Frequency of Medical X-ray Examinations in Monroe County, New York

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IN RECENT YEARS, a substantial interest has developed in the doses of ionizing radiation received by the population from manmade and natural sources. This interest has stemmed from an increasing awareness of the genetic and somatic effects of ionizing radiation and from the realization that the radiation exposures received by the population may not always be so small as to be without harmful effects.

Of the various forms of manmade radiation, that administered during diagnostic X-ray practice is the largest contributor to population exposure. Laughlin and associates (*1*) have estimated that medical exposures in the United States deliver an average gonadal dose of 5 roentgens during the prereproductive years of life. A comprehensive epidemiologic and dosimetric study (*2*) in the United Kingdom in 1960 indicated that the medical sources of that country deliver an exposure of about 0.5 roentgen to the reproductive organs of the population during the first 30 years of life.

Benefits from the use of X-rays in the diagnosis and treatment of disease are substantial. If unnecessary irradiation is avoided, biomedical risks to the individual patient are not likely to be large, although their cumulative effect in the entire population may be substantial. In view of such cumulative effects, the increasing application of X-rays in medicine, and the not infrequent carelessness with which these X-rays are used, public health authorities need detailed and continuing information on the radiological practices of the health professions. The numbers and types of examinations being performed largely determine the doses of ionizing radiation received by the population from X-ray sources. Thus, surveys to develop such information are an important part of public health programs concerned with the use, effects, and control of ionizing radiation. Surveys of appropriate population groups not only permit an evaluation of the general magnitude of the radiation dosage levels to which the public is exposed, but also, through the use of suitable dosimetric data, may provide relatively precise estimates of the doses certain critical tissues receive.

This paper reports a survey to determine the frequencies of the various medical radiological examinations performed in a large, predominantly urban population. It describes the second of two similar surveys; the first dealt with radiological examinations performed by dentists (*3*).

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Survey Procedure

Study area. Monroe County, N.Y., which includes Rochester and its environs, was selected for study because of its high level of medical care, stability of population, complete registration with the county health department of X-

ray machines used by physicians, its well-organized and cooperative radiological and medical societies, large population, diversified industry, geographic isolation, and other characteristics.

Random sampling of Blue Cross and Blue Shield claims revealed that only 5 percent of claims paid for Monroe County residents were to physicians or facilities outside of the county. Since these results confirmed other evidence that county residents were not likely to receive medical care elsewhere, the survey was based on examinations of county residents performed within the county.

Preliminary survey. A preliminary survey was conducted in 1958 to provide information for planning of the more detailed work which followed. All hospitals, clinics, and physicians operating diagnostic X-ray equipment were visited to determine the approximate numbers of X-ray examinations of various types being performed annually within the county and to learn which of these facilities maintained records adequate for survey purposes.

On the basis of this survey it was estimated that 80 to 90 percent of diagnostic X-ray examinations of Monroe County residents were performed by or under the supervision of radiologists. This included virtually all roentgenological examinations in hospitals, radiologists' offices, and industrial, public health, and veterans clinics. In general, these examinations were found to be the only ones for which adequate records existed. Consequently, since the objective of the study was the determination of examination rates rather than X-ray dosages, we decided to concentrate on these well-recorded examinations, basing the documentation of the relatively small remainder on the results obtained through a special system of data collection established for the purpose.

Methods. The basic data for the survey included the age, sex, and residence of each person examined, the type of X-ray facility where he was examined (hospital or radiologist's office, for example) and the date of examination. Whenever possible X-ray technicians or others familiar with the specific records abstracted the

Table 1. Percentages of X-ray examinations performed in Monroe County, N.Y., in various types of facilities, by age and sex

Age (years)	Males				Females				Both sexes			
	Hospitals	Radiologists' offices	Industrial clinics	Other	Hospitals	Radiologists' offices	Industrial clinics	Other	Hospitals	Radiologists' offices	Industrial clinics	Other
0–4	79	8	------	13	77	7	------	15	78	7	------	14
<1	85	7	------	8	72	5	------	24	79	6	------	15
1	87	4	------	8	80	7	------	13	83	6	------	11
2	75	9	------	16	79	12	------	8	77	10	------	13
3	64	10	------	26	84	7	------	8	73	9	------	18
4	71	9	------	19	80	9	------	11	76	9	------	15
5–9	63	13	------	24	70	10	------	19	66	12	------	22
10–14	63	11	------	27	65	14	------	21	64	12	------	24
15–19	56	15	6	23	56	18	10	17	56	16	8	21
20–24	46	18	19	18	53	18	15	13	49	18	17	16
25–29	42	18	27	13	56	23	12	9	48	20	21	12
30–34	44	17	25	15	55	20	11	15	48	18	19	15
35–39	44	17	25	14	43	22	13	22	44	19	20	17
40–44	40	15	28	17	47	19	13	21	43	17	21	19
45–49	41	16	30	13	45	21	11	23	43	18	22	17
50–54	42	17	26	15	50	22	8	20	46	19	18	17
55–59	50	16	21	13	54	21	8	17	51	18	15	15
60–64	58	15	17	10	54	23	4	19	57	18	11	14
65–69	67	14	7	12	62	19	3	16	65	16	5	14
70–74	69	10	4	16	66	19	------	15	68	14	2	16
75–79	85	9	------	6	70	15	------	15	77	12	------	10
80–84	89	7	------	4	78	12	------	10	83	10	------	7
85 and over	84	4	------	12	86	5	------	9	85	5	------	10
Average, all ages	52	15	18	15	56	19	8	18	54	17	13	16

necessary information. In the few instances where data were unavailable, estimates were made either from the same sources in other time periods or from other similar sources. The field supervisor closely observed and checked collection of the data. Only examinations performed on residents of Monroe County were included in the final tabulations. Examinations performed in the Rochester State (mental) Hospital were excluded.

Data for four 4-week periods, each representing a different season, were collected from all hospitals, radiologists' offices, and industrial, public health, and veterans clinics in the study area. The collection periods were October 15–November 11, 1958, January 14–February 10, 1959, April 15–May 12, 1959, and July 15–August 11, 1959. All examinations recorded at each facility in each time period were counted. In very active departments and offices, however, the age and sex distributions of persons receiving chest and other very numerous examinations were estimated by subsampling.

The remaining operators of diagnostic X-ray equipment, such as board-qualified specialists in internal medicine, surgery, orthopedic surgery, and pediatrics, as well as general practitioners, osteopaths, and various non-board-qualified specialists who were certified to process workmen's compensation cases, were surveyed between March and June 1961. Examinations performed in each office during a 2-week period were recorded by age and sex of patient and type of procedure. One-half of the general practitioners and internists and all those in the remaining categories were sampled in this way. The 12 podiatrists operating X-ray equipment were not included because the preliminary survey had shown that the number of X-ray examinations they performed was negligible.

To estimate the minimum percentage of women pregnant when X-rayed, New York State's birth records were used to identify women in selected examination groups who were pregnant at the time of examination. Pregnancy was assumed in each case in which the estimated date of conception (obtained by subtracting the length of gestation from the subse-

Table 2. Annual X-ray examination rates, Monroe County, N.Y., all types combined, by age and sex

Age (years)	Males			Females			Both sexes		
	Population	Examinations per year	Examinations per 1,000	Population	Examinations per year	Examinations per 1,000	Population	Examinations per year	Examinations per 1,000
0–4	33, 296	5, 204	156	31, 648	4, 556	144	64, 944	9, 760	150
<1	6, 726	1, 969	293	6, 350	1, 641	258	13, 076	3, 610	276
1	6, 693	939	140	6, 376	988	155	13, 069	1, 927	147
2	6, 787	823	121	6, 347	627	99	13, 134	1, 450	110
3	6, 525	803	123	6, 306	614	97	12, 831	1, 417	110
4	6, 565	670	102	6, 269	686	109	12, 834	1, 356	106
5–9	29, 308	3, 907	133	28, 593	2, 801	98	57, 901	6, 708	116
10–14	25, 943	4, 498	173	24, 945	3, 088	124	50, 888	7, 586	149
15–19	18, 252	5, 320	291	19, 297	4, 124	214	37, 549	9, 444	252
20–24	13, 836	6, 048	437	17, 011	4, 934	290	30, 847	10, 982	356
25–29	16, 814	7, 783	463	17, 851	5, 237	293	34, 665	13, 020	376
30–34	18, 925	8, 778	464	20, 259	6, 702	331	39, 184	15, 480	395
35–39	20, 121	10, 102	502	21, 916	7, 877	359	42, 037	17, 979	428
40–44	19, 454	11, 275	580	21, 147	9, 158	433	40, 601	20, 433	503
45–49	17, 937	11, 036	615	19, 003	8, 791	463	36, 940	19, 827	537
50–54	15, 557	10, 443	671	16, 620	8, 881	534	32, 177	19, 324	601
55–59	14, 042	9, 597	683	15, 047	7, 926	527	29, 089	17, 523	602
60–64	12, 365	9, 139	739	14, 092	6, 932	492	26, 457	16, 071	607
65–69	10, 544	6, 210	589	12, 719	6, 272	493	23, 263	12, 482	537
70–74	8, 023	4, 904	611	10, 161	4, 420	435	18, 184	9, 324	513
75–79	5, 012	2, 795	558	6, 866	2, 997	437	11, 878	5, 792	488
80–84	2, 435	1, 404	577	3, 739	1, 820	487	6, 174	3, 224	522
85 and over	1, 203	903	751	2, 406	1, 178	490	3, 609	2, 081	577
Average, all ages	283, 067	119, 346	422	303, 320	97, 694	322	586, 387	217, 040	370

quent date of delivery) preceded the date of examination. The estimated percentage pregnant was then compared with the expected percentage for Monroe County women in the same age group.

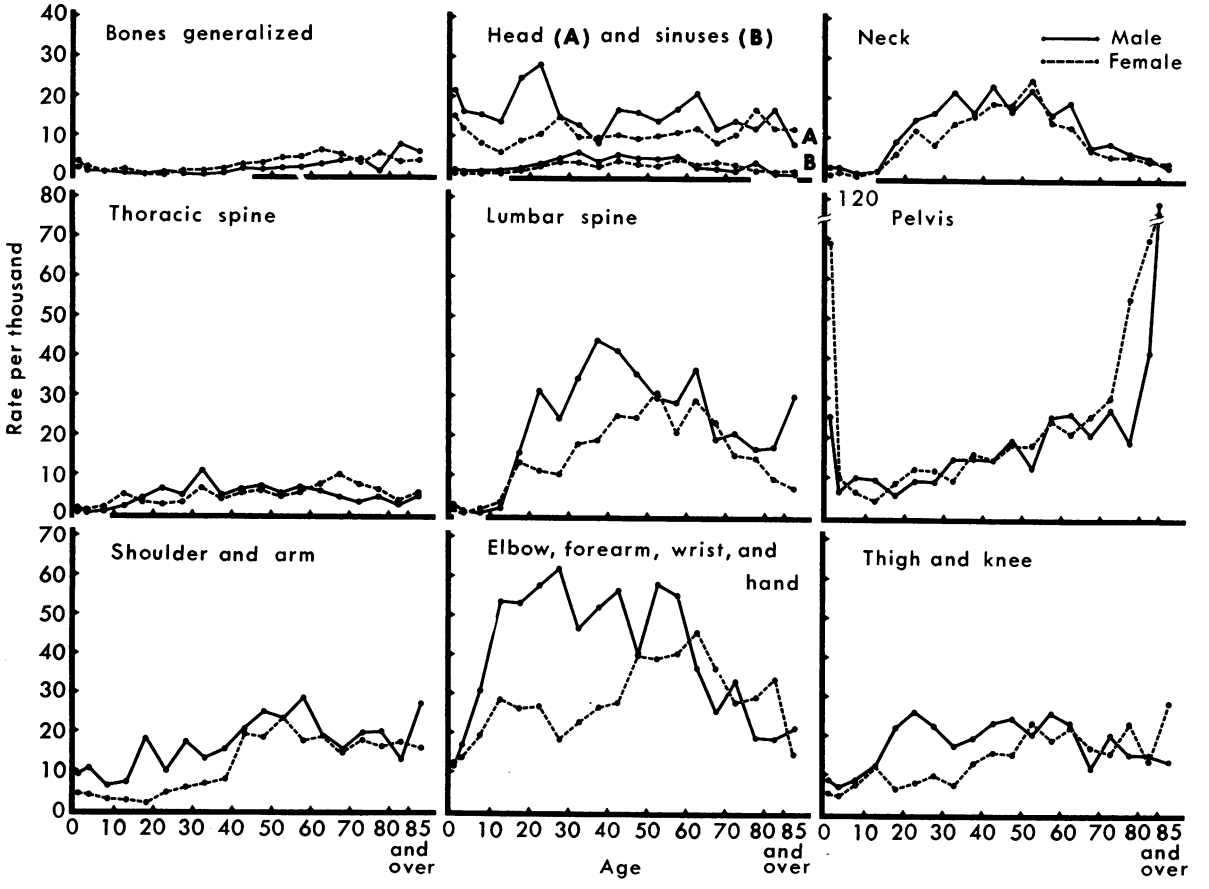
Groups requiring X-ray diagnosis might be expected, because of their disease or injury, to have a lower survival experience than other persons of the same age and sex. Thus, counting the X-rays of persons requiring diagnosis without appropriate adjustment of the data might lead to overestimation of the X-ray examination experience of the entire population. For this reason, State files of deaths were used to identify members of selected examination groups who died during the 3 years subsequent to examination. The resultant death rates were then compared with those of the Monroe County population to determine if the differences were large enough to take into consideration.

Results of Survey

The results of this survey are presented in the tables and figures. As appropriate, the rates have been based on the 1960 Monroe County population as enumerated by the U.S. census. They have been adjusted to give X-ray examinations per year rather than examinations per sampling period. No adjustment was made for the estimated 5 percent of medical care received by county residents outside of the county.

Rates so obtained describe the total number of X-ray examinations performed per year on the members of each population group considered. They do not give the numbers of individuals in each such group examined per year. Since some persons among those examined radiographically have disproportionate numbers of examinations, the fractions of the total population at risk that are actually examined per year are lower than indicated by these rates.

Figure 1. Examinations per 1,000 persons per year, by age and sex



Conversely, the X-ray exposures of the groups actually examined are correspondingly higher. Determination of the extent, however, to which various high-risk subgroups contribute to the general population's X-ray exposure experience and to what extent members of these groups actually are irradiated during various periods of their lives was beyond the scope of this study despite the crucial importance of such information.

Examining facilities. At the time of the survey about 85 percent of the X-ray examinations performed in Monroe County were undertaken in hospitals, radiologists' offices, or industrial clinics (table 1). Radiologists or personnel under their supervision carried out the great majority of these. For persons in the middle years of life, about 20 percent of X-ray procedures were conducted in industrial clinics; examinations in such clinics were infrequent, however, before the age of 20 and above the age of 65. Taking all ages together, less than 20 percent of X-ray examinations were performed in places other than hospitals, radiologists' offices, or industrial clinics.

Examinees' sex and age. The frequency with which X-ray procedures are performed shows a general rise with increasing years, a rise beginning early in childhood and in men increasing to the age of 65 (table 2). Thereafter examination frequency for this sex drops to a substantially lower level, possibly because many men retire at age 65 and hence are not eligible for study in industrial clinics; also, after the age of 65, many men probably have diminished resources available for medical care. The examination frequency for women shows the same general characteristics as for men, with the drop in examinations beginning about 5 years earlier. In addition, the examination rates of women in almost all age groups are considerably lower than those of men.

Figure 2. Examinations per 1,000 persons per year, by age and sex

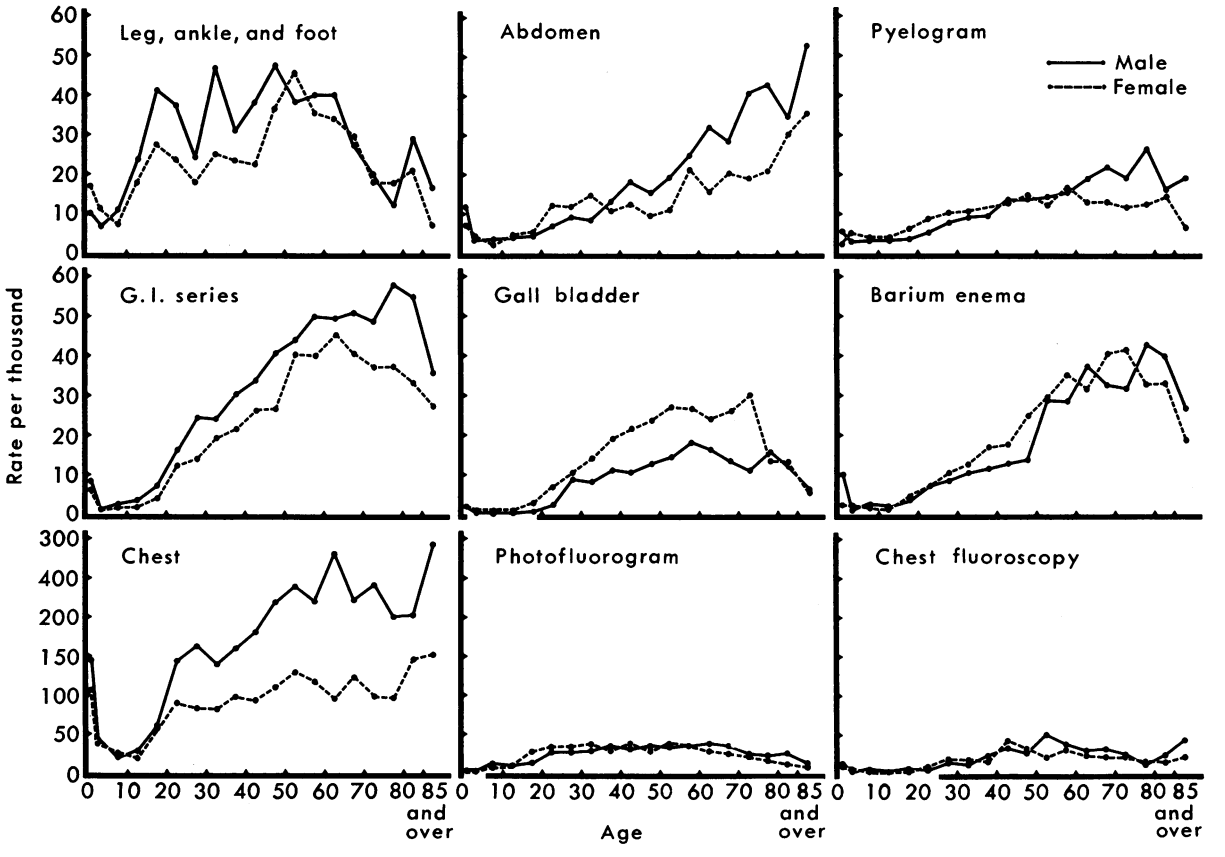


Table 3. Annual X-ray examination rates per 1,000 persons of both sexes, by type and by age of examinee, Monroe County, N.Y.

Age (years)	Head	Sinuses	Neck	Chest [1]	Photofluorogram	Thoracic spine	G.I. series	Gall bladder	Barium enema	Pyelogram	Abdomen
0–4	14.8	0.29	1.68	57.3	0.35	0.32	2.2	0.45	2.1	4.2	4.6
<1	18.2	[3].23	1.22	125.6	-------	[3].23	7.3	1.5	6.2	4.0	9.5
1	19.4	[3].23	[3].69	60.1	-------	[3].46	2.2	[3].2	1.2	2.8	3.7
2	13.1	[3].23	1.75	34.0	[3].23	[3].46	.8	[3].2	1.3	4.4	3.9
3	10.6	.78	4.52	33.7	.78	[3].23	[3].7	-------	1.0	3.0	4.3
4	12.6	-------	[3].23	32.4	.78	[3].23	-------	[3].23	[3].7	6.7	1.7
5–9	11.7	.62	.47	23.0	9.08	1.07	2.0	[3].16	1.7	3.9	2.6
10–14	9.6	.88	1.20	22.1	9.00	3.46	2.5	.31	1.2	3.5	4.2
15–19	16.5	1.49	7.38	57.3	21.63	3.62	5.3	1.54	3.9	5.0	4.6
20–24	18.3	2.43	13.06	112.3	31.19	4.41	13.8	4.64	6.9	7.4	9.6
25–29	15.2	4.04	12.20	119.5	30.95	3.92	18.7	9.66	9.4	9.2	10.3
30–34	11.2	4.80	17.56	107.7	34.33	8.73	21.2	11.13	11.5	9.9	11.5
35–39	9.0	2.81	15.84	126.7	33.02	4.33	25.4	15.15	14.2	9.3	11.6
40–44	13.4	4.33	20.86	133.8	35.05	5.96	29.5	16.26	15.3	13.0	15.0
45–49	12.9	3.52	17.89	160.4	32.92	6.85	33.2	18.22	19.3	14.2	12.2
50–54	12.0	3.23	23.43	180.2	36.73	4.94	41.8	20.82	29.0	13.2	14.5
55–59	14.1	4.37	14.99	171.3	35.75	5.91	44.3	22.45	31.7	16.0	22.7
60–64	16.3	2.49	15.84	183.1	33.30	6.77	46.9	20.37	34.0	15.7	22.8
65–69	9.9	2.79	7.44	166.7	30.48	7.82	45.0	20.20	36.8	17.2	23.6
70–74	12.1	2.20	6.82	160.3	23.37	5.55	41.8	21.83	36.8	14.7	28.1
75–79	15.0	2.19	5.81	139.8	20.29	5.56	45.7	14.23	37.0	18.4	30.1
80–84	14.1	[3].49	4.54	167.0	17.82	3.08	41.6	12.63	35.6	15.2	31.4
85 and over	10.8	[3].83	3.60	198.4	10.25	5.26	29.9	5.54	21.3	10.8	41.0
Average	13.1	2.42	10.54	106.8	23.6	4.40	21.4	10.2	14.3	9.5	11.9

[1] Exclusive of photofluorograms.
[2] Includes only fluoroscopy without associated radiography. Radiographic examinations which included fluoroscopy are tabulated in the preceding categories.
[3] Rates based on less than 10 examinations.
NOTE: 93 cardiac catheterizations, 6 angiocardiograms, and 62 cinefluorographic examinations performed in the four 4-week primary sampling periods have been omitted in the calculation of the rates in this table.

Types of examinations. Radiological practice currently comprises more than 40 examination types. Many of these are performed rather infrequently, however, and hence, in this study a number are grouped together. (Figures 1 and 2 show graphically annual rates for the major categories of examinations.) For example, all examinations of the head with the exception of radiography of the sinuses are placed in a single category; this category includes studies of the skull, mastoids, petrous pyramids, and optic foramina, as well as ventriculography and cerebral arteriography. Groupings are also made of examinations of the shoulder and arm, of the elbow, forearm, wrist, and hand, of the thigh and knee, and of the leg, ankle, and foot.

The more frequently performed types of examinations are categorized with greater specificity. For example, examinations of the chest, gall bladder, renal system, and the various divisions of the spine and the gastrointestinal tract are separately categorized.

Among the several examination categories, it is noteworthy that variations in sex and age had considerably different effects on examination rates (table 3 and figs. 1 and 2). For example, although in most categories rates tended to increase with age, this tendency was by no means invariable, as the rates for head examinations well demonstrate. Thus it is impossible to generalize, and each examination must be considered separately lest erroneous conclusions result, particularly when the objective is calculation of whole-body or organ-specific dose rates.

Table 3 shows that by far the commonest examinations were those related to the chest, either routine examinations or photofluorographic studies. These tables show also that fluoroscopic examinations conducted in the absence of radiography were relatively uncommon.

Table 3. Annual X-ray examination rates per 1,000 persons of both sexes, by type and by age of examinee, Monroe County, N.Y.—Continued

Age (years)	Lumbar spine	Pelvis	Shoulder, arm	Elbow, forearm, wrist, hand	Thigh, knee	Leg, ankle, foot	Bones, generalized	Fluoroscopy			Examination type unspecified
								Chest [2]	Abdomen [2]	Type unspecified [2]	
0–4	0.9	16.0	7.1	13.9	5.8	9.6	1.65	5.5	[3] 0.05	0.35	0.95
<1	2.0	46.5	6.7	10.9	6.7	13.2	2.52	10.5	-------	1.30	2.22
1	1.8	17.8	4.3	12.2	4.8	7.7	2.75	4.0	-------	[3] .23	1.07
2	[3] .2	4.7	14.8	11.0	6.0	9.1	.91	2.0	[3] .23	-------	[3] .69
3	[3] .5	5.1	4.5	15.3	7.9	7.6	1.79	7.9	-------	-------	[3] .23
4	-------	5.6	5.3	20.5	3.7	10.4	[3] .23	3.3	-------	[3] .23	[3] .55
5–9	1.0	8.3	4.5	24.7	7.8	8.9	.62	3.0	-------	.17	.55
10–14	2.2	7.0	4.7	40.7	12.2	21.0	.83	1.7	-------	.51	.45
15–19	14.6	7.2	9.7	38.7	13.6	34.1	[3] .08	4.0	-------	.69	.32
20–24	20.4	11.0	6.8	40.7	15.8	29.9	[3] .19	6.1	-------	[3] .29	.52
25–29	16.8	10.6	11.5	39.2	15.9	20.7	.40	16.4	-------	[3] .17	.92
30–34	26.2	12.1	9.8	34.0	11.8	35.6	[3] .15	14.3	-------	[3] .23	.77
35–39	30.8	15.6	11.4	38.7	15.8	26.9	.71	18.5	-------	.64	.95
40–44	32.7	14.6	20.0	41.2	19.4	29.9	2.07	38.1	[3] .07	1.13	1.50
45–49	29.9	18.8	21.5	40.0	19.2	41.9	2.11	28.4	-------	2.27	.70
50–54	30.4	15.5	23.4	48.0	21.6	41.9	3.01	34.2	-------	1.43	1.40
55–59	24.5	24.8	22.9	47.3	22.1	37.5	3.47	32.6	[3] .10	2.37	1.03
60–64	32.8	23.6	18.8	41.7	22.5	36.7	4.80	25.8	-------	1.70	1.21
65–69	21.4	23.3	14.5	31.3	14.2	28.5	4.64	26.0	.73	2.75	1.07
70–74	17.4	29.0	18.6	30.2	17.2	18.9	3.57	21.3	-------	2.47	.55
75–79	15.6	39.7	17.8	24.9	19.4	15.6	3.79	13.6	-------	2.02	1.43
80–84	12.5	59.0	15.7	27.7	13.8	24.1	5.34	18.3	-------	[3] .49	1.62
85 and over	14.7	116.9	20.0	16.9	23.3	10.3	4.43	28.8	-------	[3] 1.11	[3] 1.11
Average	17.8	16.1	12.6	34.8	14.7	25.9	1.70	16.3	0.04	0.97	0.86

Almost all such examinations without radiography were performed by nonradiologists using X-ray equipment in their offices. This clear-cut difference in roentgenological practice raises serious questions as to whether this difference is justified and in the best interest of the patients.

Pregnant examinees. Among 377 women age 15 to 44 years examined consecutively in 3 general hospitals, we estimated that at least 29 (7.7 percent) were pregnant:

Type of examination	*Number examined*	*Number pregnant*
Head	32	0
Chest	59	3
Photofluorogram	161	20
Thoracic spine	4	0
Gastrointestinal series	27	1
Gall bladder	25	0
Barium enema	13	0
Pyelogram	24	4
Abdomen	32	1

Similar data were obtained through the followup of a group of women examined in radiologists' offices; one woman of 37 years receiving a chest examination at a tuberculosis hospital was also pregnant. These figures should be considered minimum estimates since pregnancies which terminated very early or on the day of examination were not included. Of the 29 women estimated to be pregnant when examined, 26 were examined at least 1 month before delivery.

In the general population of women 15–44 years of age in Monroe County, about 32 of 377 (8.5 percent) would be expected to be pregnant at any given time, a rate not significantly different from that of the women examined radiographically.

Survival of examinees. Table 4 summarizes the 3-year survival experience of Monroe County residents and of a consecutive series of persons of both sexes examined in a general hospital. The data in this table will interest those concerned with effective population dosage value. It has been pointed out that persons undergoing diagnostic X-ray study may be unlikely to live as long as those in the general population and hence radiography is not likely to constitute as

large a genetic risk for them as for the general population. Although table 4 clearly indicates that persons receiving X-ray study who were more than 35 years old exhibited a lower survival in the 3 subsequent years than that of the general population of Monroe County, persons examined in the age groups under 35 years had essentially the same survival as the general population. Table 4, of course, does not give information concerning the reproductive potential of the patients X-rayed who were under 35 years. From the standpoint of survival, however, the X-rayed persons under age 35 apparently do not belong to a group whose life expectancy is much different from that of the population as a whole.

Seasonal rate variation. Table 5 gives the seasonal variation in the rates for each type of examination, expressed in percent deviations from the corresponding mean annual rates. It illustrates a substantial seasonal variation in the frequencies with which a number of examinations are conducted. (See also figures 3 and 4.) This seasonal variation may introduce substantial biases in results obtained in surveys based on examinations in periods not statistically representative of all seasons of the year.

In the fall, skeletal examinations of teenage males rise precipitously. This presumably relates to the high incidence of injuries from football. In this context, a substantial portion of the diagnostic irradiation of somatic and genetic tissues must be considered one of the undesirable byproducts not only of occupational injuries but also of injuries sustained in football and other sports with high injury rates. Since sports injury rates are believed to vary considerably between countries and cultures (*4*), injury prevention and modification in sports patterns may provide one means of reducing unnecessary X-radiation, particularly to the young.

Among women age 40 and above, skeletal examinations of certain types are much more frequent in winter than during the remaining months of the year. This is believed to be related to an increased likelihood of injury during the icy conditions of winter in upstate New York. Not all fractures among women,

Table 4. Comparison of 3-year survival experience of X-rayed hospital patients with that of the general population of Monroe County, N.Y., by age group

Age group (years)	Patients examined [1]	Persons surviving 3 years		
		Patients		Monroe County population (percent)
		Number	Percent [2]	
>5	61	57	93	98.5
5–14	48	45	94	99.9
15–24	71	71	100	99.8
25–34	112	108	96	99.7
35–44	95	83	87	99.4
45–54	117	99	85	99.4
55–64	124	104	84	95.3
65–74	131	84	64	88.6
≥75	89	50	56	72.3
Total	848	701	[3] 88.3	97.0

[1] Based on X-ray examinations of the following types performed consecutively in a general hospital: head, chest, thoracic spine, G.I. series, gall bladder, barium enema, pyelogram, and abdomen.

[2] These percentages should be taken as maximum estimates since deaths among persons who moved from the county during the 3-year period are not included.

[3] Total survival adjusted to age distribution of the Monroe County population.

however, show substantial seasonal variation. Both the data obtained in this survey with respect to the examinations of the thigh and knee (a category which included examinations of the hip) and results of an unpublished study of femoral fracture rates in another upstate New York county by J. E. Goggin, W. Haddon, Jr., G. S. Hambly, and J. R. Hoveland show no such variation. Nonetheless, seasonal variation in skeletal X-ray examinations when it does occur serves as another example of how factors contributing to physical injury and other pathological conditions substantially determine the extent to which the population is irradiated diagnostically.

In this connection, it would be useful to regard the prevention of unnecessary irradiation in much broader terms than is usually the case, considering, for example, not only the various exposures to X-radiation and their justifications but also the prevention of the conditions which lead to such exposure. Until prevention

is thus broadly based, the X-irradiation that man receives is unlikely to be reduced to the extent desirable.

Finally, as the foregoing comments on seasonal variation suggest, the study of type-specific X-ray examination rates can provide epidemiologists with several types of useful information. Where a given category of examination bears a substantial relationship to the suspicion of disease in a specific structure or organ, distribution of that examination by age, sex, and other population characteristics can be used both as the basis of epidemiologic investigations of that disease and as the starting point in planning studies of more precise focus. Variations in type-specific examination rates can also serve as one basis of the choice of study groups in investigations of the effects of X-rays on human health.

Summary

The doses of ionizing radiation received by the population from medical X-ray sources are determined by the numbers and types of examinations performed and by certain dosimetric

Table 5. Seasonal variations in X-ray examination rates, expressed in percent deviation from corresponding mean annual rates, Monroe County, N.Y., 1958–59

Examination	Fall	Winter	Spring	Summer	Examination	Fall	Winter	Spring	Summer
Head:					Abdomen:				
Males	−6	6	−1	1	Males	−3	3	−2	2
Females	−1	−2	1	2	Females	−6	−6	7	5
Both sexes	−4	3	1	0	Both sexes	−4	−2	3	3
Sinuses:					Lumbar spine:				
Males	9	15	9	−33	Males	−7	6	3	−2
Females	25	25	−9	−41	Females	−3	9	−3	−3
Both sexes	17	19	1	−37	Both sexes	−5	7	0	−2
Neck:					Pelvis:				
Males	−3	6	2	−6	Males	−14	8	14	−8
Females	−14	−9	23	1	Females	−6	28	−8	−14
Both sexes	−8	−1	12	−3	Both sexes	−10	19	2	−11
Chest:					Shoulder and arm:				
Males	−1	1	11	−11	Males	−4	8	−10	6
Females	−4	9	9	−14	Females	−9	19	0	−10
Both sexes	−2	4	10	−12	Both sexes	−6	13	−6	−1
Photofluorograms:					Elbow, forearm, wrist, and hand:				
Males	−25	−20	18	26	Males	1	−8	−1	8
Females	−18	−26	23	20	Females	−14	31	−4	−13
Both sexes	−21	−23	21	23	Both sexes	−5	7	−2	0
Thoracic spine:					Thigh and knee:				
Males	−25	15	4	5	Males	−3	10	3	−9
Females	6	2	−6	−1	Females	3	−3	−6	7
Both sexes	−9	8	−1	2	Both sexes	−1	4	−1	−3
G.I. series:					Leg, ankle, and foot:				
Males	−14	7	24	−17	Males	−12	7	−5	10
Females	−11	16	13	−19	Females	−7	12	−11	6
Both sexes	−13	11	19	−18	Both sexes	−10	10	−7	8
Gall bladder:					Bones, generalized:				
Males	−2	17	−1	−15	Males	−7	5	−21	23
Females	−4	7	8	−11	Females	4	−14	16	−6
Both sexes	−3	11	5	−12	Both sexes	0	−7	3	4
Barium enema:					Fluoroscopy of chest:				
Males	14	−2	13	−25	Males	−1	−3	−7	11
Females	13	3	−5	−11	Females	10	−23	16	−2
Both sexes	13	1	3	−17	Both sexes	3	−11	2	6
Pyelogram:									
Males	6	−2	−15	11					
Females	1	−2	4	−3					
Both sexes	3	−2	−5	4					

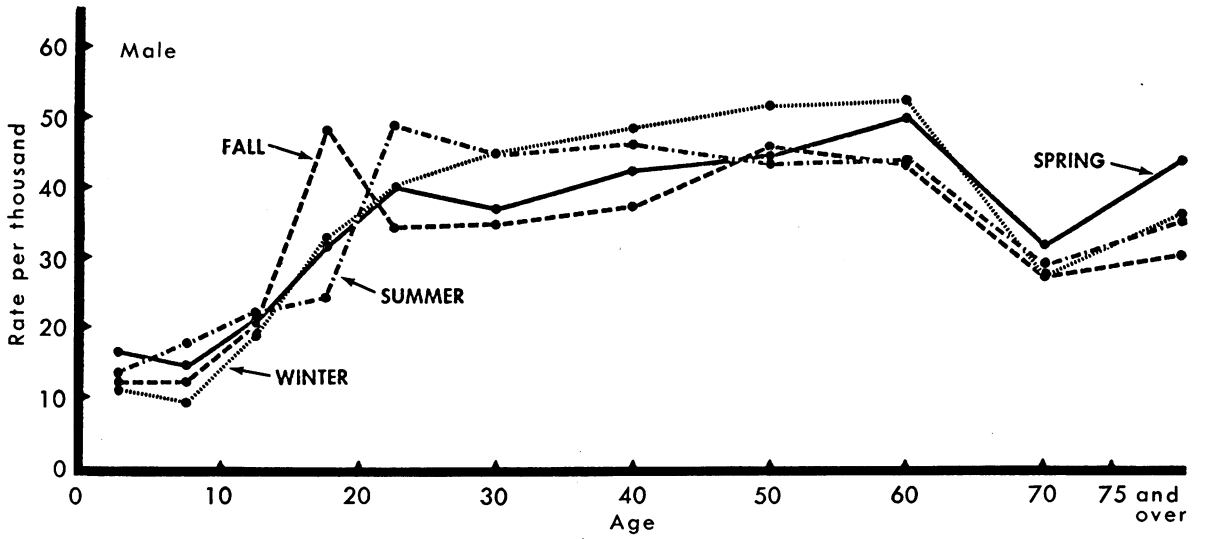
NOTE: Differences from zero in the line totals are due to rounding.

relationships associated with the techniques employed in each examination type. In Monroe County, N.Y., a survey was undertaken to determine the per capita rates with which the various medical radiological examinations were performed in a large, predominantly urban population with a high level of medical care.

Age, sex, and type-specific rates are given for 20 categories of diagnostic examinations. Rates in general increased with age, but the patterns of increase varied considerably by age, sex, and type of examination. Many skeletal and other examinations varied seasonally, in some cases apparently as the result of variations in weather and in athletic activities.

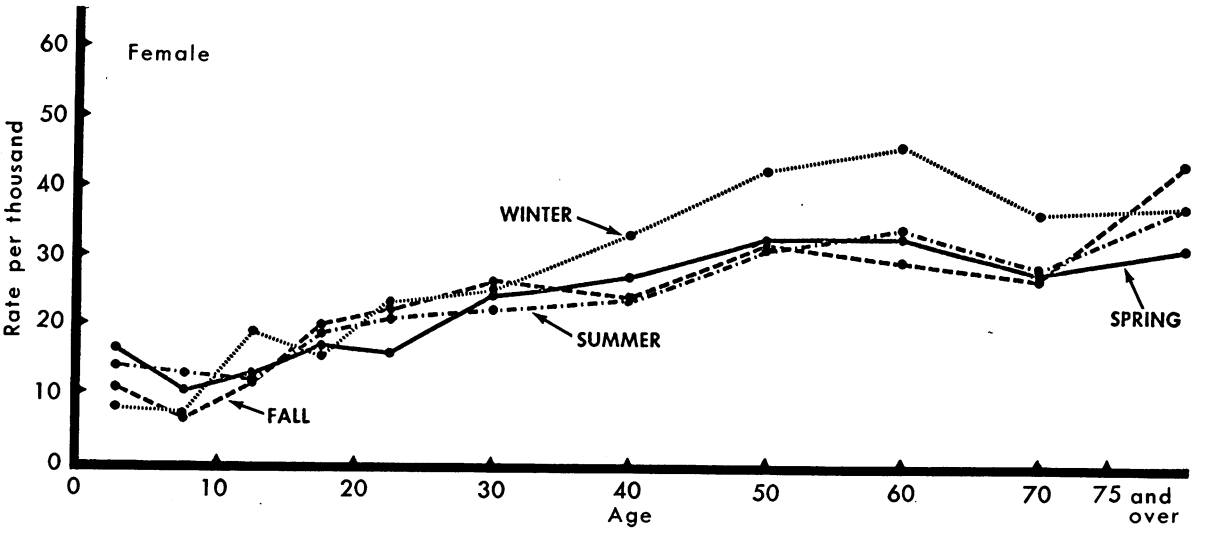
In a subsample of those examined, the percentage of women pregnant was similar to that estimated for the general population. Also, the

Figure 3. Skeletal examinations per 1,000 males per year, by age and season



NOTE: Examinations included in calculations of these rates were of the head; neck; thoracic spine; lumbar spine; pelvis; shoulder and arm; elbow, forearm, wrist, and hand; thigh and knee; and leg, ankle, and foot.

Figure 4. Skeletal examinations per 1,000 females per year, by age and season



NOTE: Examinations included in calculations of these rates were of the head; neck; thoracic spine; lumbar spine; pelvis; shoulder and arm; elbow, forearm, wrist, and hand; thigh and knee; and leg, ankle, and foot.

3-year survival rates of examinees under 35 years of age were essentially the same as those of the general population.

In addition to the use of X-ray examination rates in assessing population doses of ionizing radiation, the study of such rates is useful to epidemiologists in a variety of ways.

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(*1*) Laughlin, J. S., Meurk, M. L., Pullman, I., and Sherman, R. S.: Bone, skin and gonadal doses in routine diagnostic procedures. Amer J Roentgenol 78: 961–982 (1957).

(*2*) Ministry of Health: Radiological hazards to patients. Second report of the committee. London, 1960.

(*3*) Haddon, W., Jr., Carlos, J. P., and Ast, D. B.: Frequency of dental X-ray examinations in a New York County. Public Health Rep 77: 525–532, June 1962.

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DOCUMENTATION NOTE

Additional tables showing annual rates for various types of X-ray examinations for both sexes and all age groups in this Monroe County, N.Y., survey have been deposited as document No. 8345 with the American Documentation Institute, Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington, D.C., 20025. A photocopy or a 35-mm. microfilm of the additional tables may be obtained by remitting in advance $1.25. Make checks or money orders payable to Chief, Photoduplication Service, Library of Congress.

New Facility for Mentally Retarded

The Public Health Service has awarded a $724,725 grant to the Fernald State School, Waltham, Mass., under the Mental Retardation Facilities and Community Mental Health Construction Act of 1963. The grant will aid in the construction of a new research center and a community evaluation and rehabilitation center, which will be used for diagnostic and evaluation procedures and for training in the medical specialties, special education, psychology, social work, nursing, and other areas. The total construction cost will be approximately $2.6 million.

Fernald State School is the third recipient of a construction grant under the act. In February, grants totaling $3,860,250 were awarded to the Children's Rehabilitation Institute, Reisterstown, Md., an affiliate of Johns Hopkins University Medical Center, Baltimore, and to Georgetown University Medical Center, Washington, D.C.