ORIGINAL ARTICLE

X-ray based Radiological Procedures in Malaysia - 1990-1994

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Summary

X-ray based radiological procedure statistics and trend in Malaysia for 1990 - 1994 is reported; this information allows comparisons to be made with the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) Report. Additionally it is essential information for health care planners and providers. Malaysia is categorised as a health care level II country based on the UNSCEAR definition. In 1994, the number of physicians, radiologists, x-ray units and x-ray examinations per 1000 population was 0.45, 0.005, 0.065 and 183 respectively. 3.6 million x-ray examinations were performed in 1994, with chest radiography being the commonest study (63%). Information on x-ray examinations, number of hospitals and x-ray units is reported for the Ministry of Health, private practice and teaching hospitals. Examination frequency increased in computed tomography (161%), cardiac procedures (190%), and mammography (240%); while a decrease in barium studies (-23%), cholecystography (-36%), and intravenous urography (-51%) was noted. There is a potential and need to expand and upgrade radiological services.

Key Words: X-ray examinations, Diagnostic radiology, Medical radiation, Diagnostic imaging, Statistics

Introduction

Of the medical uses of radiation, the examination of patients with x-rays for diagnostic purposes is by far the most frequent practice. Such examinations are performed in all kinds of health care establishments, including hospitals and clinics. Although the doses from diagnostic x-ray examinations are generally low, the magnitude of the practice makes for a significant radiological impact and this is outweighed by the direct benefits in health improvement. Nevertheless, there is a continuing need to analyse the frequencies, doses and trends of radiological procedures[1]. Such information permits comparison with medical radiation usage in other parts of the world, comparisons with other sources of radiation, identification of areas of concern, and estimation of associated detriment. It helps to assess how the introduction of new techniques, radiation protection regulations or quality programmes affect the trends.

Four levels of health care in the world have been defined based on the population per physician in the UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) 1988 report[2]. At the highest level of health care (Level I), there are one or more physicians for each 1000 population. In less developed countries with lower levels of health care, there is one physician each for 1000 to 3000 population (Level II), 3000 - 10,000 population (Level III) or >10,000 population (Level IV).

A national dose survey conducted in a total of 12 randomly selected public hospitals from 1993 to 95 had established baseline data of radiation doses received by

patients undergoing seven common types (12 projections) of x-ray examinations[3]. Survey results are generally comparable with those reported in the UK, USA and International Atomic Energy Agency (IAEA). This information will be useful in the formulation of national guidance levels and as part of the quality assurance programme. Another study reported on radiation exposure (annual dose per caput and collective effective dose) with reference to the optimum utilisation of radiation[4].

The objective of this study is to furnish information for medical radiation from radiological procedures in Malaysia. This information will reflect the trend for the period 1990 - 1994 and allows comparisons to be made with the rest of the world according to the latest UNSCEAR report that covered the period 1985 - 1990[5]. Additionally it also provides essential information for health care planners and providers.

Materials and Methods

Three categories of hospitals were included in this study: Ministry of Health hospitals, teaching university hospitals and private clinics and hospitals. Frequency (the number of x-ray examinations per year) of the various types of x-ray procedures were compiled and analysed from the records obtained from the Ministry of Health and teaching university hospitals. The number of x-ray units was collated from the Ministry of Health and equipment vendors. Data on the number of radiologists and physicians was obtained from the Malaysian Radiological Society and the Malaysian Medical Association respectively.

Due to the paucity of data from the private practice, the needed information was estimated from the hospital's patient workload supplemented by extrapolation from film utilisation rate and supply data from the vendors.

Results

Table I compares the number of physicians, radiologists, x-ray units and x-ray exams per 1000 population between Malaysia and the information for health care level I and II published by the UNSCEAR survey[1].

In 1994 there was 0.45 physician per 1000 population (or one physician for 2216 persons) and this placed Malaysia in health care level II. In the same year there was 0.005 radiologists per 1000 population (or one radiologist for 200,000 persons). A total of 3.58 millions x-ray examinations were performed, the average number was estimated as 183 per 1000 persons. The x-ray units per 1000 and the X-ray examinations per unit at that time was 0.05 and 2817.5 respectively.

The percentage increase (1990 - 1994) for population, number of physicians, radiologists, x-ray units, and x-ray examinations was 10%, 26%, 47%, 43%, and 24% respectively (Table II).

Rapid increase was noted in the number of specialised modalities (Table III). Just looking at the number of CT

Table I
Comparison of Malaysian data with health care Level I and II average data

Quantity	Malaysia (1990) Level II	Malaysia (1994) Level II	Level II#	Level I#
No of physicians per 1000 population	0.40	0.45	0.55	2.6
No of radiologists per 1000 population	0.004	0.005	0.041	0.072
X-ray units per 1000 population	0.05	0.065	0.086	0.35
X-ray exams per 1000 population	162	183	140	860

 # Based on UNSCEAR survey (1985-1990)

Table II
Percentage increase in population, physicians, radiologists, x-ray units and examinations

Numbers	1990	1994	Percentage increase
Population	17.76 million	19.57 million	10
Physicians	7012	8831	26
Radiologists	68	100	47
X-ray units	889	1270	43
X-ray exams	2.88 million	3.58 million	24
X-ray exams per units	3245	2817	-13

Table III
Percentage increase in the number of specialised modalities

Modality	1990	1994	Percentage Increase
Computed Tomography	19	38	100
Cardiac catherisation lab	5	8	60
Mammography	8	25	212.5

scanners there were 38 in 1994 (60.5% of which were in the private practice) while in 1990 there were only 19 i.e. an increase of 100%. As for mammography units there was an accelerated increase of 212.5%, from 8 units in 1990 to 25 units in 1994 (60% of which were in the private practice).

Fig. 1-3 compare the Malaysian data (1990) with Level I-IV countries as well as the world average value for x-ray units per 1000, x-ray examinations per 1000, and x-ray examinations per x-ray unit (1985 - 90). The distribution of the types of x-ray examinations for 1994 is shown as a pie chart in Fig 4. Chest radiography was the most frequently performed examination, it made up 63% of the total. (cf. 60% in Level I, 70% in all other countries, 1985 - 1990). This is followed by plain radiography of the skull and extremities, which accounted for 22.4% of studies. On the whole plain radiography accounted for 93.4% of radiological procedures with the other special studies e.g. CT, mammography, and others making up the remainder.

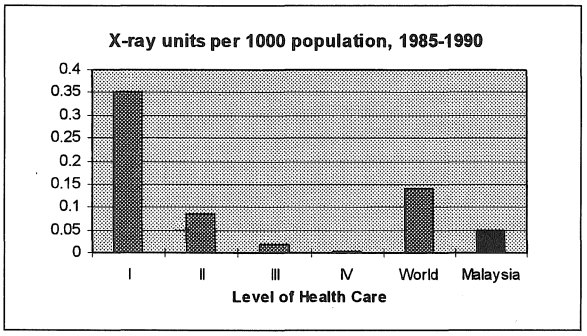

Fig. 1 X-ray units per 1000 population, 1985-1990.

Fig. 5 compares the number of x-ray examinations for the three categories of hospitals from 1990 - 1994. Figs. 6 and 7 show the trend of the number of hospitals and x-ray units. Of the 1270 x-ray units in 1994, 501 (39.4%) were in the Ministry of Health, 38 (3%) in the teaching university hospitals and 731 (57.6%) in private clinics and hospitals. Rapid increase in the number of x-

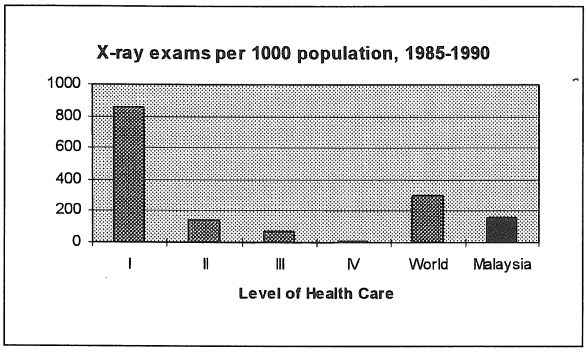

Fig. 2 X-ray exams per 1000 population, 1985-1990.

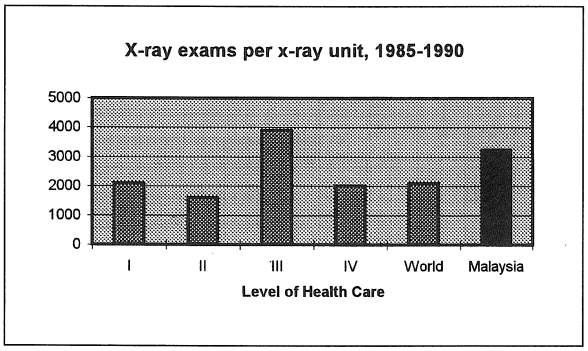

Fig. 3 X-ray exams per x-ray unit, 1985-1990.

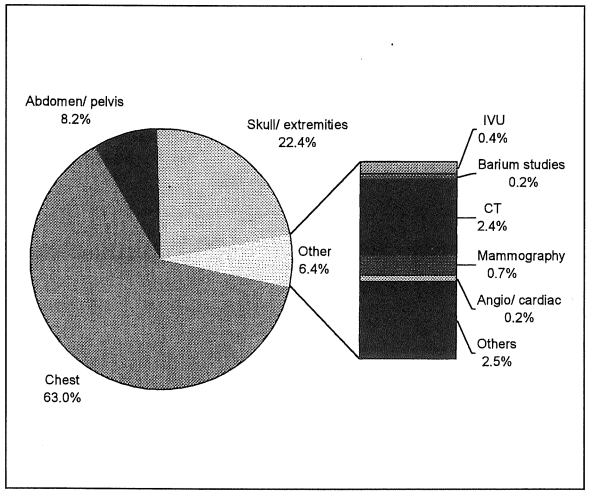

Fig. 4 Frequency of the types of x-ray examinations in Malaysia,1994.

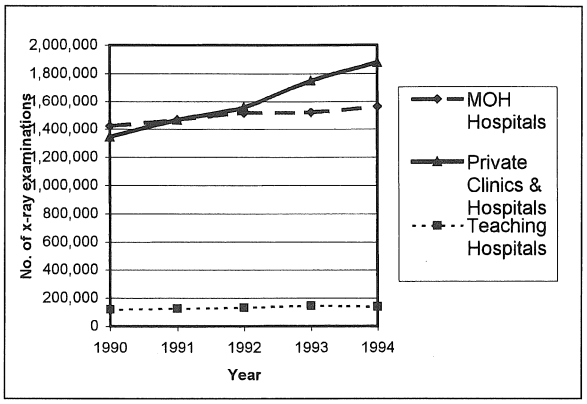

Fig 5. Number of x-ray examinations performed in MOH hospitals, private practice, teaching university hospitals from 1990-1994.

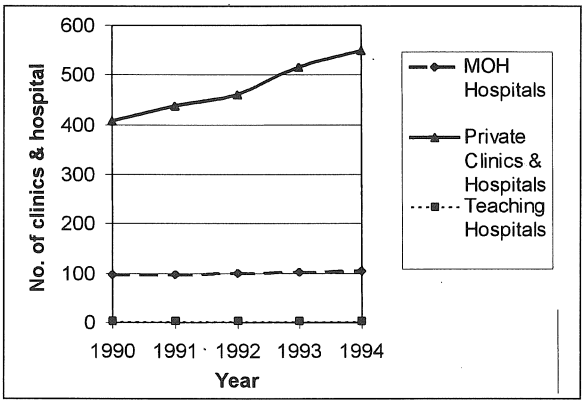

Fig. 6 Number of clinics and hospitals in MOH, private practice and teaching university hospitals from 1990-1994.

ray examinations, number of x-ray units and hospitals was observed in private clinics and hospitals especially from 1992 onwards.

The trends of some specialised x-ray examinations from 1990 - 94 are shown in Fig 8. Notable increases were seen in computed tomography (161%), cardiac procedures (190%) and mammography (240%). However some procedures experienced decrease such as barium studies, cholecystography and intravenous urography (decrease of 23%, 36%, and 51% respectively).

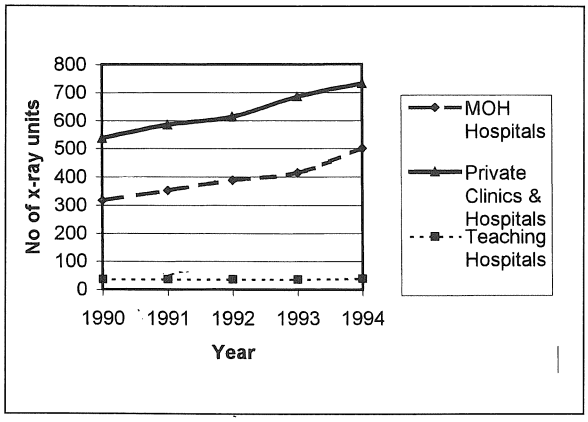

Fig. 7 Number of x-ray units installed in MOH hospitals, private clinics and hospitals, teaching university hospitals from 1990-1994.

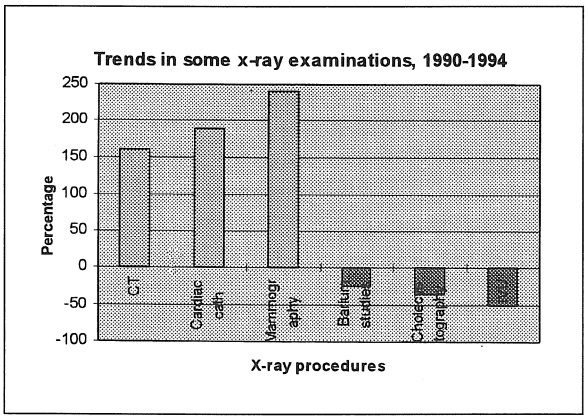

Fig. 8 Trends in some specialised x-ray examinations in Malaysia, 1990-1994.

Discussion

In the UNSCEAR 1988 Report[2], a good correlation was shown to exist between the number of x-ray examinations per unit of population and the number of physicians per unit of population. From an economic point of view, the number of physicians increases with higher GDP per capita. A similar pattern has been reported worldwide by the World Health Organization (WHO) especially in the advanced western countries[6,7]. In a recent study on the development in South East Asia it has been shown that the number of radiologists per population is correlated with GDP per capita[8]. The practice of radiology reflects the strides made in health care in the 90's, which in turn reflects Malaysia's rapid economic growth in the first half of the 90's.

A remarkable observation is that while Level I countries account for 25% of the world population, they are responsible for some 70% of the total diagnostic x-ray examinations. This is even higher for radiotherapy and nuclear medicine treatments where they make up 90% of the patients[5]. There is still a far cry from equitable distribution of medical radiation services in the world where 50% of population live in Level II countries.

The range of examinations per 1000 population in Level I countries is a factor of 6 (200 - 1280 examinations per 1000 population) and an order of magnitude or more in Levels II and III (15 - 520 and 10 - 180 examinations per 1000 population). This clearly shows that there is no good correlation between stratification according to level of physician per 1000 to the x-ray examinations per 1000 population.

In terms of X-ray units per 1000 and X-ray examinations per X-ray unit, Malaysia lies between Level II and III countries (Fig. 1 & 3) where due to lower number of X-ray units a greater number of procedures need to be performed on each machine. In terms of X-ray examinations per 1000 we lie between level I and II countries (Fig. 2).

The main type of examination at all levels is chest x-ray. This examination made up 60% of the total in Level I countries during 1985 - 1990 and 70% in all other countries. Our local experience conforms to this trend. Examinations of the extremities, the remainder of the skeleton and the digestive system accounted for just over 10% each of the total in Level I countries and just under 10% in other countries. However in Malaysia these account for about 30% of which 22% are for the skull and extremities. We suspect that this is due to the much higher incidence of motor vehicular accidents in Malaysia compared to most other countries[9].

It is interesting to note that the private practice contributed approximately half (47%) of the total national radiological procedures performed in 1990 and

increased to about 52% in 1994 (Fig. 5). This was also reflected in the larger number of x-ray units installed in the private practice 731(57.6%) compared with MOH 501(39.4%) in 1994 (Fig. 6). This trend reflects the greater emphasis placed by the government on the involvement of the private sector in providing health care service. Faster growth of private practice with imaging facilities was evidenced since 1992 in tandem with rapid national economic progress.

The increasing trend in some specialised procedures such as CT, cardiac studies and mammography are concomitant with the increase in the number of machines installed (refer to Table III). The decreasing trend in some studies in our country are due to technological developments in alternative non-radiological modalities (Fig. 5). The decreased utilisation of barium studies is due to greater reliance on fiberoptic endoscopy and the tendency for self referral by the physicians[10]. As for the decreasing trend with cholecystography and intravenous urography these would be due to the increasing use of ultrasound, CT and MRI. A similar trend had also been reported in other countries[11]. Both the increasing and decreasing trends are expected to continue.

In order to attain Level I status (developed countries) Malaysia needs to train more physicians, specialists and allied health professionals. The projected target for a population of 22 million would be 57,200 physicians and 1584 radiologists. We are still far from achieving the Level I target. Furthermore there is no equitable geographical distribution of physicians and radiologists in the country, with higher concentration in the urban areas especially in the Klang Valley (Currently 45% of the radiologists practice in the Klang Valley based on the registry of the Malaysian Radiological Society). Thus there is a tremendous potential and need to expand, upgrade and provide a wider coverage for radiological service in Malaysia. To meet this challenge the Malaysian universities have started post-graduate training programs in radiology with an average of 10 to 15 radiologists being qualified every year.

Acknowledgement

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