STATIC MASS RADIOGRAPHY IN A LONDON BOROUGH

BY

G. Z. BRETT, M.D.

Medical Director, Islington Mass X-ray Unit, North-West
Metropolitan Regional Hospital Board

B. BENJAMIN, Ph.D., F.I.A.

Statistician

J. WALLACE CRAIG, M.D.

Chest Physician, Islington

AND

V. FREEMAN, M.R.C.S., L.R.C.P., D.P.H.

Medical Officer of Health, Islington

Any mass miniature radiography unit depends upon voluntary use by the public, and unless 100% of the population attend it must be concerned with a biased sample of the population; if earlier work is accepted (Cochrane, 1950) the sample is usually biased toward underestimating the prevalence of disease, since there is commonly a tendency for symptomatic cases to hang back. This handicap, however, may be reduced if the unit remains continuously in the neighbourhood; for, on the one hand, familiarity with its presence reduces fear and, on the other, every new examinee gradually increases the total coverage. There is a gradual process of attrition which must result in a higher level of case finding.

This study is therefore *not* concerned with whether or not a static unit examines a representative sample of the population but with the precise character of the sample it *does* touch, with the volume and nature of tuberculous disease brought to light, and with the improved level of case-finding in both tuberculosis and cancer of the lung resulting from "static" operation.

A static M.M.R. unit was set up by the N.W. Metropolitan Regional Hospital Board in the Metropolitan Borough of Islington in February, 1952. Islington was selected because of the higher than average tuberculosis mortality in the area. During the first three years of working there were 87,261 adult examinees composed as follows:

	Males	Females
Islington residents:		
First entrants	16,650	23,908
Repeat examinations	2,522	4,757
Non-Islington:		
First entrants	16,142	18,042
Repeat examinations	2,627	2,613
Total	37,941	49,320
	87,261	

Of the 74,742 first entrants, more than half (40,558) were residents of Islington. The remainder were either working in the borough or living near by. The sex and age distribution of these Islington residents is shown for each source of reference in Table I, which also gives the structure of the Islington population as a whole. The final column shows that in total the first entrants from Islington addresses differed in age and sex distribution from the general population of the area only in a relative deficiency of men and women over 65 and a relative excess of young women. Leaving aside the

obviously select groups of contact and antenatal examination, these differences are most pronounced in the individual volunteers ("general public") and organized groups, especially the latter, which, being drawn from the working population of offices and factories, must be expected to have a younger age structure than that of the population of Islington as a whole. The age and sex distribution of doctors' patients resembled more closely the Islington population as a whole, the minor difference here being the younger age structure of women referred by doctors.

Table II shows the distribution of the male first entrants in the five social classes into which the Registrar-General divides unit groups of the Classification of Occupations.

Generally speaking, the social class structure of the examinees showed higher proportions in Social Classes III and IV and lower proportions in Social Classes I and II than in the male population of Islington as a

TABLE I.—Islington Residents—First Entrants (Three Years Combined)

Sex and Age	Percentages in Sex and Age Groups					
	Islington Met. Boro Census, 1951	Static Unit Examinees				
		Doctors' Patients	Antenatal	Individual Volunteers	Organized Groups	Contacts
Males:						
15-24	7.1	6.1	—	8.4	9.7	10.6
25-34	10.6	10.5	—	13.7	13.4	13.5
35-44	10.0	9.0	—	8.0	8.7	9.6
45-54	7.8	8.9	—	5.4	5.4	6.4
55-64	5.3	6.5	—	2.8	3.0	2.1
65+	5.3	4.8	—	2.3	0.8	0.2
	46.1	45.8	—	40.6	41.1	42.4
Females:						
15-24	8.7	12.3	41.7	15.7	21.3	13.8
25-34	10.7	13.9	48.1	15.4	14.9	13.5
35-44	10.1	10.0	10.1	12.1	11.8	11.8
45-54	8.5	8.2	0.1	8.7	8.2	10.3
55-64	7.1	5.5	—	5.0	2.4	6.1
65+	8.7	4.3	—	2.5	0.3	2.1
	53.9	54.2	100.0	59.4	58.9	57.6
Persons age 15 and over	100.0	100.0	100.0	100.0	100.0	100.0
No. of examinees						
Male:						
1st year	2,061	—	3,723	1,918	249	7,951
2nd "	2,400	—	1,434	422	180	4,436
3rd "	2,463	—	1,113	582	105	4,263
	6,924	—	6,270	2,922	534	16,650
Female:						
1st year	2,891	—	5,324	2,645	362	11,222
2nd "	2,781	640	2,295	736	259	6,711
3rd "	2,538	958	1,545	830	104	5,975
	8,210	1,598	9,164	4,211	725	23,908

TABLE II.—Percentage Distribution of Islington First Entrants (Men) by Social Class and Source—Three Years Combined

Social Class	Islington* Met. Boro Census, 1951	Source				
		Doctors' Patients	Individual Volunteers	Organized Groups	Contacts	Total
Social class I ..	1.2	0.8	0.5	0.2	—	0.6
" " II ..	8.1	4.2	4.3	3.3	3.4	4.1
" " III ..	52.4	57.3	61.9	64.4	66.1	60.6
" " IV ..	11.7	12.3	15.7	12.5	15.5	13.7
" " V ..	16.1	17.1	11.0	15.5	12.7	14.3
Students ..	1.4	1.5	2.4	3.1	2.1	2.1
Retired ..	6.6	6.4	3.7	1.0	—	4.2
Unemployed ..	2.5	0.4	0.5	—	0.2	0.4
Total ..	100.0	100.0	100.0	100.0	100.0	100.0

* Estimated on assumption that "retired" are distributed by social class in same way as "occupied." (The Census figures show only "occupied and retired" as one distribution.)

whole. This is not an unexpected result, since many of those in better circumstances are inclined to seek private rather than "mass" forms of diagnostic examination. What is of interest, however, is the lower proportion in the lowest Social Class V in examinees as compared with the general population of Islington *except in doctors' patients*; providing a measure of the comparative lack of understanding of the value of miniature radiography among those in occupations falling within this class.

Extent of Cover

The facts so far recounted may be summarized in relation to the extent to which, taking three years' working as a whole, the population of Islington was covered by the unit. On the whole, about one-fifth of the adult resident population of Islington was examined for the first time. For men the proportion fell from 23-24% at adult ages under 35 to 17-18% at ages 35-64 and 12% at ages 65 and over. For women the proportion fell from 41% at ages 15-24 to 24% at ages 35-44 and 7% at ages 65 and over. With regard to coverage in the social classes, the proportions for men were 8-9% in Social Classes I and II, 20-21% in Social Classes III and IV, and 16% in Social Class V.

Incidence of Tuberculous Disease requiring Treatment

During the three years a total of 572 cases of tuberculosis requiring treatment were discovered among first entrants (or 7.7 per 1,000), distributed in groups (see Table III), with the rate per 1,000 examinees shown in brackets.

Excluding antenatal examinations, which are of a highly selected population—that is, those who marry and incur pregnancy—the lowest yield was obtained from the organized groups: the rates here were nearer those commonly found in the operation of mobile M.M.R. units operating among those fit to attend their place of employment. As might be expected, the highest yield came from those referred by doctors, even though these were not only based upon chest or other symptoms related to tuberculous disease but were in a large proportion of cases routine; the rates ranged from 10.9 and 7.6 for men and women respectively living outside Islington to 20.5 and 11.8 for men and women Islington residents. These rates are comparable with those for contacts

TABLE III

Group	Islington Residents		Non-Islington	
	Men	Women	Men	Women
Doctors' patients ..	142 (20.5)	97 (11.8)	44 (10.9)	31 (7.6)
Antenatal ..	—	2 (1.3)	—	2 (1.5)
Individual volunteers ..	58 (9.3)	71 (7.7)	30 (8.2)	21 (3.9)
Organized groups ..	12 (4.1)	12 (2.8)	22 (2.9)	12 (1.7)
Contacts ..	7 (13.1)	9 (12.4)	— (—)	— (—)
Total ..	219 (13.2)	191 (8.0)	96 (6.3)	66 (3.7)

—13.1 and 12.4 for males and females. The yield from the individual volunteers was, however, higher than normally found by mobile units—for Islington residents 9.3 and 7.7 per 1,000 for men and women respectively, for those living outside Islington 8.2 and 3.9 per 1,000 for men and women.

The overall yield from the static unit (7.7 per 1,000) is therefore much higher than that of mobile units—however, many may be concentrated in one place (Cox and Hughes, 1955)—largely as a result of the deeper "dredging" in the resident population which results from persistent tenure of contact with the general public.

Further evidence is provided by analysis of the figures for Islington residents for the main groups into the individual years of operation of the unit (Table IV).

There was no falling off in the rates in successive years as might occur if most cases were discovered at the first impact of M.M.R. on the neighbourhood. On the contrary, the rates in the second and third years were as high as in the first year. Thus time was on the side of the unit.

Variation in Yield with Sex, Age, and Social Class

Except for contacts, where the risks are much more equalized, the prevalence of pulmonary tuberculosis was higher in men than in women. Table V shows the cases and rates per 1,000 in individual age groups (three years combined).

The rates accord with current experience in showing a rising trend with age in men, and a declining trend in women. The relatively large number of cases among men over age 45 is of special significance, on account both of their poorer prognosis and of the possibly lengthy period of unsuspected infectiousness prior to diagnosis.

With regard to social class variation the numbers of cases, and rates, in male residents of Islington examined for the first time were as shown in Table VI (three years combined).

TABLE IV.—Pulmonary Tuberculosis—Rates per 1,000. Islington Residents, First Entrants

	1st Year	2nd Year	3rd Year
Doctors' patients:			
Men	38 (18.4)	53 (22.1)	51 (20.7)
Women	34 (11.8)	28 (10.0)	35 (11.8)
Individual volunteers:			
Men	35 (9.4)	14 (9.8)	9 (8.0)
Women	47 (8.8)	17 (7.4)	7 (4.5)
Organized groups:			
Men	6 (3.1)	3 (7.1)	3 (5.1)
Women	9 (3.4)	2 (2.7)	1 (1.2)

TABLE V.—Prevalence Rates by Age and Sex

Age	Islington		Non-Islington	
	Men	Women	Men	Women
15-24	28 (9.2)	58 (8.7)	19 (4.7)	37 (5.5)
25-34	50 (10.4)	73 (11.3)	36 (7.5)	12 (2.3)
35-44	37 (11.1)	36 (7.9)	18 (5.2)	10 (3.4)
45-54	49 (18.5)	10 (3.0)	12 (5.2)	5 (2.5)
55-64	33 (19.9)	7 (3.8)	8 (7.2)	1 (1.2)
65 and over ..	22 (19.2)	7 (6.4)	3 (7.4)	1 (3.2)
Total	219 (13.2)	191 (8.0)	96 (6.3)	66 (3.7)

TABLE VI.—Social Class Analysis

Social Class	Cases	Rate per 1,000
Class I	1	10.8
" II	9	11.8
" III	115	11.4
" IV	33	14.4
" V	44	18.4
Students	1	2.8
Retired	15	21.3
Unemployed ..	1	16.7

As might be expected from the age trend noted above, the rate was highest (21.3) for the retired. It was also conspicuously high (18.4) for Social Class V, which has been earlier noted as being more difficult to bring to M.M.R. Indeed, at ages 45 and over chronic infectious tuberculosis was found in 19.5 per 1,000 of Islington residents in Social Class V, compared with only 14.0 in the retired and 11.0 in Social Class III.

Type of Disease Found

An analysis of the extent of tuberculous disease found is shown in Table VII. Among the 315 men with tuberculosis, 14 (4%) had minimal, 69% had medium, and 27% had extensive disease. There was no significant departure from these proportions in any of the different source groups. For females the overall proportions were: minimal, 15%; medium, 71%; extensive, 14%. There was rather more variation between the source groups, but in no instance was this statistically significant.

Infectiousness

Table VII also shows the proportions with positive sputa on diagnosis: 62% of male cases and 37% of female cases were sputum-positive. For males there was little variation

between the source groups, but among female cases a higher proportion of those referred from general practitioners were positive than among those discovered in organized groups or in individual volunteers. For females, also, the proportion with positive sputum was higher for Islington than for non-Islington cases; for males the slight excess in non-Islington cases was not statistically significant.

Table VIII shows for all cases with Islington residence the proportions sputum-positive in each age group and (for men) social class.

TABLE VII.—*Extent of Disease and Sputum State; First Entrants—Three Years Combined*

Source Group	Sex	Minimal	Medium	Extensive	Positive Sputum		
					No.	%	
<i>Islington Residents</i>							
Doctors' patients	{	M	5	94	43	84	59
		F	8	72	17	52	54
Antenatal ..	{	F	—	1	1	1	50
Individual volunteers	{	M	1	40	17	34	59
		F	17	48	6	24	34
Organized groups	{	M	—	10	2	6	50
		F	2	9	1	3	25
Contacts ..	{	M	3	4	—	3	43
		F	3	5	1	4	44
Total ..	{	M	9	148	62	127	58
		F	30	135	26	84	44
<i>Non-Islington Residents</i>							
Doctors' patients	{	M	1	32	11	32	73
		F	4	24	3	8	26
Antenatal ..	{	F	1	1	—	—	—
Individual volunteers ..	{	M	2	20	8	22	73
		F	1	16	4	2	10
Organized groups	{	M	2	17	3	13	59
		F	2	8	2	2	10
Contacts ..	{	M	—	—	—	—	—
		F	—	—	—	—	—
Total ..	{	M	5	69	22	67	70
		F	8	49	9	12	18
Grand total	{	M	14	217	84	194	62
		F	38	184	35	96	37

TABLE VIII.—*Sputum State—Islington Cases*

Age	Males				Females			
	Positive		Social Class	% of Tuberculosis Cases in Group	Positive	Age	Positive	
	No.	% of Tuberculosis Cases in Group			No.		No.	% of Tuberculosis Cases in Group
15-24	12	43	I	1	70	15-24	22	37
25-44	52	60	II	6	46	25-44	50	46
45-64	52	63	III	63	55	45-64	8	47
65+	11	50	IV	16	48	65+	4	57
			V	33	75			
			Retired Student Unemployed	7	47			
				1	100			
	127	58			127	58		
							84	44

Generally speaking, the older adult cases were more positive than those below the age of 25, for both men and women; the rise above the age of 25 was not steep.

The striking feature of Table VIII is the higher proportion of positive sputa among the tuberculosis cases found in Social Class V. As has already been remarked in the discussion on Table VI, it is in Social Class V that the chronic infectious cases are more frequently found. They do not come so readily as others to M.M.R., and it seems likely that this serious problem of infectious tuberculosis is best dealt with by the patient and constant attendance of the static unit.

Repeat Examinations

It remains only to indicate the subsequent incidence of disease in examinees who were clear at first examination in 1952 or later and were re-examined in 1953 or 1954. For

men with Islington residence there were 907 repeat examinations in 1953, and among these there was only one case of tuberculosis needing treatment. In 1954 there were 1,615 re-examinations with a yield of six cases. If the duration of exposure in the second group be taken as 1.5 years on the average, the total annual attack rate of new disease is $\frac{1 + \frac{1}{2}(6)}{907 + 1615} = 2.0$ per 1,000. This rate for all ages is consistent with the Civil Service (and largely urban) data (industrial and non-industrial males) of Springett (1951), who found attack rates ranging from 3.0 at ages 15-24 to 1.0 at ages 45-59, and an average of the order of 2.0 for all ages combined. For women with Islington residence there were 5 cases among 1,878 re-examinations in 1953 and 8 cases among 2,879 re-examinations in 1954—an annual attack rate of 2.2 per 1,000. Among non-Islington repeats the annual attack rates were: men 0.3 (1 case) and women 2.7 (7 cases). It may be noted that the gross incidence rate in repeat examinations for Islington residents (2.8 per 1,000 for men and 2.7 per 1,000 for women) compare with the national incidence in repeat examinations of 1.0 per 1,000 in the second half of 1954 (Ministry of Health, 1956, personal communication). In total, therefore, repeat examinations yielded a further 28 cases to bring the grand total of tuberculosis cases found during the three years to 600, 430 of them among Islington residents.

Cancer

Table IX gives an analysis of the 115 cases of primary carcinoma of the bronchus which were discovered during the three years. Most of these cases were in men over the age of 45.

For men with Islington residence Table X gives incidence rates in each social class and among the retired.

TABLE IX.—*Primary Carcinoma of the Bronchus by Age and Source*

Age Group	Doctors' Cases				Individual Volunteers				Total
	Islington		Non-Islington		Islington		Non-Islington		
	Men	Wom.	Men	Wom.	Men	Wom.	Men	Wom.	
35-44 ..	3	—	3	—	1	—	1	1	9
45-59 ..	13	3	13	2	8	4	5	1	49
60 and over ..	28	4	10	1	9	3	2	—	57
Total ..	44	7	26	3	18	7	8	2	115

TABLE X.—*Primary Bronchial Carcinoma by Social Class—Islington Men*

Social Class:	I	II	III	IV	V	Retired	Total
No. x-rayed	93	678	10,086	2,285	2,390	704	16,236
No. cases	—	1	28	6	15	12	62
Rate per 1,000	—	1.45	2.8	2.6	6.3	17.0	3.8

The high rate among the retired is not unexpected, but the high rate in Social Class V is noteworthy: the excess above Social Class III is just statistically significant at the 5% level. If it should prove to be the case that occupations in this category are associated with higher rates of smoking or with adverse atmospheric conditions this would lend significance to the finding—certainly an inquiry into possible aetiological factors appears to be called for. In the occupational mortality investigation of 1950 (Registrar-General, 1954) there was a social class gradient, but the excess of mortality from cancer of the lung in Social Class V was not so marked; the standardized mortality ratios for the classes were; I, 80; II, 79; III, 108; IV, 89; V, 116.

Discussion

Static M.M.R. units in England and Wales are few in number and have been in operation for a relatively short time. The Islington unit had the advantage of being set up in a "black spot" and the disadvantage of having a

relatively small area from which to draw volunteers. Every possible source, therefore, was used to ensure reasonable attendance figures. The North-West Metropolitan Regional Hospital Board undertook to make beds immediately available for cases of pulmonary tuberculosis discovered by the unit.

1. *Doctors' Patients*.—The co-operation of about 120 general practitioners in the borough was obtained by a series of personal interviews. The suggestion that everybody on their lists should have an x-ray report was in many cases accepted, which resulted in a regular service for patients with and without symptoms. Despite this liberal policy, our discovery rate of pulmonary tuberculosis requiring treatment in this group (16 per 1,000) compares on the whole with the finding of Sutherland (1952), 28 per thousand; of Nash *et al.* (1953), 20 per thousand; and of Barr and Ritchie (1955), 22 per thousand.

2. *Individual Volunteers*.—The propaganda measures directed towards this group during the first two years of the survey were confined to Islington and comprised the house-to-house distribution of leaflets, slides in cinemas, posters, announcements in the local press, displays in shop windows, mobile booking offices in the streets during the summer months, and talks to clubs and meetings. For six months two canvassers were employed for house-to-house visiting—but this was found to be of little value. Spot inquiries during the first year showed, however, that by far the largest number of individual volunteers came on personal recommendation. The high yield of pulmonary tuberculosis in this group underlines the importance of the measures taken to attract individual volunteers to the unit.

3. *Social Class V*.—The finding of a high incidence of chronic infectious tuberculosis in this group is of especial interest, and, if true of areas with a similar social structure to Islington, provides a pointer to the direction in which further efforts should be made. It has been accepted for a long time that the respiratory tuberculosis mortality rate is higher in Social Class V than in Social Class III (or higher classes)—at the 1930–2 occupational mortality investigation the excess was 25% (Registrar-General, 1938), and at the 1950 investigation the excess was 46% (Registrar-General, 1954). It is now clear that this excess is not attributable to higher case fatality but to the higher incidence of undiscovered disease. The overall yield of pulmonary tuberculosis in Social Class V may not always have exceeded that in other social groups, but could have been over-emphasized by a decrease of the disease in those groups which for years have made more use of x-ray facilities.

4. *Antenatal Examinations*.—These have not proved a profitable source of case finding in this survey. The discrepancy in the incidence of pulmonary tuberculosis between this group and women of the same age in other groups is of interest and may warrant further investigations.

5. *Mobile and Static M.M.R.*—In comparing the relative values of mobile and static M.M.R. in a continuous anti-tuberculosis campaign, their differences in scope and mode of operation should be borne in mind. Table XI lists some of these differences.

Mobile M.M.R. forms thus an important *protective* service for the organized groups of the working population, while static M.M.R., owing to its wider range of coverage and persistence of tenure, can contribute to a substantial reduction of the disease in areas in which pulmonary tuberculosis is a serious problem. For the same reason static

mass radiography is capable of playing an important part in the detection of cancer of the lung.

Summary

During three years of operation a static M.M.R. unit based on the Metropolitan Borough of Islington x-rayed 87,261 adults, of whom 86% were first entrants. Over half were residents of Islington, forming about 21% of the adult population of the borough.

Figures for the prevalence of pulmonary tuberculosis requiring treatment are given by age, sex, source, and social groups.

The overall incidence of pulmonary tuberculosis was 7.7 per 1,000: for Islington residents, men 13.2, women 8.0; for non-Islington residents, 6.3 and 3.7 respectively. The highest yields came from doctors' patients and individual volunteers. The disease, particularly the chronic infectious type in those over 45 years of age, was more prevalent in men of Social Class V and in the retired.

It was found that 62% of male cases and 37% of female cases were sputum-positive.

A total of 115 cases of cancer of the lung were discovered. Prevalence appeared to be higher in Social Class V.

The methods of work and the implications of the results are discussed.

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MORTALITY FROM FOG IN LONDON, JANUARY, 1956

BY

W. P. D. LOGAN, M.D., Ph.D., D.P.H.

Chief Medical Statistician, General Register Office

There was some fog in the London area on January 3, 1956. This became thick on the morning of January 4 and persisted until the morning of January 6, when it began to disperse. Fog was widespread throughout much of the rest of the country at the same time, and in some places continued longer. In London the fog was thick enough to cause very severe disruption of traffic, particularly on the evening of January 5. Newspapers carried headlines about "killer smog," described the widespread investigations that were being conducted during the fog into the degree of atmospheric pollution that was taking place, and reminded readers that the previous severe London fog, in December, 1952, had caused several thousand deaths in the London area.

Following the fog of December, 1952, a period of some weeks had to elapse before the mortality returns could be analysed and the total number of deaths due to the fog could be estimated—about 4,000 deaths in the Greater London area (Logan, 1953; Ministry of Health, 1954). After a similar delay it is now possible to give a corresponding estimate for the January fog of this year—about 1,000 deaths in the Greater London area.

The number of deaths occurring each day from December 25, 1955, to January 19, 1956, in the London Administrative County are shown in Table I and Fig. 1.

TABLE XI

	Mobile	Static
Source of examinee ..	Mainly organized groups	All sources
Social structure of examinee ..	Mainly Class III	All social classes, including the retired
Field of operation ..	Industrial areas	Dormitory areas
Proportion of first examinations ..	Low	High
Yield of P.T. ..	Declining	Persistently high