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EFFECTIVENESS OF NUCLEAR MEDICINE IN HONG KONG

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Nuclear medicine in Hong Kong began in 1957. Dr. Steven Sturdon at the Hong Kong Sanitorium, started the use of Radioiodine I-131 for thyroid uptake and therapy, and also the use of Phosphorous P-32. By 1959, the first Scintillation counter arrived at Queen Mary Hospital and unsealed radioisotope studies began in the government hospitals. Colloidal gold in the treatment of malignant ascites was also started the same year.

In 1961, the first Rectitinear Scanner began operation at Queen Mary Hospital. Radioimmuuossay work began by 1964 at Queen Elizabeth Hospital. In 1974, the first 19 PM tube Gamma Camera was installed at Queen Elizabeth Hospital. However, nuclear medicine did not have its full bloom as it deserves in those years because of the lack of doctors dedicated to this specialty. In 1980 the first 37 PM tube Gamma Camera was installed in Hong Kong by the Hong Kong Institute of Nuclear Medicine. And the full range of various nuclear medicine procedures began to be available in Hong Kong. The first Gamma Camera Computer in Hong Kong was installed by the end of 1982 at Queen Mary Hospital. The first government consultant in nuclear medicine was appointed in late 1983. He is now responsible for the supervision and development of nuclear medicine services in the government hospital in Hong Kong. Throughout the years, it is by the dedication and efforts of our physicists colleagues, who are responsible for the smooth running of the nuclear medicine units. And most of all, attribute must be given to Professor John H.C. HO, who has been trying throughout the years to develop nuclear medicine in Hong Kong.

Developmental Factors

Effectiveness of nuclear medicine in Hong Kong is governed by the following factors: –

1) The approval of policy to establish nuclear medicine services in all regional hospitals will provide the required space, funding and staffing. An independent or autonomous department of nuclear will quicken the development by introducing the specialisation of knowledge, devotion of effort, continuity of staff, efficient organisation and better budget sharing.

2) Research and Advances

   Advances and researches from collaeagues in the field all over the world ensures the introduction of clinically useful procedures continually.

3) Nuclear Medicine Specialist

Properly trained and qualified nuclear medicine specialist are few in Hong Kong. Qualification from abroad has to receive recognition by the government (in 1982) in order that they can use what they have learned to serve the community. A full time specialist will provide not only the technical know-how but the necessary dedication and enthusiasm to help the field grow.

4) Equipment

The number (or quantity) of equipments like Gamma Camera available not only limits the number of procedures, which can be performed but also the kind of procedures. The type of quality of the equipment will limit the kind of procedures which can be performed, e.g. thallium scintiscan requires a 37 photomultiplier tube camera and multi-gated cardiac studies requires a nuclear camera computer.

5) Staff Training

Nuclear Medicine Technologists or nucleographers should be trained properly instead of being a part-time radiographer. New procedures are constantly evolving in a progressive nuclear medicine department. Training programme is being planned locally in conjunction with the Hong Kong Polytechnic College. Alternate training pathways abroad in U.K., U.S.A., Canada and Australia is also usually available in 1 year course.

Resident doctor training faces the problem of attaining higher qualification. Since the Collegiate Joint Committee on Nuclear Medicine Training in U.K. has ruled in 1982 against the establishment of any examination leading to nuclear medicine specialisation, there are no clear pathway for a nuclear medicine resident to receive higher qualification after local training. A comparison of the various pathways is listed in Table 3. We are looking forth to develop our own certification.

Table I. Historical Milestones in Hong Kong

1957	Dr. Steven Sturdon (Hong Kong Sanitorium) I-131 for thyroid uptake and therapy P-32.
1959	1st Scintillation well counter and probe (Queen Mary Hospital)
1959	Colloidal Gold in treatment of malignant ascites.
1961	1st Rectilinear Scanner (Queen Mary Hospital)
1964	RIA Work (Queen Elizabeth Hospital)
1974	1st Liquid Scintillation Counter (Queen Elizabeth Hospital)
1974	1st Gamma Camera 19 PMT (Queen Elizabeth Hospital)
1980	1st Gamma Camera 37 PMT (H.K. Institute of Nuclear Medicine)
1982	1st Gamma Camera Computer (Queen Mary Hospital)
1983	1st Nuclear Medicine Consultant.

Table 2. Major Factors Affecting Nuclear Medicine Development (Institutional)

1. Medical Administration

Policy	Organisation
Space	Specialisation
Funding	Devotion
Staffing	Continuity of staff
	Efficient structure
	Budget

2. Research and Advance
3. Nuclear Medicine Specialist
   Paucity of qualification
   Recognition
   Full time
4. Equipments
   Quantity of equipment
   Quality of equipment
5. Training of Staff
   Physician and higher qualification
   Nucleographer
6. Education of Clinicians
   Undergraduate Curriculum
   Continuing Education
7. Education of Public
8. Radionuclides
9. Efficiency of Service
   Requisition Procedure
   Waiting Period
   Consultation

Factors Affecting Private Nuclear Medicine Development

1. Financial Factors : Equipment
   Cost of isotopes
   Scan fee
2. Education of Clinicians : Lectures
   Literatures
   Personal Communication
3. Efficiency of Service : Consultation
   Response Time
4. Education of Public
5. Radiation Legislation : Laboratory design
   Radioactive Waste Disposal

Table 3. Pathways for Nuclear Medicine Qualification

	Post-graduate Qualification	Minimum Training* Requirement			Examination	
		Clinical/ Radiology Training	Nuclear Medicine Training	Minimum total Post-graduate Training	Minimum Post-graduate Year before Exam.	Special Examination on Nuclear Medicine
1.	Diploma in Nuclear Medicine (D.A.B.N.M.) by the American Board of Nuclear Medicine.	2 years	2 years	4 years	4 years	Yes
2.	Fellowship of the Royal College of Physicians of Canada, F.R.C.P.(C) in Nuclear Medicine by the Royal College of Physicians in Canada.	2 years	2 years	4 years	4 years	Yes
3.	Fellowship of the Royal Australian College of Physicians in Nuclear Medicine (F.R.A.C.P.) by the Royal Australian College of Physicians.	4 years	2 years	7 years	3 years	No. (By Supervisor's Report)
4.	Diploma in Diagnostic Radiology with Special Competence in Nuclear Radiology by the American Board of Radiology.	1 year	3 years (Nuclear Medicine + Radiology)	4 years	4 years	Yes
5.	Special Competence Certificate in Radioisotopic Pathology by the American Board of Pathology	2 years	1 year	4 years	4 years	Yes
6.	Master of Science in Nuclear Medicine (M. Sc., London) at University of London, U.K.	0	1 year	2 years	2 years	Yes
7.	Master of Science in Nuclear Medicine (M. Sc., London) in addition to F.R.C.R.	3 years	1 year	4 years	4 years	Yes

* Training means training received in an accredited hospital with an accredited program by the qualification granting body, and does not mean training received in just any hospital with nuclear medicine service.

6) Education of Clinicians

Undergraduate curriculum must include the indications and utility of nuclear medicine procedures. Continuous post-graduate education for clinicians has to be delivered in the form of lectures and in conference rounds.

7) Public Education

Public should be properly educated on the safety of the procedure and allay their phobia on "nuclear" matters. Individual patients attending our department receives explanation on the nature of the examination.

8) Radionuclides

Short half life isotopes like I-123 are difficult to obtain. Cost of radioisotopes per patient dose is still quite high and can be a limiting factor in the growth of the field.

9) Efficiency of Service

Simplification in requisition procedures will increase utilisation. The longer the waiting period results in decreased effectiveness and utilisation. Availability of a nuclear medicine physician to advise clinical management problems increases utilisation. The shorter the response time in production of scan reports has also been shown in other laboratory studies to be a major factor influencing the utilisation of a service.

Laboratory Design

A well planned department, especially regarding the type of equipments affects the outcome of nuclear medicine development. Good discussion can be found with the articles of World Health Organisation Technical Report No. 59[1], and Henkin et al.[2] The experiences of designing nuclear medicine laboratory in the States and 5 different units in Hong Kong has provided further insights each time.

A list of the desirable rooms are listed in Table 4. This list can be tailored to space available. But the list is essential to avoid the error of finding certain rooms not being allowed for after construction is in progress.

Detailed discussion on various aspect of laboratory design is beyond the scope of this paper. But a few points which are commonly overlooked are reviewed below.

(A) General

Patient toilets are contaminated and should not be shared by ultrasound patients. Elbow operable water taps and foot operated soap dispenser should be used at the sinks. Oxygen and vacuum should be available in procedure rooms. Patient waiting area should be large enough to accomodate 2 – 3 stretchers. Intercom systems should not require hand operation to answer call in. Soft music loudspeaker system in the ceiling is desirable to allay anxiety of patients.

(B) Gamma Camera Room

Since Xenon – 133 will be used, the room ventilation should be designed in accordance with anticipated patient number. Using the States CFR recommendation (Title 10 Pent 20.106 (q)), we aim at to maintain the air radioactivity limits as follows: –

Restricted area = 1×10^{-5} uCi/ml per week
Unrestricted area = 3×10^{-7} uCi/ml per week

Table 5 lists out the room ventilation rate required to achieve this at various number of xenon studies per week.

Table 4. Nuclear Medicine Department Planning

Procedure Areas	Administration Area
1. Gamma Camera Rooms (2)	1. Reception & Offices
2. Computer Room	2. Secretarial Office
3. Tracer Uptake Room	3. Consultant's Offices
4. Hot Lab.	4. Physicist's Office
5. Radiopharmacy	5. Residents' Office
6. Radioactive Waste store	6. Chief Nucleographer's Office
7. RIA Lab.	7. Failing Room
8. Isotope Therapy Room	8. Common/Changing Room
9. Dark Room	9. Reporting/Conference Room
10. NMR Rooms	10. Library
Patient Area	
1. Patient Waiting Area	3. Utilities
2. Toilets	4. Decontamination Room

Table 5. Room Ventilation in Xenon Studies

No. of Xenon Study/Week	Dose (mCi/40 hrs.)	Ventilation Rate (litre/min.)
10	100	1041
8	80	833
4	40	416
2	20	208
1	10	104

Assume: 25% leakage

The ventilation system should therefore be separated from the hospital system. The Gamma Camera Room should have a negative pressure to prevent gas leakage entering the corridor. An emergency exhaust air vent should be installed for use during radioactive gas spillage on during xenon study.

With the moving detector type of whole body scanning, floor levelness (e.g. 0.5cm per 3 metre) and floor hardness are easily overlooked. Avoidance of direct ceiling light over scanning table will give better patient comfort. Dimmable light switch is desirable in Camera Room.

(C) Radiopharmacy

Fume cupboard exhaust fume hood is a must for storage of radioiodine and xenon. Laminar Flow cupboard requires also an exhaust vent.

Future

At present there are 5 Gamma Camera's in Hong Kong. The projected growth in the next 7 years is shown in Table 6. These are not official figures but is a reflection of the direction which we are moving ahead in the field of nuclear medicine in Hong Kong.

Table 6. Future Development of Nuclear Medicine in Hong Kong

	No. of Gamma Cameras						
	QMH	QEH	PWH	PMH	TMH	SKWH	EKH
1985	1	1	2	0			
1985	1	2	2	0			
1986	1	2	2	2			
1987	2	3	2	2			
1988	2	3	2	2	2		
1989	2	3	3	2	2	2	
1990	3	3	3	2	2	2	2

Key: QMH = Queen Mary Hospital
QEH = Queen Elizabeth Hospital
PWH = Prince of Wales Hospital
PMH = Princess Margaret Hospital
TMH = Tuen Mun Hospital
SKWH = Shau Kei Wan Hospital
EKH = East Kowloon Hospital

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