimizing the use of economic and financial resources and adapting them to the region's priority needs. Improved collaboration between countries outside the region, and those within it, should make it possible to improve international input to Latin America by mobilizing new resources likely to promote and accelerate socio-economic development. Health is a fundamental part of this development and the right to live is unchallenged. Efforts made to eliminate differences between north and south are based on political, social, even economic factors. But in terms of health they are a categorical imperative. Life expectancy from the moment of conception should be identical for all human beings. The peaceful applications of nuclear energy in biology and medicine are ends in themselves and should never be allowed as a pretext for the use of nuclear energy for military purposes. Latin America needs development and peace, and nuclear medicine should play its small part by promoting the health of the whole of its population.

* The first quote is from a statement by the President of the Republic of Argentina, Dr Raúl Ricardo Alfonsín, at San Carlos de Bariloche, May 1985.

Atoms in Latin American health care: Historical perspectives

The first medical applications of radioisotopes in Latin America were carried out some 43 years ago by the University of Brazil's Institute of Biophysics in Rio de Janeiro, using phosphorus-32 to study patients with haematological disorders. A little over a decade later, a group at the Thyroid Institute of the University of Cuyo in Mendoza Province in Argentina began studying endemic goitre in the Andean region using iodine-131.*

The second stage of development was marked by training abroad of distinguished scientists. Those scientists, motivated by a belief in the potential of radioisotopes, went mainly to centres and laboratories in the United States, the United Kingdom, France, and Italy. On their return to Latin America, they joined the group of pioneers who were promoting greater use and popularity of this special field.

In 1956, training courses began in the region and during the ensuing decade were concentrated in the following six places: the Puerto Rican Nuclear Centre; the Argentine National Atomic Energy Commission; the University of Brazil's Institute of Biophysics; the Nuclear Medicine Centre at the Medical School attached to the University of São Paulo, Brazil; the Radioisotope Laboratory of the Department of Endocrinology at the Salvador Hospital of Santiago, Chile; and the Mexican National Nuclear Energy Commission.

In 1966, the first congress of the Latin American Association of Societies of Nuclear Biology and Medicine (ALASBIMN) took place in Lima, Peru. The association was founded in São Paulo, Brazil, on 21 September 1964 by Dr Tede Eston, who chaired the first congress. Papers presented reflected standards attained by various groups of specialists from Argentina, Bolivia, Brazil, Chile, Ecuador, Mexico, Puerto Rico, and Uruguay. They covered the introduction of diagnostic procedures, the beginnings of research into regional pathology, and descriptions of experiments conducted with large numbers of patients. A sound basis was thereby provided for their original conclusions or findings, similar to those which were at that time being discussed in other areas.

IAEA and national support

The IAEA played a clearcut role in this initial period by providing training for the first national groups under its technical assistance programmes, by subsidizing visits of experts to the region, by financing regional courses and fellowships abroad, and by providing equipment, radioisotopes, and consumable materials. Agency research contracts supplemented national efforts to apply radioisotopes in the study of problems typical of the region.

The national atomic energy commissions and other official bodies, especially those in the region's more developed countries, such as Argentina, Brazil, and Mexico, gave priority support to biological and medical applications at national levels. Interregional co-operation activities took the form of manpower training, particularly in the six centres which organized formal courses, and also through bilateral agreements designed to benefit services being set up in neighbouring countries less developed in nuclear medicine. Progammes included expertise, equipment, and radioisotopes which were supplied cost-free, thereby making it possible to put into effect international co-operation programmes established by the IAEA. Other United Nations organizations, such as the Pan American Health Organization of the World Health Organization (PAHO/WHO), as well as national atomic energy commissions, official bodies, and universities in the United States and Europe, also played a part in this.

The next decade

From 1966 to 1976, nuclear medicine's development in Latin America showed a marked upward trend. The improved standards of the groups meant that qualified persons were able to serve as experts under IAEA and PAHO/WHO programmes in other Latin American countries. Interest in receiving experts from the United States and Europe was maintained. However, it was recognized that there was advantage in using Latin American scientists who were best suited to programme requirements and who had had experience with problems common to the area. Service centres that were more developed in radiopharmacy and *in vivo* and *in vitro* applications, and which had more experience in Latin America, began to take fellows from other countries in the region who were financed by international organizations. Thus, they could receive a complete course of training in 1- or 2-year courses, or advanced training in specialized fields through shorter courses lasting one to six months. During these 10 years, ALASBIMN held congresses every two years.*

Concurrently, this period saw the organization of regional meetings and the establishment of the nuclear biology and medicine review committees on radiopharmacy, instrumentation and radioimmunoassay, and working groups on radiation protection and training. ALASBIMN played an important role in bringing together various nuclear medicine working groups in Latin America, as well as in facilitating communication and exchange of ideas and experience obtained during expert visits and interregional fellowships. This increased significantly the channels of communication between different, sometimes distant, services. It all proceeded in a friendly atmosphere and thereby helped to cement stronger and closer links between Latin American specialists.

In 1970, at the third ALASBIMN Congress in Mexico, the World Federation of Nuclear Medicine and Biology (WFNMB) was founded and held its first congress in

* Work at the Institute of Biophysics at Rio de Janeiro was under the direction of Dr C. Chagas; in Argentina, research encompassed Dr A. Pawlowski's studies, and the work done by Dr Héctor Perinetti's group in Mendoza in association with Dr John B. Stanbury of the Massachusetts General Hospital, Boston.

* They took place in 1968 in Mar del Plata, Argentina; in 1970 in Mexico City, Mexico; in 1972 in Santiago, Chile; in 1974 in La Paz, Bolivia; and in 1976 in Quito, Ecuador.

1974 in Tokyo and Kyoto, Japan. This meant that new links were now forged between Latin America and Asia and the Pacific; these were gradually strengthened in subsequent years.

The last years of this period were marked by political, social, and economic changes in the region, which led to increased emigration of Latin American scientists to the United States and Europe and a major turnabout in the policies of the national atomic energy commissions. The commissions, faced with the oil crisis, began to place more emphasis on energy programmes, to some extent neglecting their support for biomedical applications.

Recent advances and trends

During the years 1976-86, progress continued to be supported through international co-operation, mainly under programmes co-ordinated by IAEA in various areas, particularly nuclear equipment maintenance, standardization of *in vitro* studies, and quality assurance programmes. The WHO sponsored studies on the efficiency of techniques, on evaluation of cost-benefit and risk-benefit ratios, and on the design of flow diagrams or guides for the possible uses of radiation in diagnosis in the most frequent clinical situations. The impact of new radiation diagnostic techniques and the limitations imposed by the high cost involved made the policy necessary.

Period of expansion and constraints

Regional economic trends during the late 1970s and early 1980s brought about an expansion of nuclear medicine in the private sector. This was the result of the reduced role played by national authorities and the fact that financial institutions provided funds for specialists to purchase equipment, especially scintillation cameras with different computer data processing systems. A notable development was the introduction of cardiovascular studies, which became widely used in the majority of private centres and also in many public ones. The influence of national centres for production of radiopharmaceuticals declined due to imports of radioactive products, which came on the market during the period of temporary economic prosperity in the private services.

Although research groups continued, the main effort of the region's specialists was focused on the introduction and standardization of diagnostic and therapeutic health care procedures, particularly in the private sector.

In the early 1980s, the region's economic situation changed suddenly and foreign debt incurred by Latin American countries became an obstacle to continued equipment investment and severely reduced available resources for health care. Owing to the lack of available consumable materials, spare parts, and domestic radionuclides and radiopharmaceuticals, the service centres had difficulty in continuing to operate.

The public services, which had lost some of their influence during the period of false prosperity, continued to be short of funds and were unable to play the same leading role that they had during the early years of nuclear medicine's development. No PET system (positron emission tomography) has yet been installed in the region, and the SPECT system (single photon emission computerized tomography) is being introduced very slowly. So is the use of tracers known as MIBG, or those based on monoclonal antibodies. It is still not possible to use pharmaceuticals labelled with iodine-131 since no cyclotrons have reached the stage of normal production.

During 1976-86, ALABISMN held three congresses: in 1979 at Punta del Este, Uruguay; in 1981 at Rio de Janeiro, Brazil; and in 1984 at Montevideo, Uruguay. Contact between groups was maintained, and the similarity of problems was more clearly recognized, as was the possibility of finding common solutions. Some groups co-ordinated their clinical research work and these were the first attempts at multi-centre and multinational co-operation.

It was recognized that interregional co-operation activities had to be increased and that it was also necessary to promote further mobilization of international resources for the region. This was reflected in the establishment of the IAEA's ARCAL regional programme, as well as in the report of the regional experts' meeting that took place in Santiago, Chile, in April 1985 in preparation for the United Nations Conference for the Promotion of International Co-operation in the Peaceful Uses of Nuclear Energy (UNCPICPUNE).

Today, nuclear medicine in Latin America has a historical foundation laid by pioneers who are still influencing its future. The names of scientists, no longer with us, such as Jorge Varela of Argentina, Hugo Claure of Chile, Maximo Medeiros of Brazil, Berta del Rosario of Peru, and Roberto Pieroni of Brazil point to the way ahead. Second and third generations of young specialists are now called upon to make their contribution, to rethink ideas that serve as a framework and guide for the present management system. In so doing, plans for the next few years can be set with greater certainty to help ensure that by the year 2000 all inhabitants of the region will benefit from and enjoy the same right to health.