

## ROUTINE ROENTGENOGRAPHY ON 4,036 HEALTH SCREENING PATIENTS IN A PRIVATE HOSPITAL OUT-PATIENT CLINIC

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### SYNOPSIS

**We studied the findings, significance and relationship with clinical presentation of 4,036 patients who came for routine health screening in our hospital from December 1979 to March 1984. Among the 4,036 CXR and 1,566 AXR done, 19.6% and 22.2% of them had abnormal findings respectively, many of which were clinically significant and some of them requiring active management. We analysed the findings according to patients' sex, age and nationality and a few interesting observations were noted**

### INTRODUCTION

The value of routine chest XR and abdominal XR has long been controversial. In the 40's and 50's, mass screening chest radiography was done mainly to detect active tuberculosis. This partly contributed to the diminished incidence of tuberculosis in the western countries by early case finding among the population (1). Nowadays, with a low incidence of active pulmonary tuberculosis, the routine use of chest XR for patients without chest symptoms or diseases has been very much questioned. A national study by the British Royal College of Radiologists on 10,619 patients undergoing non-acute, non-pulmonary surgery concludes that pre-operative chest XR should be performed only

in patients at high risk of post-operative complications or undiagnosed chest diseases (e.g. immigrants) (2). Rucker and Staten studied 905 pre-operative patients and found that only 0.3% of those not at risk for abnormal chest XR has a positive finding (3). Peterborough Anaesthetic Department analysed 1,000 cases of pre-operative chest XR and concluded that it should be done only for patients over thirty years old as the incidence of unexpected finding before such age is very low (4). While some would argue for the routine use of pre-operative chest XR in children (5), the Committee on Hospital Care of the American Academy of Pediatrics recommended that it be done only if indicated by clinical suspicion of chest related problems (6). The practice of routine chest XR for psychiatric, surgical, general medical and obstetric patients has been strongly criticised (7, 8, 9, 10), mainly on the ground of low incidence of positive finding among patients with no clinical suspicion of chest disease, cost-effectiveness and irradiation risk. On the other hand, Fink et al concluded from a study of 113 patients that CXR should be done routinely in veteran hospitals because of the high incidence (46%) of chest problems among those patients (11). Based on a study of 10,000 hospitalised patients, Sagel et al suggested that both posteroanterior and lateral CXR be done routinely for hospitalised patient 40 years of age or older (12). He found 26% of this group of patients had abnormality on screening CXR, although he admitted that some of the patients actually had a history of prior pathologic process or definite symptoms or physical finding compatible with the XR findings. Minifilm mass screening radiography still has its advocates (13, 14).

The value of routine abdominal XR has been less controversial than that of chest XR. Most clinician would dismiss it because of its supposedly low yield and sensitivity, cost and unnecessary irradiation exposure. Only 10-30% of gall stones are radio-opaque (15). Abdominal mass or lesion does not show up readily in the soft tissue (or water) density of the abdomen in contrast to the air-density of the chest. Radiological diagnosis of hepatomegaly and splenomegaly are not accurate or sensitive as one would desire. Despite all these, routine abdominal XR is not without advocates. Levine and Crosbie found out that in a series of 242 consecutive patients admitted to a veterans administration hospital, mainly for minor operations such as tonsillectomy, herniorrhaphy or hemorrhoidectomy, 11% of otherwise unsuspected diseases were disclosed by routine XR (1). Rosenbaum et al did routine AXR for 500 consecutive inpatients and outpatients over the age of 40 and found 40 (8%) significant pathology unsuspected on initial clinical evaluation (16). Nishio and Levine studied 500 consecutive routine AXR of adults hospitalized for chest disease and found 22.4% of them revealed significant findings (17). Gillespie is in favour of performing routine AXR in periodic health examinations because 35% of his patients had positive findings (18).

No similar studies have been done about the findings and value of routine CXR and AXR among the South-East Asian population, where the prevalence of tuberculosis though on the decrease is still relatively high compared with western countries (19, 20) and where the percentage of gall stone being radio-opaque might be higher. Few research have been made about the value of routine abdominal film in healthy individuals. This study investigates the findings, significance and relationship with clinical presentation of routine chest and abdominal XR in a subgroup of the South-East Asian population.

## METHOD

About 4,500 patients presented themselves at our out-patient clinic for routine medical check-up from December 1979 to March 1984. An attempt was made to seek out all these patients' records and X-ray reports among other out-patients' records. A few cases with acute diseases which were warded immediately after being examined by our doctors were excluded from this study. 4,036 cases with their XR reports attached were identified. Chest XR was done routinely for all the patients and abdominal film was done on the basis of the patient's age, patient's request and clinical indication. It is noteworthy that patients with clinical features suggestive of a particular disease, e.g. cholelithiasis or urinary calculi were investigated primarily with the relevant radiological procedure instead of a plain AXR, although the plain film may sometimes be done as well. Thus, the abdominal XR was done mainly as a scout film.

Patients' sex, age and nationality were recorded and are shown in Diagrams 1 and 2. It is important to note that our patient population comprises mainly visitors from other South-East Asian countries, especially Indonesia and Malaysia. Interesting enough, the 30-39 years old age group has the most number of patients irrespective of nationality and sex, suggesting that this is the age when one is most conscious of health and likely to present themselves for routine check-up.

Radiological findings are tabulated as shown in Table 1 and 2 and analysed according to sex, age and nationality. They are classified as insignificant findings such as congenital anomaly, non-pathological process or evidence of old trauma which is at present of no clinical significance, and significant group which is subdivided into A and B. Significant A group includes pathological processes whether quiescent or active do not require treatment or close follow-up but their recognition and documentation may be of help to future management of the patient. Significant B group includes diseases which require further investigations, treatment or close follow-up.

For the significant B group, the patients' records were referred to in order to find out whether the patients had any symptoms or past history related to the pathology found. Also, 573 consecutive patients' records were studied thoroughly irrespective of presence of absence of XR findings to see if the patients had any chest or abdominal complaints.

Suspicious lesions on the plain film were followed up with relevant investigations and the final diagnosis are reported. Because a large number of our patients are from overseas, some of them defaulted follow-up and their suspected findings are registered in a separate column from those with definitive diagnosis.

## RESULTS

Among the 4,036 CXR, there were 791 (19.6%) positive findings. Of these, 122 findings (3%) were considered insignificant. 669 cases (16.6%) were significant. Among these, only 91 cases (2.3%) belonged to significant group B and 46 of the 91 cases were symptomatic whilst only 43 (1.1%) were totally asymptomatic.

The incidence of significant findings was plotted against age in Diagram 3. As expected, the incidence increased with age. There were no positive significant findings among the 80 patients below twenty years old.

The incidence of old tuberculosis increased proportionately with age as shown in Diagram 4. Its relation-

DIAGRAM 1 SEX AND AGE DISTRIBUTION OF ALL THE PATIENTS

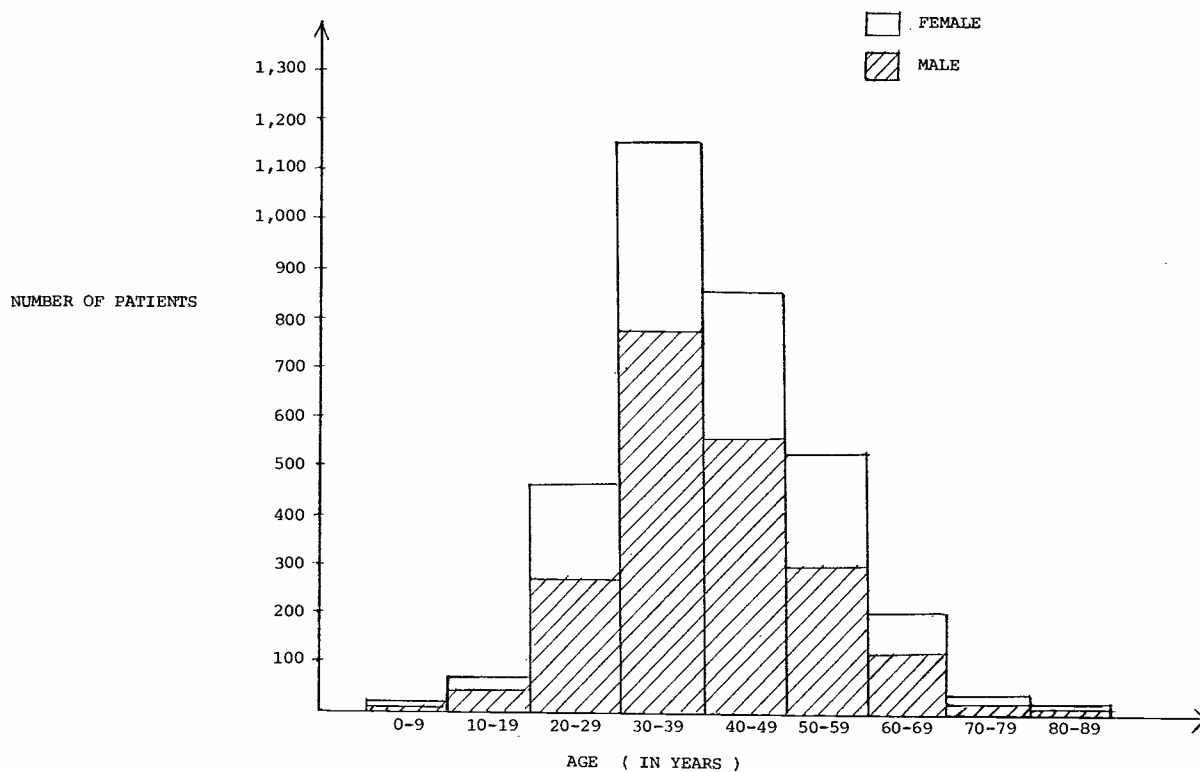
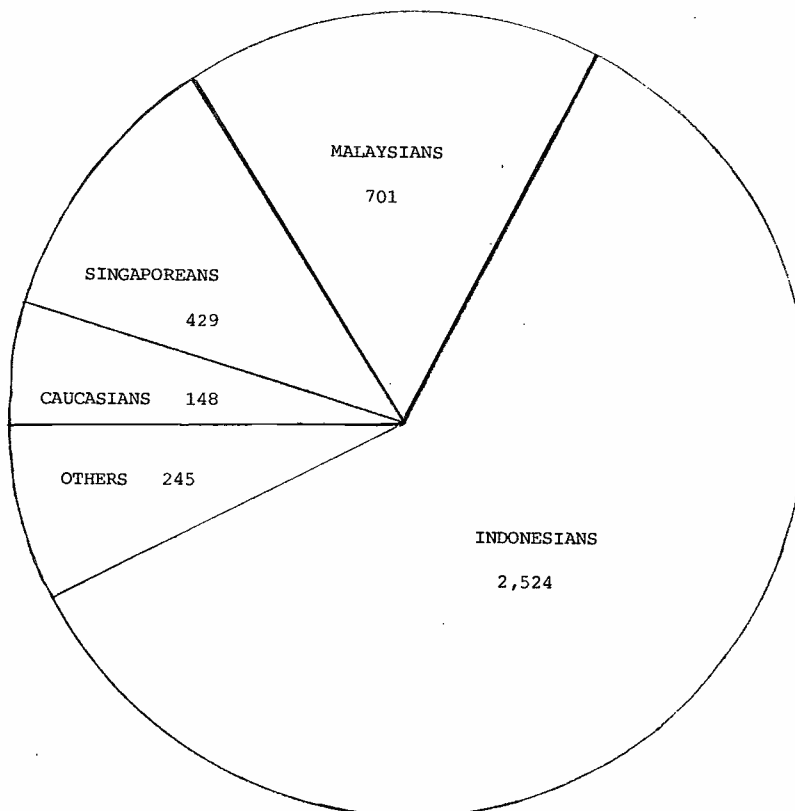


DIAGRAM 2 NATIONATLY DISTRIBUTION OF ALL THE PATIENTS



**TABLE 1**  
**ABNORMAL FINDINGS IN 4,036 CXR:**  
**Prefix (a) signifies Significant A findings**  
**Prefix (b) signifies Significant B findings**  
**No prefix signifies insignificant findings**

		No. of Patients	%	
<b>LUNG, MEDIASTINUM AND PLEURA</b>				
Inflammation:	Pneumonia	( a. Old	15	0.4
		( b. Active	22	0.5
	Tuberculosis	( a. Active		8
		( b. Inactive	350	8.7
	b. Bronchiectasis		15	0.4
Neoplasm:	b. Benign		2	0.05
	b. Malignant	( Primary	5	0.1
( Secondary		2	0.05	
Miscellaneous:	b. Pulmonary oedema		3	0.07
	a. Emphysema		38	0.09
	a. Pleural thickening (isolated finding of unknown aetiology)		35	0.09
	b. Pneumoconiosis		2	0.05
	Non-tuberculous calcification		18	0.4
	a. Plate atelectasis		7	0.2
	Foreign bodies, charm needles		5	0.1
	b. Cervical tracheal extrinsic compression/ deviation		12	0.3
	b. AV Malformation		1	0.02
<b>HEART AND GREAT VESSELS</b>				
a. Cardiomegaly without evidence of cardiac failure		130	3.2	
b. Cardiomegaly with upper lobe venous diversion		8	0.2	
a. Pericardial deficiency		1	0.02	
b. Pulmonary hypertension		4	0.1	
b. Valvular diseases		6	0.1	
b. Aortic aneurysm		1	0.02	
<b>SKELETAL</b>				
Congenital anomaly		22	0.5	
Developmental abnormality/disturbance of growth		46	1.1	
Old fracture		29	0.7	
Post-operative		2	0.05	
a. Degenerative joint disorder of spine		2	0.05	

**TABLE 2**  
**ABNORMAL FINDINGS IN 1,566 AXR:**  
 Prefix (a) signifies Significant A findings  
 Prefix (b) signifies Significant B findings  
 No prefix signifies insignificant findings

		No. of Patients	%
LIVER:	Riedel's lobe	12	0.8
	b. Moderate to severe enlargement	6	0.4
GALL BLADDER:	b. Calculi	25	1.6
SPLEEN:	b. moderate to severe enlargement	2	0.1
KIDNEY:	b. Mass lesion (Foetal lobulation)	1	0.06
	(Benign cyst)	4	0.3
	b. Urinary stone	26	1.7
	b. Renal calcification other than calculi	2	0.1
PROSTATE:	b. Calcified prostatomegaly requiring surgery	1	0.06
UTERUS:	b. Calcified myofibromata	4	0.03
SKELETAL:	Congenital — Spina bifida occulta	107	6.8
	Malsegmentation of spine	1	0.06
	Six lumbar vertebrae	1	0.06
	Pseudoarthrosis of spine	7	0.4
	a. Spondylo-epiphyseal dysplasia	1	0.06
	Development — a. Scoliosis	32	2.0
	Post-inflammatory	6	0.4
	Post-operative	1	0.06
	Post-traumatic	3	0.2
	a. Degenerative Joint Disorder	93	5.9
	b. Ankylosing spondylitis	1	0.06
	a. Osteoporosis (severe)	6	0.4
BOWEL:	b. Partial obstruction of small bowel	2	0.1
MASS:	b. (1 leiomyoma of small bowel, 2 ovarian cysts)	3	0.2
DEFAULT FOLLOW-UP			
	? Cholelithiasis	13	0.8
	? Urinary calculi	18	1.1
	? Renal mass	1	0.06
	? Abdominal mass	3	0.2

DIAGRAM 3 INCIDENCE OF SIGNIFICANT FINDINGS IN CHEST XR AGAINST AGE

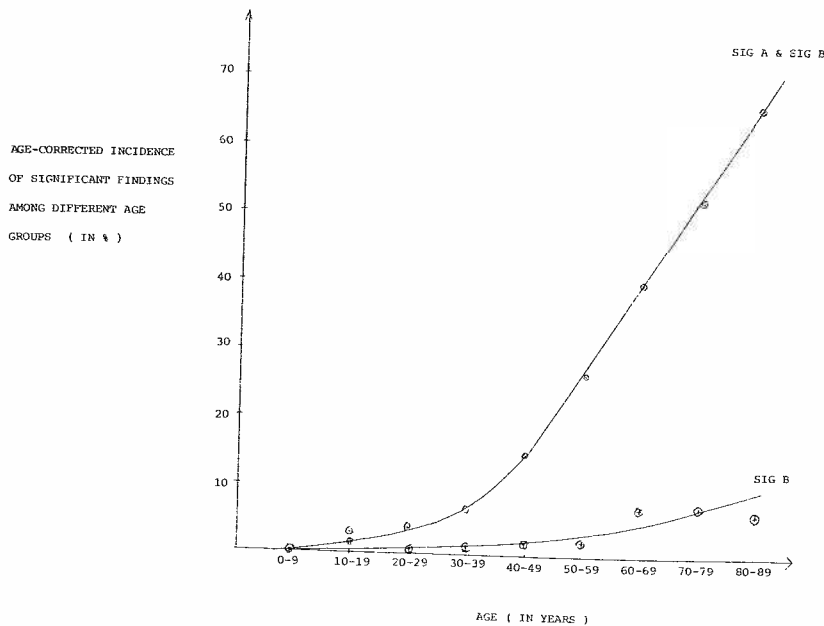
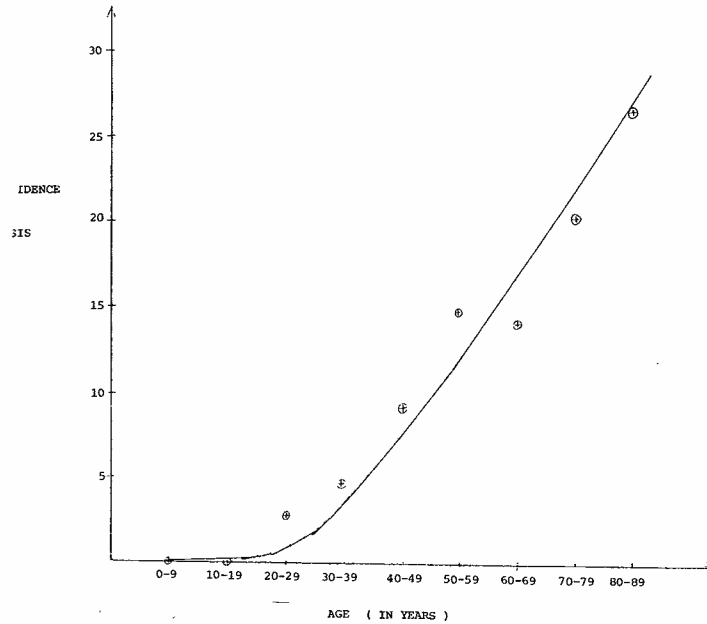


DIAGRAM 4 INCIDENCE OF OLD PULMONARY TUBERCULOSIS AGAINST AGE



ship to nationality was as follows:-

Indonesian	9.0%
Malaysian	7.0%
Singaporean	11.5%
Caucasian	3.3%
Others	7.2%

The incidence of cardiomegaly without evidence of heart failure showed a remarkable difference between male and female populations. Among patients over 40 years of age, 2.8% (43 cases/1540) of male and 9.4% (84 cases/889) of female showed cardiomegaly.

The percentage of patients who presented with chest or abdomen related symptoms were shown in Table III.

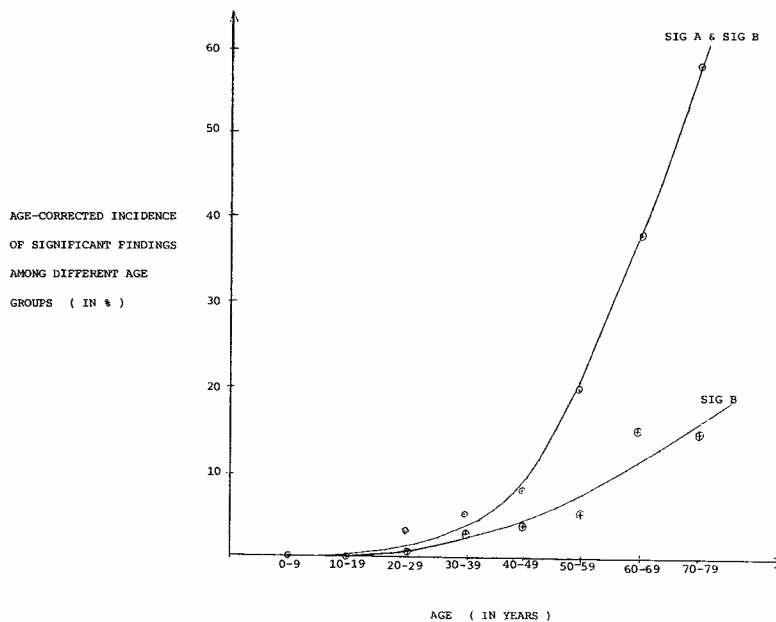
Among the 1,566 AXR, there were 347 (22.2%) positive findings. Of these, 208 cases (13.3%) were

significant and 72 cases (4.6%) belonged to the significant group B. Two-thirds of these 72 cases (3.0%) were asymptomatic and hence could not be diagnosed unless routine abdominal XR is done.

The incidence of significant findings in AXR was plotted against age in Diagram 5. Before the age of 30, only 5 cases were significant among the 183 AXR done. 4 were scoliosis and 1 was benign renal cyst.

The overall incidence of spina bifida occulta in our series was 6.6%. The incidence of this congenital anomaly among our male and female patients were 9.0% and 2.5% respectively. There is a 3-4 fold difference between the two sexes. Similarly, the incidence of moderate to severe degenerative joint disorder of the spine over the age of 40 demonstrated a significant difference between our male and female populations (7.2% and 13.1% respectively).

DIAGRAM 5 INCIDENCE OF SIGNIFICANT FINDINGS IN ABDOMINAL XR AGAINST AGE



## DISCUSSION

The value of routine CXR and AXR includes: detection of diseases, establishment of a baseline from which subsequent problems can be compared with, provision of information about normality for various groups of the population (21) and reassurance to the patient that, in the present state of our knowledge, he or she is in reasonably good health.

As far as detection of disease is concerned, our routine CXR has an overall 16.6% yield of significant findings. This figure is higher than that of pre-operative patients in the western series. In the Peterborough Anaesthetic Department studies of 1,000 patients in 1977, Loder found 11.4% of abnormal CXR among pre-operative patients over the age of 30 (4). In our series, the incidence of significant findings among patients over 30 is 21.4% which is even higher. Loder noted a 50% drop of the number of old tuberculosis found and the absence of active TB in his series in 1977 compared with a similar study of 1,000 patients by him in 1955. He discounted old tuberculosis as significant finding whereas in our studies, it accounts for about half of our significant findings. Therefore, if we exclude the cases of old TB from our series, our incidence of significant abnormal findings would be similar to Loder's.

Suspected old tuberculosis makes up 52.3% of our findings. While some may concede that old TB is of no clinical significance, one must remember that tubercle never dies and apical scar may contain viable organism which may reactivate many years later (20). In fact 14% of active TB notified in Singapore in 1983 were of patients with relapse of old disease (19). Our overall incidence of old tuberculosis is 8.5%. This is higher than the 3.2% reported by the Singapore Anti-Tuberculosis Association in 1982 (22). This may be due to the different sample population and XR technique. 70% of SATA patients comprises patients in the TB and Heart Insurance Scheme, Company Group Examination and Pre-employment and other medical certification. These groups of patients probably is younger and healthier than ours. 86% of the CXR film taken by SATA are 100 mm photofluorography instead of standard CXR as in our study. Therefore, their pick-up rate would be expected to be lower.

The fact that Singaporeans have the highest incidence of old TB among other South-East Asian patients probably reflects the prevalence of TB in Singapore many years ago and that dense population is a predisposing factor to tuberculosis. It is observed that all the 8 cases of active tuberculosis discovered in our series are visitors from other South-East Asian countries.

Although our number of patients below the age of 20

is relatively small ( $n=80$ ), our findings echo Sagel's finding among his 521 patients of the same age group that no significant abnormalities can be discovered.

Few studies attempted to further subdivide the significant findings according to whether they require further investigation, treatment and close follow-up or not. We subdivided this group and correlated the highly significant group with symptoms. The incidence of findings which are going to influence patient management among patients without symptoms are 1% and 3% for CXR and AXR respectively. Therefore, if one argues purely from cost-effectiveness and immediate management benefit points of view, such routine examinations have a low yield among asymptomatic patients. We observe that despite all the studies about the limited usefulness of routine CXR, it is still practised widely in situation where reassurance of patient's general well being is the main concern, such as pre-employment check-up and examination for taking up life insurance policy. In our patient population, which has a high incidence of tuberculosis both active and old, routine CXR for health screening patients above the age of 20 is a reasonable investigation in terms of good overall yield and reassurance to the patients.

Routine AXR in our series has a significant yield of 12.9%. This is higher than the 11% unexpected finding in Levine and Crosbie's series (1) and the 8% of significant pathology unsuspected on initial clinical evaluation in Rosenbaum's study (16). The difference may be accounted for because our 12.9% findings includes patients who may present with some related symptoms. Nishio and Levine reported 22.4% of significant findings but they included findings which are considered insignificant in other series including ours, such as lymph nodes, prostatic and vascular calcifications (17).

There were no highly significant findings in abdominal film among the 183 patients below the age of 30. The incidence of significant findings among patients above 40 years old is four times as high compared with that below 40. The ionizing radiation exposure resulting from AXR is considerably higher than that of CXR. The gonadal dose of AXR delivered to the male and female has been estimated to be about 125 mr and 250 mr respectively (17). Although this is below the 333 mr. per annum safe radiation exposure limit set by the American National Committee on Radiation Protection and Measurement (23), such radiological examination should not be performed routinely among patients whose expected yield is low. Therefore, we recommend that routine AXR be done for screening purposes only for patients above 40 years of age.

From Table 3 we observe that abnormal CXR is more commonly associated with symptoms compared with

TABLE 3  
PRESENCE OF SYMPTOMS IN RELATIONSHIP TO NORMAL AND  
ABNORMAL RADIOGRAPH IN 573 CONSECUTIVE PATIENTS

	Total Number of XR	Number of Patients with related Symptoms	% of XR with Positive Symptoms
NORMAL CXR	478	8	1.7%
Abnormal CXR	95	22	23.2%
Normal AXR	173	22	12.7%
Abnormal AXR	66	7	10.6%

normal CXR, whereas abnormal AXR is not more related to symptoms compared with normal AXR. Possible reasons to account for the difference between these examinations are that abdominal pathology is less symptomatic (e.g. silent biliary and urinary calculi) and that abdominal pathology is less detectable on a plain XR film.

There are a few interesting findings in our series. The incidence of cardiomegaly without evidence of heart failure among females over 40 years of age is about 3 times as high compared with that of males ( $p < 0.001$ ). This striking difference was also reported by Rabushka and Melamed (21). Over the age of 65, their male and female incidence of cardiomegaly were 13.5% and 38% respectively but no explanation was given to account for this difference. We are uncertain about the exact cause of this difference. The increased propensity to obesity in female may possibly be part of the cause. An obese individual tends to have flat diaphragm and the cardiac silhouette may thus appear larger on posteroanterior projection because of the more transverse position of the heart. Hyperactive thyroid gland in the female may account for a small proportion of cases.

## CONCLUSION

With the prevalence of tuberculosis among the South-East Asian population, routine CXR is still of value for health screening purpose in terms of reasonable yield of abnormality and reassurance of patient. We recommend its use for patients above 20 years of age because of the low incidence of findings among patients below such age. The yield of AXR compare favorably with that of CXR and we recommend its routine use as part of the health screening examination for patients above 40 years old. There are a few interesting observations that deserve further investigation and research, namely the striking difference in incidence of cardiomegaly, spina bifida occulta and degenerative joint disease of the spine between the two sexes.

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