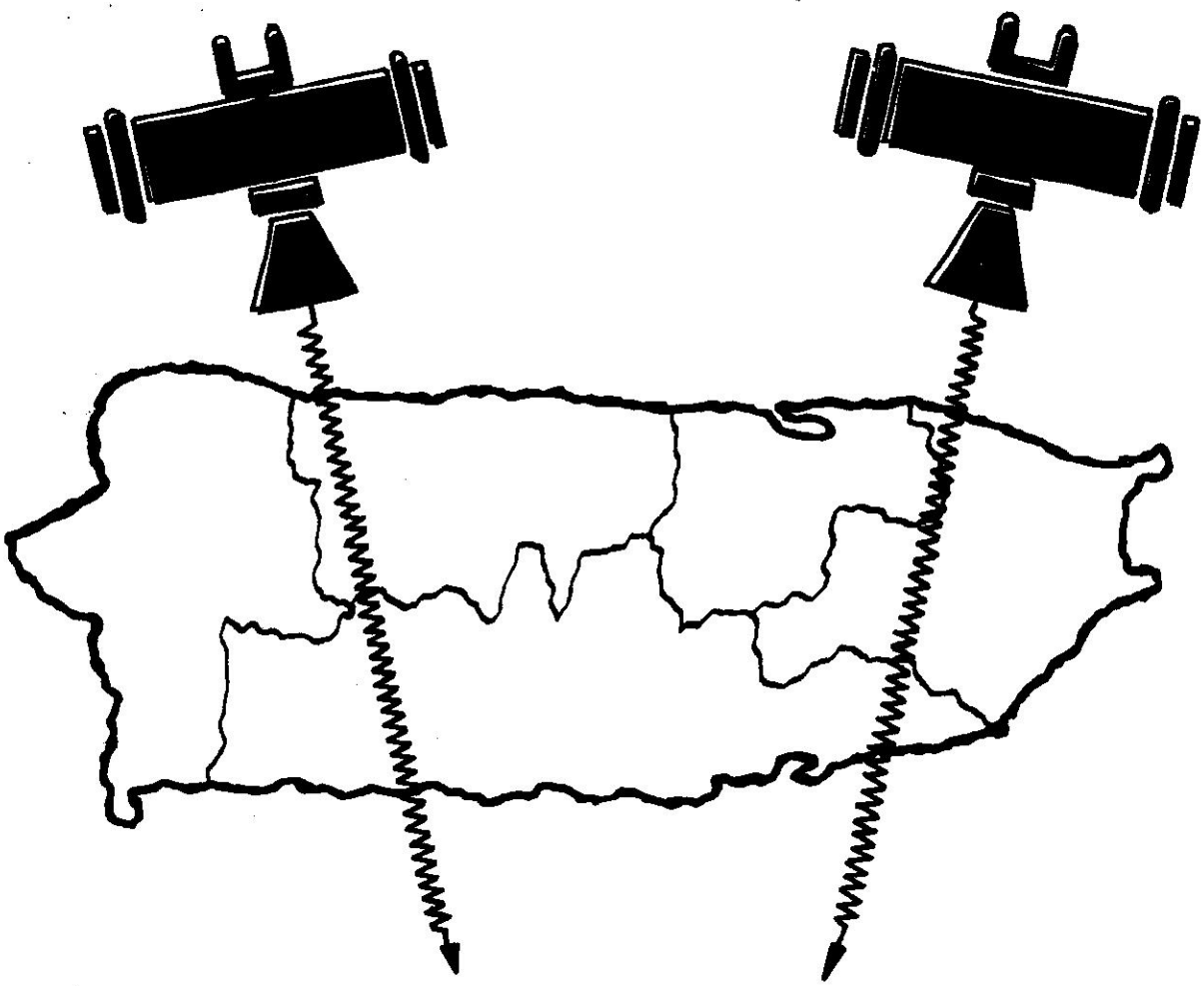
JOINT RADIATION SURVEY



COMMONWEALTH OF PUERTO RICO

NUCLEAR CENTER

DEPARTMENT OF HEALTH

EVALUATION OF HEALTH HAZARDS DUE TO UNINTENTIONAL IRRADIATION OF THE GONADS DURING ROUTINE ABDOMINAL X-RAY EXAMINATION OF MALE AND FEMALE PATIENTS IN PUERTO RICO.

REPORT NUMBER 3 - SURVEYED AREAS OF THE NORTHERN REGION

ARECIBO - BAYAMON - CAGUAS - FAJARDO AREAS

MICHAEL GILEADI - SENIOR ASSOCIATE

PUERTO RICO NUCLEAR CENTER

MAY 1971

MOTTO

"I believe it is important that we keep in mind that our goal is not to deny or even delay a single x-ray examination that is needed by a patient. Rather, we wish to develop a system such that only those x-rays are given which are needed and only the best techniques are employed to reduce the average doses from x-ray examinations to not more than 10% of present values".

Dr. Karl. Z. Morgan, Director
Health Physics Division, Oak Ridge National Laboratory

(From the testimony presented before the House of Representatives on bill H. R. 10790, October 11, 1967).

The primary purpose of the Joint X-ray Radiation Survey sponsored jointly by the Puerto Rico Nuclear Center and the Department of Health of the Commonwealth of Puerto Rico is to evaluate possible radiation hazards associated with selected groups of x-ray diagnostic procedures.*

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* The responsibility for radiation protection and control — associated with the use of radiation in medicine, education and commerce in Puerto Rico — rests with the Radiological Health Program, in the Department of Health of the Commonwealth of Puerto Rico.

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ACKNOWLEDGEMENT

TO ALL THE WONDERFUL MEDICAL WORKERS
IN THE SMALL AND IN THE BIG COMMUNITIES,
WHO IN SPITE OF THEIR TREMENDOUS WORKLOAD
SO WILLINGLY DEVOTED THEIR TIME AND EFFORT
TO HELP US IN THIS SURVEY
— THIS THIRD REPORT IS DEDICATED —

INTRODUCTION

This is the third progress report within the framework of the Joint Radiation Survey, sponsored by the Department of Health of the Commonwealth of Puerto Rico and the Puerto Rico Nuclear Center.

It contains information related to the evaluation of possible health hazards associated with a selected group of diagnostic x-ray procedures performed in the four central and northeastern areas of the Northern Region of Puerto Rico, namely Arecibo, Bayamón, Caguas and Fajardo. This is a densely populated region, with a total population of 1,168,500. Most of the information is presented in the form os statistical and dosimetric data-valuable both per se and within the context of the hazards' evaluation.

As the survey progressed, more and more ramifications of the problem became apparent. This is significant, since our most efficient weapon in radiation protection is possibly the knowledge and the awareness of potential hazards associated with certain procedures.

This report contains an appendix on radiotherapy practices in Puerto Rico; to our knowledge, the first survey on this subject. Since the first x-ray unit was brought to the Island in 1912-to La Princesa prison in San Juan by Dr. Jose Carbonell, and the first fifty milligrams of radium were bought by Dr. I. González Martínez in 1923-both diagnosis and therapy in our community have made enormous progress. Today we have twenty x-ray units for various types of x-ray radiation therapy, about fifteen radio-isotope units for deep penetrating radiation and more than fifty units in nuclear medicine.

In our community, cancer is the second cause of death. The considerable development of radiotherapy and nuclear medicine indicates the dimension of the efforts put forth against this major foe of our population. Nuclear medicine, which more than any field of medicine has benefited from the close cooperation of

various disciplines such as electronic engineering, physics, chemistry and medicine, has made enormous progress in the last few years in Puerto Rico. More than ten centers around the Island, both public and private, are already using the most modern instruments for nuclear-medical procedures such as for renal function, thyroid uptake, blood volume determination, and nuclear scanning procedures for the inner organs of the body.

There is data pointing to a correlation between radiation and tumors in the blood-forming organs (leukemia), in the skin, skeleton (sarcoma of the bone), in the lungs, liver, etc. Excessive radiation may reduce the life span of the irradiated individual as irradiation decreases the general immunity of the body.

The following table points to a shortening of the life span of radiologists due to an accumulated occupational dose.

AVERAGE AGE AT DEATH*
United States-1956

Physicians having no known contact with radiation	65.7 years
Specialists having some exposure to radiation (Dermatologists, urologists, etc.)	63.3 "
Radiologists	60.5 "

In Puerto Rico**, the average life span for those over age twenty five in 1966 was:

Males - 67.49 years

Females - 73.11 years

* National Academy of Sciences-National Research Council. "The Biological Effects of Atomic Radiation". Summary Reports, Washington, D. C. 1956.

** Puerto Rico Department of Health, Division of Demographic Registry and Vital Statistics. 1968.

The above statistical findings indicate that radiation damage may justly be considered as an occupational hazard, and that we ought to investigate and determine the occupational exposures of various types such as the average exposure received by radiologists, x-ray technicians, radiotherapists, nuclear medicine technicians and industrial workers dealing with radiation sources.

It is our intention to computerize our data for increased efficiency and for better accessibility.

Due to our interest in the well being of the younger generation, we also intend to investigate radiation sources and measurements in the secondary schools and college laboratories, scheduled as a future joint project of the Department of Health and the Nuclear Center, whose collaboration has produced such fruitful results to date.

Ernesto Colón Yordán, M.D.
Secretary of Health

SUMMARY

Per capita annual gonadal doses associated with a selected group of abdominal and thoracical x-ray diagnostic procedures have been determined in the four Surveyed Areas of the Northern Region during 1968.

The Genetically Significant Dose for the Northern Region of Puerto Rico 1968 will be evaluated after completing the Survey of the San Juan Metropolitan Area, which probably has more x-ray units than the four surveyed areas of the Northern Region.

The most significant results and data are tabulated below:

Summary of Significant Results

	Surveyed Areas of the Northern Region-1968				
	Caguas	Fajardo	Arecibo	Bayamon	Total
Number of diagnostic x-ray units (excluding dental x-ray units) in Area	52	18	46	34	150
Total number of abdominal x-ray diagnostic examinations termed "genetically hazardous" performed in public institutions and in private offices	42,201	11,330	37,572	20,101	111,204
Total number of thoracical examinations performed in public institutions and in private offices	89,654	12,638	78,209	43,493	223,994
Number of x-ray diagnostic examinations performed in public institutions only	131,710	43,211	133,916	44,405	353,242
Total number of all x-ray diagnostic examinations performed in public institutions and in private offices	166,933	48,803	166,596	77,102	459,434
Population per x-ray unit	7,096	6,450	7,452	17,647	7,790
Number of x-ray examinations per 100 patients in public institutions	18.2	10.5	24.0	8.1	15.8
Number of radiologists in area	2	2	3	6	13
Population per radiologists in area	184,500	58,050	114,226	56,776	89,884
Mean gonadal dose per abdominal x-ray diagnostic examination (mrads)	517.2	511.8	513.9	551.1	521.7
Mean gonadal dose per thoracical x-ray diagnostic examination (mrads)	0.93	1.03	.70	1.04	.88
Per capita per annum gonadal dose due to abdominal and thoracical x-ray diagnostic examinations (mrads)	58.3	50.0	56.4	32.6	49.8

The Arecibo Area dose evaluations are based on dose measurement made at the Arecibo District Hospital, using a Siemens-300 MA x-ray unit as irradiation source. This source was chosen as typical because of its frequency of occurrence in this area.

Dose evaluations in the Caguas, Fajardo and Bayamón Areas are based upon measurements made on a Picker-200 MA unit - typical of these areas.

An appendix added to this report contains information concerning Radiotherapy and Nuclear Medicine in Puerto Rico.

SURVEYED AREAS OF THE NORTHERN REGION

The Northern Region consists of five Areas: (1) the San Juan Area, (2) the Arecibo Area, (3) the Bayamón Area, (4) the Caguas Area, and (5) the Fajardo Area.

Areas surveyed in this report include:

The	Arecibo Area,	population	342,800
"	Bayamón "	"	340,600
"	Caguas "	"	369,000
"	Fajardo "	"	116,100

Total population of surveyed Areas 1,168.500

The four surveyed Areas represent the most densely populated parts of Puerto Rico. There are two District (Regional) Hospitals in these surveyed Areas, one in Arecibo and one in Fajardo (in Caguas a Sub-Regional Hospital will be opened in July, 1971).

The major medical facilities in the surveyed Areas include:

(a) 23 Health Centers
(b) 10 private hospitals
(c) 9 private clinics
(d) 4 Public Health Units
(e) 3 T.B. hospitals and T.B. Centers

There are a total of one-hundred fifty diagnostic x-ray units in the Surveyed Areas (with the exception of dental units) and there were 459,434 x-ray examinations performed in the surveyed Areas in 1968, including 111,204 abdominal examinations termed "genetically hazardous", and 223,994 thoracical examinations. During the same time interval, 555,014 exposures (films) were made.

During the year 1968, 459,434 diagnostic x-ray examinations among a population of 1,168.500 amount to an average of 39 x-ray examinations administered per 100 population. The global gonadal dose received by the total population of 1,168,500 in the year 1968 was evaluated by the present survey as 58,213,828 mrads. This figure includes gonadal doses due to a selected set of abdominal x-ray diagnostics as well as all thoracical x-ray diagnostics.

Background Facts

Some basic background facts referring to the specific demographic and socioeconomic patterns of Puerto Rico are given herewith in an attempt to facilitate the understanding and interpretation of data and results presented within the framework of this Survey.

Puerto Rico is the smallest and most easterly Island of the Greater Antilles with an approximate area of 3,435 square miles. Approximately 75 percent of its total area are mountains and hills--the rest is a narrow coastal area, with some valleys. The population of the Island was 2,739,100 in 1968 and the projected population for 1973 is 2,985,000. The mountainous area is preponder-

ately rural, where the population lives in a rather traditional fashion. As a contrast the urban areas are rapidly developing, industrializing and changing their socioeconomic structure.

In the past Puerto Rico's economy was largely agricultural (sugar, coffee, tropical fruits, etc.) — but in the last two decades dramatic changes and tremendous technical developments have taken place, raising the average per capita income substantially.

The development of the economy was accompanied by even more significant improvements in the field of health, the most significant ones being enumerated below:

(a) The death rate has been dramatically reduced from 20.9% in 1937 to 6.0% in 1970.
(b) Infant mortality has been reduced from 138.5 per 1000 live births in 1937 to 28.5 per 1000 live births in 1970.
(c) Deaths associated with deliveries and/or complications of pregnancy were 7 per 1000 live births in 1932, it has dropped to .5 per 1000 live births in 1970.
(d) Life expectancy increased from 46 years in 1940 to 71.7 in 1970.

These achievements, no doubt, are due to improvements of public health, and of the socio-economic level, especially during the last few years.[1]

Out of a total population of 2,739,100 in 1968 there were 1,361,300 males and 1,377,800 females. In the 15-29 age group the number of males and females was approximately equal, however in the 30-44 age group the number of females was significantly larger: 181,300 males as compared to 218,500 females.[2]

Among others this may be a reason why the total number of x-ray examinations is higher for females than for males in Puerto Rico and so is the global gonadal dose to the female population.

For example, in the Bayamón Health Center a total of 16,749 photofluorographies were performed in 1968. Out of this, 3,350 were for male patients and 13,399 were for female patients. The preponderance of the female patients in photofluorography-cases was due to the fact that the Bayamón Health Center mostly screens the working population in the industrial area of Bayamón, of which about 80% are women.

In the Fajardo District Hospital it was pointed out by the Chief Radiologist that females receive 70% of the x-ray examinations in the hospital due to the specific demographic distribution of the area.

Early marriages are customary in Puerto Rico; there were 149 live births to mothers below 15 in 1968 and 11,393 live births to mothers within the 15-19 age bracket. Total live births in Surveyed Areas of the Northern Region-1968: 22,579.

LIVE BIRTHS BY MEDICAL FACILITIES AND BY LOCATION, P. R.– 1968.

Geographic Location	Government Hospitals, Municipal Hospitals & Health Centers	Private Hospitals	Home & Other Locations	Total
Caguas and Fajardo	7,645	1,975	536	10,156
Arecibo	6,103	1,394	498	7,995
Bayamón	3,300	999	129	4,428
TOTAL	17,048	4,368	1,163	22,579

[1] Data based on Plan for Hospital and Medical Facilities, 1968. Commonwealth of Puerto Rico, Department of Health.

[2] Vital Statistics of the Department of Health, Commonwealth of P.R.

The number of pelvimetries performed in 1968 in the Surveyed Areas is 2,120, meaning that approximately one out of every ten live births was accompanied by a pelvimetry. Of 9,223 live births in the Western Region in 1968, one of every three live births was accompanied by a pelvimetry and in the Southern Region in 1968, which had 13,931 live births, approximately one of every twenty-eight live births was accompanied by a pelvimetry.

Two levels of health care are conducted by the Puerto Rico Department of Health: local Health Centers and District (Regional) Hospitals.

The basic unit of health-care in Puerto Rico is the Health Center, which provides free medical care, preventive health services, and certain social services. There are sixty-six Health Centers on the Island distributed among seventy-seven communities.

There were five District (Regional) Hospitals operating on the Island in 1968:[1]

(1) The District (Regional) Hospital in Ponce, serving the twenty municipalities comprising the Southern Region, with a 412 bed capacity and 15 x-ray units. The total number of x-ray examinations performed in the hospital during 1968 was 33,126.

(2) The Fajardo District Hospital serves the seventeen municipalities comprising the Fajardo Area; has a 280 bed capacity and 5 x-ray units. X-ray examinations performed in this hospital in 1968 totaled 26,548 in number.

(3) The Arecibo District Hospital, serving twelve municipalities, has 280 beds and 6 x-ray units. The number of x-ray examinations performed in this hospital in 1968 was 33,800

(4) The Aguadilla District Hospital, also serving twelve municipalities, has 300 beds and 3 x-ray units. In 1968, 27,565 x-ray examinations were performed in this hospital.

(5) The Río Piedras District (Regional) Hospital is also the University Hospital. This facility has 395 beds and 30 x-ray units. During 1968, 70,620 x-ray examinations were performed

Also in 1968, there were four tuberculosis hospitals with 7 x-ray units, two hospitals for mental illness and one hospital for leprosy.

In addition, there were 16 private hospitals with 38 x-ray units and 16 private clinics with 25 x-ray units.

The following table shows the trend in exposures in the last fifteen years in the District Hospitals.

[1] Commonwealth of P.R. Department of Health, Plan for Hospital and Medical Facilities, 1968.

WORK PERFORMED IN THE RADIOLOGY DEPARTMENTS OF THE DISTRICT HOSPITALS *

NUMBER OF EXPOSURES (FILMS) TAKEN IN THE DISTRICT HOSPITALS IN THE LAST FIFTEEN FISCAL YEARS, BY LOCATION AND BY YEARS
PUERTO RICO 1954-1970

Years	Aguadilla	Arecibo	Fajardo	Ponce	Rio Piedras
1954-55	10,124	13,559	16,176	7,239	21,415
1955-56	11,731	12,598	18,017	14,155	27,498
1956-57	12,438	15,336	16,735	27,756	30,966
1957-58	14,246	15,933	19,989	30,124	33,421
1958-59	15,146	16,626	21,379	33,564	37,467
1959-60	18,729	19,773	20,854	40,145	38,275
1960-61	19,973	20,038	22,906	47,186	58,672
1961-62	19,996	22,593	22,272	53,659	75,146
1962-63	22,517	31,277	22,372	68,304	67,671
1963-64	29,574	31,635	21,590	81,704	80,946
1964-65	30,698	29,800	25,632	76,021	88,934
1965-66	36,218	29,880	26,526	77,202	49,236
1966-67	39,021	32,222	26,441	72,030	60,457
1967-68	42,412	36,019	26,147	71,473	66,745
1968-69	52,337	43,916	27,552	80,812	74,006
1969-70	57,578	50,378	30,702	80,470	73,563

* Courtesy of the Information and Control Section, Department of Health of Puerto Rico.

COLLECTION AND ANALYSIS OF STATISTICAL DATA
Surveyed Areas of the Northern Region
Puerto Rico — 1968

Following previous experience the data was collected by means of properly designed questionnaires, mailed to all public and private medical facilities in the Surveyed Areas, along with a cover letter of the Deputy Secretary of Health, Dr. Carlos Nater.

Instead of using several questionnaires — as has been done in the previous part of the survey — a special questionnaire was prepared for private medical offices in order to expedite data collection. A sample of this questionnaire and that of the cover letter is part of the report.

In spite of the high (70%) rate of response, it was nevertheless necessary to visit each facility because part of the returned questionnaires was not satisfactorily completed and because some of the data had to be rechecked.

Even though cooperation was in general very good, data from the majority of private offices was given on a weekly basis only, which understandably introduced certain inaccuracies in data compiling. For obvious reasons we chose to accept these inaccuracies instead of excluding the figures referring to the private sector.

The breakdown of data by ages also posed certain difficulties due to the fact that approximately 80% of both public and private medical facilities do not keep records of their patients' ages.

Logbooks in the x-ray departments of even the large District Hospitals were somewhat incomplete. In some places the breakdown by ages was missing, in other places data for certain months had not been entered, etc.

The breakdown by age in private offices could only be estimated from the average weekly figures.

Hopefully computerization of data which is to begin next year in all District Hospitals and some Health Centers will significantly improve this situation.

In order to collect data in some of the private hospitals, we used a sampling technique choosing data from the files for the weeks of:

March 1-6, 1968
June 9-13, 1968
September 16-21, 1968
November 23-28, 1968

All collected data were thoroughly checked for accuracy and reliability, and data pertaining to public institutions were confirmed by the signature of the responsible person in charge. Once reliability and accuracy were established, data were uniformized and tabulated, and certain rates and indicators of interest were derived, and suitable interpretations added. Wherever considered desirable figures were added for better presentation and clarification of the situation.

RECOMMENDATION LETTER AND

SAMPLE QUESTIONNAIRE

ESTADO LIBRE ASOCIADO DE PUERTO RICO

DEPARTAMENTO DE SALUD

SAN JUAN, PUERTO RICO, 00908

OFICINA DEL SECRETARIO DE SALUD

24 de junio de 1970

MEMORANDO

A : Médicos de Hospitales Públicos y Privados, Médicos en Práctica Privada y Radiólogos

De : Carlos E. Náter, M.D.
Subsecretario de Salud

Asunto : Encuesta sobre radiación y evaluación de la irradiación de los gónados durante los exámenes de rutina de Rayos X en los hombres y las mujeres de Puerto Rico.

El Departamento de Salud, conjuntamente con el Centro Nuclear de la Universidad de Puerto Rico, perteneciente a la Comisión de Energía Atómica de los Estados Unidos, está realizando un estudio minucioso de todas las facilidades de Rayos X en Puerto Rico mediante una encuesta y una evaluación de los posibles peligros no intencionados que pudieran tener los diferentes equipos de Rayos X existentes en la Isla.

Esta encuesta está realizándose por el Sr. Michael Gileadi, M.S., Científico Asociado del Centro Nuclear de Puerto Rico, y sus ayudantes, quienes le visitarán próximamente para explicarles cómo se conducirá dicha investigación.

En las Regiones Oeste y Sur de Puerto Rico se hizo un estudio similar que fue de gran provecho para todas las instituciones y médicos privados, ya que se pudo identificar y corregir a tiempo pequeños defectos en los equipos que ofrecían algún peligro de radiación no intencionada. Al mismo tiempo se pudo determinar con gran acierto qué medidas tomar para evitar radiación innecesaria a los gónados de ambos sexos.

Esperamos que se le ofrezca al señor Gileadi la mayor cooperación y toda la información necesaria para que esta investigación científica e instructiva tenga el mejor de los éxitos.

LIST OF TABLES

TABLE I-N

MUNICIPALITIES IN SURVEYED AREAS OF THE NORTHERN REGION.
PUERTO RICO - 1968 [1]

AREA	MUNICIPALITIES	POPULATION
CAGUAS	AGUAS BUENAS	19,200
	AIBONITO	22,100
	CAGUAS	77,000
	CAYEY	43,400
	CIDRA	23,400
	GURABO	20,100
	HUMACAO	34,200
	JUNCOS	28,500
	LAS PIEDRAS	17,800
	NAGUABO	20,900
	SAN LORENZO	30,500
	YABUCOA	31,900
CAGUAS AREA, TOTAL		369,000
ARECIBO	ARECIBO	83,400
	BARCELONETA	25,600
	CAMUY	20,000
	CIALES	16,200
	HATILLO	24,900
	LARES	24,600
	MANATI	33,300
	MOROVIS	20,100
	QUEBRADILLA	14,500
	UTUADO	47,700
	VEGA BAJA	32,500
ARECIBO AREA, TOTAL		342,800
FAJARDO	CEIBA	13,100
	CULEBRA	900
	FAJARDO	24,700
	LOIZA	32,800
	LUQUILLO	12,100
	RIO GRANDE	24,100
	VIEQUES	8,400
FAJARDO AREA, TOTAL		116,100
BAYAMON	BARRANQUITAS	19,000
	BAYAMON	117,000
	CATAÑO	23,900
	COMERIO	21,100
	COROZAL	28,100
	DORADO	18,600
	NARANJITO	19,600
	OROCOVIS	21,200
	TOA ALTA	18,700
	TOA BAJA	30,500
	VEGA ALTA	22,900
BAYAMON AREA, TOTAL		340,600
SURVEYED AREAS OF THE NORTHERN REGION.		1,168,500

[1] THE ABOVE DATA ARE QUOTED FROM THE ANNUAL VITAL STATISTICS REPORT, 1968, DEPARTMENT OF HEALTH, PUERTO RICO.

TABLE 2-N

DISTRIBUTION OF X-RAY UNITS BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY AND POPULATION PER X-RAY UNIT.

SURVEYED AREAS OF THE NORTHERN REGION

PUERTO RICO-1968.

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
CAGUAS	AGUAS BUENAS	PRIVATE OFFICES	1	19,200	19,200
	AIBONITO	MENNONITE HOSP.	2	22,100	11,050
	CAGUAS	MUNICIPAL HOSP.	1		
		SAN RAFAEL HOSPITAL	4		
		PUBLIC HEALTH UNIT AND T.B CENTER	2		
		PRIVATE OFFICES	10		
		CAGUAS TOTAL	17	77,000	4,529
	CAYEY	T.B. HOSPITAL AND T.B CENTER	2		
		FONT CLINIC	1		
		HEALTH CENTER	1		
		PRIVATE OFFICES	4		
		CAYEY TOTAL	8	43,400	5,425
	CIDRA	PRIVATE OFFICES	1	23,400	23,400
	GURABO	SAN JOSE CLINIC	1	20,100	20,100
CAGUAS	HUMACAO	ORIENTE CLINIC	1		
		HEALTH CENTER	3		
		FONT MARTELO HOSPITAL	1		
		RYDER MEMORIAL HOSPITAL	2		
		PRIVATE OFFICES	3		
		HUMACAO TOTAL	10	34,200	3,420
	JUNCOS	T.B. CENTER	1		
		PRIVATE OFFICES	5		
		JUNCOS TOTAL	6	28,500	4,750
	LAS PIEDRAS			17,800	NO X-RAY UNIT
	NAGUABO			20,900	NO X-RAY UNIT
	SAN LORENZO	PRIVATE OFFICES	4	30,500	7,625
	YABUCOA	PRIVATE OFFICES	2	31,900	15,950
CAGUAS AREA TOTAL			52	369,000	7,096

TABLE 2-N (CONT.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
FAJARDO	CEIBA	HEALTH CENTER		13,000	NO X-RAY UNIT
	CULEBRA			900	NO X-RAY UNIT
	FAJARDO	MUNICIPAL HOSP.	—		
		DISTRICT HOSP.	5		
		FAJARDO CLINIC	1		
		PUBLIC HEALTH UNIT AND T.B CENTER	1		
		DR. GUBERN HOSP.	1		
		PRIVATE OFFICES	6		
		FAJARDO TOTAL	14	24,700	1,764
	LOIZA AND CANOVANAS	MUNICIPAL HOSP.			NO X-RAY UNIT
		SAN ANTONIO CLINIC	1		
		HEALTH CENTER			NO X-RAY UNIT
		PRIVATE OFFICES	1		
		LOIZA AND CANOVANAS TOTAL	2	32,800	16,400
FAJARDO (CONT.)	LUQUILLO	MUNICIPAL HOSP.			
		PRIVATE OFFICES	—		
		LUQUILLO TOTAL	—	12,100	—
	RIO GRANDE	HEALTH CENTER			
		PRIVATE OFFICES	1		
		RIO GRANDE TOTAL	1	24,100	24,100
	VIEQUES	HEALTH CENTER	1	8,400	8,400
FAJARDO AREA TOTAL			18	116,100	6,450
ARECIBO	ARECIBO	DISTRICT HOSP.	6		
		MUNICIPAL HOSP.	2		
		PUBLIC HEALTH UNIT AND T.B. MOBILE UNIT	2		
		EL BUEN PASTOR CLINIC	1		
		DR. SUSONI HOSP.	1		

* One Siemens x-ray unit is not in use because of the frequent overflow of the Rio Grande River waters.

TABLE – 2N (CONT.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
ARECIBO (CONT.)	ARECIBO				
		PRIVATE OFFICES	8		
		ARECIBO TOTAL	20	342,800	17,140
	BARCELONETA	MUNICIPAL HOSP.	—		NO X-RAY UNIT
		PRIVATE OFFICES	2		
		BARCELONETA TOTAL	2	25,600	12,800
	CAMUY	HEALTH CENTER			
		PRIVATE OFFICES	1		
		CAMUY TOTAL	1	20,000	20,000
	CIALES	HEALTH CENTER	—	16,200	NO X-RAY UNIT
	HATILLO	HEALTH CENTER			
		PRIVATE OFFICES	1		
		HATILLO TOTAL	1	24,900	24,900
	LARES	PUB. HEALTH UNIT	1		
		CASTANER HOSP.	1		
		LARES TOTAL	2	24,600	12,300
ARECIBO	MANATI	MUNICIPAL HOSP.			
		PUBLIC HEALTH UNIT	1		
		SAN AGUSTIN HOSP.	2		
		DOCTORS CENTER HOSPITAL	1		
		PRIVATE OFFICES	3		
		MANATI TOTAL	7	33,300	4,757
	MOROVIS	MUNICIPAL HOSP.	—		NO X-RAY UNIT
		PRIVATE OFFICES	2		
		MOROVIS TOTAL	2	20,100	10,050
	QUEBRADILLAS	HEALTH CENTER			
		PRIVATE OFFICES	2		
		QUEBRADILLAS TOTAL	3	14,500	7,250
	UTUADO	HEALTH CENTER	1		
		SAN MIGUEL CLINIC	1		

TABLE - 2N (CONT.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
ARECIBO	UTUADO	DR. EDUARDO CINTRON CLINIC	2		
		PRIVATE OFFICES	2		
		UTUADO TOTAL	6	47,700	7,950
	VEGA BAJA	HEALTH CENTER	—		NO X-RAY UNIT
		SANCHEZ CASTAÑO CLINIC	1		
		PRIVATE OFFICES	2		
		VEGA BAJA TOTAL	3	32,500	10,833
ARECIBO AREA TOTAL			46	342,800	7,452
BAYAMON	BARRANQUITAS	HEALTH CENTER	1		
		PRIVATE OFFICES	3		
		BARRANQUITAS TOTAL	4	19,000	4,750
	BAYAMON	HEALTH CENTER	2		
		HERMANOS MELENDES HOSPITAL	4		
BAYAMON	BAYAMON	RUIZ SOLER HOSPITAL	3		
		PRIVATE OFFICES	17		
		BAYAMON TOTAL	26	117,000	4,500
	CATAÑO	HEALTH CENTER	—	23,900	NO X-RAY UNIT
	COMERIO	HEALTH CENTER	—	21,100	NO X-RAY UNIT
	COROZAL	HEALTH CENTER	—	28,100	NO X-RAY UNIT
	DORADO	HEALTH CENTER	—	18,600	NO X-RAY UNIT
	NARANJITO	PRIVATE OFFICES	3	19,600	6,533
	OROCOVIS	HEALTH CENTER	—	21,200	NO X-RAY UNIT
	TOA ALTA	HEALTH CENTER	—	18,700	NO X-RAY UNIT
	TOA BAJA	HEALTH CENTER	—	30,500	NO X-RAY UNIT
	VEGA ALTA	HEALTH CENTER	—		
		PRIVATE OFFICES	1		
		VEGA ALTA TOTAL	1	22,900	22,900

TABLE - 2 N (CONT.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
BAYAMON AREA TOTAL			34	340,600	10,017
SURVEYED AREAS OF THE NORTHERN REGION			150	1, 168,500	7, 790

Figures in Table 2-N show that one x-ray unit serves on the average approximately 6000-7000 people in the Arecibo, Caguas and Fajardo Areas whereas in the Bayamon Area the corresponding figure is above 10,000.

The total population of the Surveyed Areas of the Northern Region (1,168,500) is 78% larger than the population of the Western and Southern Regions combined (908,900), whereas the total number of x-ray units in the Surveyed Areas of the Northern Region is less (150) than the number in the Southern and Western Regions combined (161). Therefore, in the Surveyed Areas of the Northern Region, the number of population per x-ray unit (7,790) is larger than in the Southern Region (5,824/x-ray unit) and in the Western Region (5,325/x-ray unit).

After the completion of the survey and inclusion of the Metropolitan Area in it, the number of population per x-ray unit is expected to drop substantially due to the concentration of x-ray units within the population of the Metropolitan Area.

TABLE 3N

① TOTAL NUMBER OF X-RAY EXAMINATIONS IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS.

SURVEYED AREAS OF THE NORTHERN REGION, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
AGUAS BUENAS	HEALTH CENTER	14,540	—	—
AIBONITO	MUNICIPAL HOSPITAL	72,306	—	—
	MENNONITE HOSPITAL ②	26,981	7,000	25.9
	AIBONITO TOTAL	99,287	7,000	7.0
CAGUAS	MUNICIPAL HOSPITAL	139,982	6,304	4.5
	SAN RAFAEL HOSPITAL	9,065	29,705	327.6
	PUBLIC HEALTH UNIT AND T.B. CENTER	15,167	15,792	104.1
	CAGUAS TOTAL	164,214	51,801	31.5
CAYEY	T.B. HOSPITAL AND T.B. CENTER	8,618	11,026	127.9
	FONT CLINIC	26,173	15,600	59.6
	HEALTH CENTER	35,481	1,734	4.8
	CAYEY TOTAL	70,272	28,360	40.3
CIDRA	HEALTH CENTER	9,993	—	—
GURABO	MUNICIPAL HOSPITAL	25,720	—	—
	SAN JOSE CLINIC	800	624	78.0
	GURABO TOTAL	26,520	624	2.3
HUMACAO	HEALTH CENTER AND T.B. CENTER	47,741	10,678	22.3
	ORIENTE CLINIC	2,554	7,105	278.1
	FONT MARTELO HOSPITAL	6,627	9,158	138.1
	RYDER MEMORIAL HOSPITAL	48,905	5,596	11.4
	HUMACAO TOTAL	105,827	32,537	30.7
JUNCOS	HEALTH CENTER	41,330	—	—
	PUBLIC HEALTH UNIT AND T.B. CENTER	10,501	11,388	108.4
	JUNCOS TOTAL	51,831	11,388	21.9

(1) The term "Public Institution" is interpreted here as a medical facility with a profile of hospital or clinic even if the institution belongs to a missionary group or has private owners.

(2) A correction in the total number of x-ray examinations was received from the Mennonite Hospital, Aibonito, after part of this report was in final preparation for printing and will be included in the Summary Report.

TABLE 3N (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
LAS PIEDRAS	HEALTH CENTER	10,549	—	—
NAGUABO	HEALTH CENTER	25,385	—	—
SAN LORENZO	MUNICIPAL HOSPITAL	2,189	—	—
YABUCOA	MUNICIPAL HOSPITAL	41,010	—	—
CAGUAS AREA TOTAL		721,617	131, 710	18.2
CEIBA	HEALTH CENTER	8,186	—	—
FAJARDO	MUNICIPAL HOSPITAL	54,138	—	—
	DISTRICT HOSPITAL	65,899	26,548	40.2
	DR. GUBERN HOSPITAL	4,819	2,632	54.6
	FAJARDO CLINIC	1,215	3, 185	262.1
	PUBLIC HEALTH UNIT AND T.B. CENTER	3,684	4, 361*	112.2
	FAJARDO TOTAL	129,955	36, 726	28.2
LOIZA AND CANOVANAS	HEALTH CENTER (LOIZA)	76,503	—	—
	MUNICIPAL HOSPITAL (CANOVANAS)	53,735	—	—
	SAN ANTONIO CLINIC	5,475	2,735	49.9
	LOIZA AND CANOVANAS TOTAL	135,713	2,735	2.0
LUQUILLO	MUNICIPAL HOSPITAL	16,392	—	—
RIO GRANDE	HEALTH CENTER	50,211	—	—
	PUBLIC HEALTH UNIT	20,024	—	—
	RIO GRANDE TOTAL	70,235	—	—
VIEQUES	HEALTH CENTER	41,674	3, 750	8.9
FAJARDO AREA TOTAL		410,341	43,211	10.5
ARECIBO	DISTRICT HOSPITAL	50,124	33, 800	67.4

* Including 3,938 photofluorographies.

TABLE - 3 N (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
ARECIBO	HEALTH CENTER (OLD MUNICIPAL HOSP)	26,820	14,163	52.8
	PUBLIC HEALTH UNIT AND MOBILE T.B. UNIT	23,611	15,979*	67.6
	EL BUEN PASTOR CLINIC	2,138	3,484	162·9
	DR. SUSONI HOSPITAL	28,617	3,795	13·2
	ARECIBO TOTAL	131, 310	71,221	54.2
BARCELONETA	MUNICIPAL HOSPITAL	60,337	—	—
CAMUY	HEALTH CENTER	28,228	—	—
CIALES	HEALTH CENTER	26,080	—	—
LARES	CASTAÑER GENERAL HOSPITAL	25,028	4,847	19.3
	PUBLIC HEALTH UNIT AND MUNICIPAL HOSPITAL	12,766	6,073	47. 5
	LARES TOTAL	37,792	10,920	28.8
MANATI	PUBLIC HEALTH UNIT	18,892	20,734	109.0
	SAN AGUSTIN HOSPITAL	8,036	5,389	67.0
	DOCTOR'S CENTER HOSPITAL	9,843	7,800	79.2
	MUNICIPAL HOSPITAL	49,462	—	—
	MANATI TOTAL	86,233	33,923	39.3
MOROVIS	MUNICIPAL HOSPITAL	30,012	—	—
QUEBRADILLAS	HEALTH CENTER	11,378		
UTUADO	HEALTH CENTER AND T.B. CENTER	100,265	11, 893	11.8
	DR. CINTRON CLINIC	7,865	3, 011	38.2
	SAN MIGUEL CLINIC	3,379	2, 080	61.5
	UTUADO TOTAL	111,509	16,984	15.2
VEGA BAJA	HEALTH CENTER	27, 376	—	—
	SANCHEZ CASTAÑO CLINIC	6,194	868	14.0
	VEGA BAJA TOTAL	33,570	868	2. 5

* Including 14,869 photofluorographies.

TABLE 3N (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	TOTAL OF X-RAY EXAMINATIONS PER 100 PATIENTS
ARECIBO AREA TOTAL		556,449	133,916	24.0
BARRANQUITAS	HEALTH CENTER	41,950	2,600	6 1
BAYAMON	HEALTH CENTER	254,104	23,400	9 2
	HNOS. MELENDEZ HOSP.	6,174	9,360	151 6
	RUIZ SOLER HOSP.	1,321	9,045	684 7
	BAYAMON TOTAL	261,599	41,805	15.9
CATAÑO	HEALTH CENTER	32,246	—	—
COMERIO	HEALTH CENTER	45,532	—	—
COROZAL	HEALTH CENTER	11,882	—	—
DORADO	HEALTH CENTER	27,478	—	—
NARANJITO	HEALTH CENTER	77,880	—	—
OROCOVIS	HEALTH CENTER	37,252	—	—
TOA ALTA	HEALTH CENTER	24,091	—	—
TOA BAJA	HEALTH CENTER	18,929	—	—
VEGA ALTA	HEALTH CENTER	74,451	—	—
BAYAMON AREA TOTAL*		547,981	44,405	8.1
SURVEYED AREAS OF THE NORTHERN REGION.		2,236,388	353,242①	15.8

① NOT INCLUDING PRIVATE OFFICES

* The number of x-ray examinations per 100 patients was calculated for the total number of patients in the Bayamon Area in public institutions—including medical facilities having no x-ray unit.

Table 3-N, which indicates the ratio between the total number of patients treated in an institution and the number of diagnostic x-ray examinations per 100 patients in the same institution provides interesting information concerning the procedures practiced in the surveyed medical institutions.

Some private hospitals have a ratio of 325 diagnostic x-ray examinations per 100 patients due to the practice of performing a routine chest diagnostic x-ray examination on nearly every admitted patient.

It was found that (with the exception of the tuberculosis hospitals and tuberculosis centers where the number of x-ray examinations per 100 patients is understandably high), the largest number of diagnostic x-ray examinations per 100 patients were performed in private hospitals.

TABLE 4-N

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION, BY MEDICAL FACILITY AND BY MANUFACTURER. SURVEYED AREAS OF THE NORTHERN REGION, PUERTO RICO-1968.

Geographic Location	Picker	General Electric	Westinghouse	Keleket	Siemens	Continental	Profex-ray	Hatteon	Universal	Tanka	Acoma	Fisher	TOTAL
Arecibo Area	12	7	5	3	10	4	0	1	3	0	0	1	46
Bayamon Area	15	7	2	4	0	1	2	0	2	0	0	1	34
Caguas Area	22	10	3	4	3	0	6	0	3	0	1	0	52
Fajardo Area	5	3	1	0	6	1	0	0	0	1	0	1	18
Surveyed Areas of the Northern Region Total	54	27	11	11	19	6	8	1	8	1	1	3	150

Table 4-N shows the distribution of x-ray units by manufacturer in the Surveyed Areas of the Northern Region.

Contrary to the Western and Southern Regions of the Island, where only Picker and General Electric x-ray units were represented in impressive numbers, in the Surveyed Areas of the Northern Region, Siemens (19) and Westinghouse (12) had a strong representation. Siemens units predominate in Arecibo. Westinghouse units are distributed throughout the area at present and will soon be especially well represented in Caguas with the opening of the new Caguas Area Hospital, which will have ten Westinghouse x-ray units (not included in our survey - 1968).

TABLE 5-N

CENSUS OF DIAGNOSTIC X-RAY UNITS
SURVEYED AREAS OF THE NORTHERN REGION, PUERTO RICO-1968

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MANUFACTURE AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
CAGUAS	Aguas Buenas	Private Offices	Profex-ray 100 150 kVp	1963	Dx-10 1 tube	Variable Collimator Videx	2.5	
	Aibonito	Mennonite Hospital	Picker 200 Picker 200 Mob. 120 kVp	1946 1968	(2 tubes) Dynamax 40 Dynamax 40 (1 tube)	Cone Var. Collima.	2.5 4.0	Automatic.
	Caguas	Municipal Hospital	Westinghouse 200 100 kVp (Daytona)	1964	Dynamax 40 (2 tubes)	Var. Collima.	3.5	At the time of data collection, radiation measurement badges were not used by x-ray personnel, nor by students.
		San Rafael Hospital	Picker 200 Picker 300 Siemens 500 Picker 200 Mob	1968 1968 1968 1968	Px-10 Px-10A Dynamax 40 Px-10	Var. Collima. " " " " Cone	3.0 3.0 3.0 2.5	Gonadal shielding not used on adults, used on children only occasionally.
		Public Health Unit	Picker 100 140 kVp	1968	Px-10E (2 tubes)	Var. Collima. Videx	3.0	
		T.B. Center	G.E. KXE 225 200	1966	G.E. L.W.R.T. (2 tubes)	Photo Odelca	3.5	Minograph for mass chest examinations.
			G.E. 30	1946	Px-1B	No collimator	.5*	Fluoroscopy only.
		Private Offices	Siemens 65 72 kVp	1968	Roentgen Kugel	Var. Collima.	2.5	General Practitioner.
			Picker 100	1946	PX-8E	No Collimator	.5	Not in use since Jan. 1970
			Picker 100	1940	PX-8E	No Collimator	.5	Used only for lung fluoroscopy, chest-spec.
			Universal 75	1928		Cone		Cardiology.
			Profex-ray 100	1966	PX-8	Cone	1.5	General Practitioner.
			Profex-ray 100	1966	Dynamax 40	Var. Collima. Mascot	3.5	" "
			Keleket 100	1955	Dynamax 20	No Collimator	.5	" "
			G.E. 100	1945	DXC(Coolidge)	" "	.5	" "
			Picker 200	1962	Dynamax 25	Var. Collima.	3.0	" "
	Cayey	Health Center	Picker 200	1962	Dynamax 25	Var. Collima.	3.0	No radiologist's supervision. Films interpreted at Fajardo District Hospital.
		Font Clinic	Picker 200 140 kVp	1945	Dynamax 25 (2 tubes)	Var. Collima.	3.5	
		T.B. Hospital	Picker 100	1962	PX-18	Var. Collima.	4.0	Connected with tomography.
		T.B. Health Center	G.E. 200	1966	G.E.L.W.R.T.	Photo Odelca	3.5	Mass chest examinations.

Cont. on following page

Note: Out of the 54 diagnostic x-ray units in the Caguas Area-1968, 2 units were not in operative condition.

* An 0.5 mm Al. total filtration indicates that there is inherent filtration only.

TABLE 5-N (Cont.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES MANUFACTURE AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
CAGUAS	Cayey	Private Offices	G.E. 30	1950	DX	No collimator	0.5	Fluoroscopy only.
			Picker 100	1958	PX-10A	Cone	1.5	General Practitioner.
			Picker 100	1958	PX-10A	No collimator	.5	T.B. Specialist.
			Keleket 100	1955	(2 tubes) Dynamax 40	Cone for radiography	1.5	General Practitioner.
	Cidra	Private	Acoma 50	1958	1 tube	Cone	.5	General Practitioner.
	Gurabo	Municipal Hospital	-	-	-	-	-	Vertical Fluoroscope out of order.
		San Jose Clinic	Profex-ray 300 100 kVp	1966	Profex (1 tube)	Var. collima. Videx	3.5	Mobile.
	Humacao	Health Center & T.B. Center (same location)	Westinghouse 300	1966	Eureka-RA-71	Cone	.5	Mass chest examinations
			G.E. 200	1966	G.E.L.W.R.T.	Photo Odelca	3.5	
			Westinghouse 30	1937	-	-	-	
		Oriente Clinic	Keleket 300 120 kVp	1955	Dynamax 40	Var. collima.	3.5	
		Font Martelo Hospital	Profex-ray 300 100 kVp	1947	Eureka DX-25 (2 tubes)	Cone	2.5	
		Ryder Memorial Hosp.	Picker 200 90 kVp	1959	Dynamax 25	Var. collima.	3.8	
			Universal 50		-	Cone	2.0	Mobile.
CAGUAS	Humacao cont.	Private Offices	Picker 300 140 kVp	1968	PX-10A (2 tubes)	Var. Collima.	3.5	Radiologist.
			Picker 35	1940	PX-1B	No collimator	0.5	Fluoroscopy only.
			Picker 35 100 kVp	1940	PX-1B	No collimator	0.5	Fluoroscopy only.
	Juncos	T.B. Center	Picker 200 120 kVp	1960	Eureka Ra-51 (1 tube)	Odelca camera	3.5	Mass chest examinations
		Private Offices	Universal 75	1961	Dynamax	Cone	0.5	Fluoroscopy only.
			G.E. 100 90 kVp	1961	Eureka RA (1 tube)	Cone	1.5	General Practitioner
			G.E. 100	1958	G.E. R-2 (1 tube)	No Collimator	0.5	Chest examinations only.
			Picker 30	Mfg. 1940	PX-1B	" "	0.5	Fluoroscopy was performed without gloves until our inspection.
			Picker 100	1946	PX-8E	Cone	2.5	Not in use since 1969.
	San Lorenzo	Private Offices	Picker 100	1960	Px-8E	Cone	.5	General Practitioner.
			Siemens 12 72 kVp	1968	Siemens Kugel Heliosphere	Collimator	2.5	Portable, chest exams. only.
			G.E. 100	1959	L.W.R.T.	Cone	1.5	General Practitioner.
			Keleket 100	1955	-	Cone	2.0	" "

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TABLE 5-N (Cont.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MANUFACTURER AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
CAGUAS	Yabucoa	Municipal Hospital	G.E. RB3 30	1950	-	-	-	Out of order.
		Dr. Torres-Machin Clinic	G.E. 200 100 kVp	1955	L.W.R.T.	Var. collima.	3.0	General Practitioner.
FAJARDO	Fajardo	District Hospital	Siemens 1000*	1965	2 Super-Dynamax	Var. collima.	4.5	Routine.
			Siemens 200	1964	1 Dynamax 40	" "	"	I.V.P.
			Siemens 300	1964	2 Eureka	" "	"	Routine.
			Siemens 100	1964	1 Siemens	" "	"	Mobile.
			G.E. 100	Mfg. 1946	1 PX-8R	No collimator	.5	
		Public Health Unit & T.B. Center	Picker 200	1956	1 Eureka	Cone	2.5	Minograph for mass chest examinations.
		Fajardo Clinic	Siemens 320	1964	1 Eureka	Var. collima.	4.5	
		Dr. Gubern Hospital	G.E. 100	1952	2 Eureka	Cone	2.5	
		Private Offices	Siemens 300	1965	2 Dyna'x 40	Var. collima.	4.5	Radiologist.
			Picker 30	Mfg. 1940	PX-1B	-	.5	For fluoroscopy only.
			Westinghouse 30	1950	-	No collimator	.5	Pulmonary disease. Fluoroscopy only.
			Tanka 40	1958	Not available	Cone	-	Chest. No gloves.
			Fisher 60	1940	-	Cone	1.5	For chest fluoroscopy.
FAJARDO	Fajardo cont.	Private Offices	Continental 60	1949	1 Eureka	Cone	1.0	Out of order since 1968.
	Loíza & Canovanas	San Antonio Clinic	G.E. 200	1955	1 L.W.R.T.	Cone	1.0	
		Private Offices	G.E. 30	Mfg. 1956	DX	Cone	0.5	Fluoroscopy of fractures only.
	Rio Grande	Private Offices	Picker 200	1956	1 PX-10	Cone	2.0	
	Vieques Island	Health Center	Picker 100	1961	1 Eureka PX-1B	Cone	2.5	
ARECIBO	Arecibo	District Hosp.	Siemens 700	1964	2 Dym'x40/50	Var. collima.	3.5	The first x-ray unit in this hospital was installed in 1938.
			Siemens 300	1966	1 Dynamax 40	" "	"	
			Siemens 320	1966	1 Dynamax 40	" "	"	
			Siemens 100	1966	Siemens .8	" "	"	Mobile.
			Siemens 100	1968	Siemens .8	" "	"	"
			Westinghouse 60	1950	-	-	1.5	Out of order.
		Municipal Hospital	Siemens 300	1967	2 Dynamax 40	Var. collima.		
			Siemens 300	1967	1 Dynamax 40	" "		
			Standard 30	1940	-	-	.5	Mobile. Out of order

Cont. on following page

Note: Out of the 54 diagnostic x-ray units in the Arecibo Area-1968, 8 were not in operative condition.

* Nominal control is up to 1,000 MA, but Dynamax tubes permit a maximum of only 700 MA.

TABLE 5-N (Cont.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MANUFACTURE AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
ARECIBO	Arecibo cont.	Public Health Unit & T.B. Mobile Unit	Siemens 320 125 kVp	1966	Dynamax 40	Var. Collima.	3.5	Unit in good condition. Not in use as frequent overflow of Rio Grande river waters cover unit often.
			Min-x-ray 25 with Odelca 70	1960	-	Cone	2.71	Portable x-ray for mass chest examinations.
			Picker 200 with Minograph	1968	Eureka	Cone	3.5	Transported in car to various locations.
		El Buen Pastor Clinic	Picker 200	Mfg. 1946	PX-8E	Picker collimator	3.5	New Picker 200 MA unit was installed in 1969.
		Dr. Susoni Hospital	G.E. 500 100 kVp	1950	HRT	Picker Var. collimator	3.0	Old unit.
		Private Offices	Picker 200	1946				
			Continental 60	1952	-	Cone	2.5	-
			Universal 100 Westinghouse 300 Duoflex	1964	UX-20H 2 Dynamax 40/50	Cone Var. collima.	2.5 3.5	Used for Fondo del Seguro.
			Westinghouse 300	1968	2 Dynamax 40/50	Var. collima.	3.5	
			Mattern 15	1940	-	No collimator	.5	Fluoroscopy only.
			Fisher 30	1940	-	No collimator	.5	" "
			Siemens 60,85kV	1968	-	Cone	-	Head self rectifier.
ARECIBO	Barcelon-eta	Private Offices	Picker 100 Picker 200	1965 1961	Px-10 Px-25	Var. collima. " "	3.5 "	
	Camuy	Health Center	Standard 40	1965	1 tube	-	0.5	In 1968, the unit was in good condition but never used, lack of personnel.
		Private Office	Continental 60	1952	1 tube	Var. collima.	3.5	
	Hatillo	Health Center	G.E. 15	Mfg. 1940 Purch. 1950	R-1.7	No collimator	0.5	Out of order.
		Private Office	Picker 200	1956	PX-10	Cone	0.5	Anatomatica.
	Lares	Public Health Unit	Siemens 300 125 kVp	1966	Eureka	Var. collima.	3.5	Minograph for mass chest examinations (Photofluoro.)
		Ger. Castañer Hospital	G.E. 300	1960	H.R.T. (2 tubes)	Var. collima.	3.5	
		Private Off.	Continental 100	1959	1 Eureka	Cone	1.5	General Practitioner.
	Manatí	Public Health Unit	Siemens 500 & 70 mm. camera	1967	1 Eureka	Var. collima.	3.5	Minograph added for photofluoroscopy.
		Municipal Hosp	Keleket 30	1940	-	-	0.5	Out of order for 10 years.
		San Agustín Hospital	Westinghouse 300 G.E. 30	1964	2 tubes-Dynamax40/50 G.E.-DX	Var. collima. Cone	3.5 -	Portable.

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TABLE 5-N (Cont.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MANUFACTURER AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
ARECIBO	Manatí cont.	Doctors Center Hospital	Continental 100	1959	Eureka	Collimator	2.5	
		Private Offices	Picker 100	1960	PX-8E	Cone	1.5	
			Keleket 200	1956	G.E. H.R.T.	Cone	2.5	
			Universal 75	1968	UX-20H	-		
	Morovis	Private Offices	Picker 100	1954	PX-8E	Cone	1.0	
			G.E. 200	1964	G.E.L.W.R.T.	Var. collima.	2.5	
	Quebradillas	Health Center	Picker 35	Mfg. 1940	PX-1B	No collima.	0.5	Fluoroscope. Unit in good condition but not used-1968.
		Private Offices	Westinghouse 60 100 kVp	1954	Eureka	Var. collima.	2.5	
			Universal 60	1960	UX-20H	Cone	0.5	
	Utuado	Health Center	Picker 200 and Minograph	1957	Dynamax 50	Cone	3.5	Minograph for mass chest examinations.
		San Miguel Clinic	Keleket 200	1957	Eureka DX-20	Var. collima. Videx	3.5	
		Dr. Cintrón Clinic	Picker 100 Keleket 300	Mfg. 1956	Picker DX-8E	Cone	2.5	
		Private Offices	G.E. 100	Mfg. 1945	UXC	Cone	0.5	
			Continental 100	1950	Eureka	-	0.5	
	Vega Baja	Sanchez-Castaño Clinic	G.E. 200	1958	2 L.W.R.T.	Cone	2.5	
		Private Offices	Picker 100	1960	Picker PX-8E	Cone	2.5	
			Picker 100	1965	" "	Var. collima.	3.5	
BAYAMON	Barranquitas	Health Center	G.E. 10	1940	E 1.7	-	-	Not operative.
			G.E. 300	1965	HRT-R & HRT-F	Var. collima.	3.0	Radiogr. and fluoro. tubes.
		Private Offices	Universal 60	1962	UX-20H	Cone	0.5	
			Universal 100	1968	UX-20H	Cone	1.5	
			Picker 100	1950	PX-10E	Cone	1.5	
	Bayamon	Health Center	Picker 200	1956	PX-10	Var. collima.	3.5	
			Picker 300	1968	PX-10	" "	3.5	Galaxy model.
			G.E. 30	1950	DX	No collima.	0.5	Not operative.
		Hermanos Melendez Hospital	Keleket 300			Var. collima.	3.5	Routine.
			Picker 60	1958	PX-8	No collimator	0.5	Mobile.
			Picker 200	1956	PX-10	Cone	0.5	Urology.
			G.E. 300	1965	HRT	Var. collima.	3.5	Routine.
		Ruiz Soler Hospital	G.E. 25	1955	DX-Coolidge	No collima.	0.5	T.B. Hospital
			Picker 300	1965	PX-10A	Var. collima.	3.5	
			Picker 500	1964	17-B	" "	3.5	
		Private Offices	Picker 200	1968	PX-10	Var. collima.	3.5	
			G.E. 300	1961	2 HRT tubes	Var. collima.	3.5	
			Profex-ray 300	1955	Dynamax 40	" "	3.5	

Cont. on following page.

Note: Out of the 40 diagnostic x-ray units in the Bayamon Area-1968, 6 units were not in operative condition.

TABLE 5-N (Cont.)

AREA	GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MANUFACTURE AND MODEL	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
BAYAMON	Bayamon cont.	Private Offices cont.	Kaleket 100	1949	Eureka	Cone	1.5	
			Profex-ray 100	1966	Dynamax	Var. collima.	3.5	
			Continental 300	1965	UX-40H	Var. collima.	3.5	
			Westinghouse 20	1945		No collima.	.5	Fluoroscopy.
			Picker 500	1964	PX-17B	Var. collima.	3.5	
			Kaleket 60	1940		-	-	Not available.
			Picker 65	1953		No collima.	.5	Fluoroscopy.
			Picker 200	1955	PX-10	Cone	2.5	
			Picker 300	1964	PX-10	Var. collima.	3.5	
			Fisher 200	1960	Dunlee Corp.	Var. collima.	3.5	
			Westinghouse 100	1954	Dynamax	Cone	2.0	
			Picker 100	1962	PX-8E	Cone	1.5	
			G.E. 300	1955	HRT	G.E. Field collimation	3.5	
			G.E. 200	1955	L.W.R.T.	Var. collima.	3.5	
	Comerio	Health Center	Picker 200	1956	PX-10	Var. collima.		Not operative.
	Naranjito	Private Offices	Kaleket 100	1949	-	Cone	1.5	
			Picker 100	1946	PX-8E	Cone	2.5	
			G.E. 15	1940	DX	No collimator	-	Not operative.
	Orocovis	Health Center	Picker 100	1956	PX-8E	-	-	Not operative.
	Toa Alta	Health Center	Mattern 200	1955	-	-	-	Not in use since 1968, reason unknown.
	Vega Alta	Health Center	Standard 40	1946	-	Cone	0.5	Not operative.
		Private Off.	Picker 100	Mfg. 1946	PX-8E	Cone	1.5	

In the Census of Diagnostic X-ray Units, thirteen x-ray units were found out of order and five units were found in good condition but not in use for various reasons, such as lack of personnel and in one case because of recurrent overflow of the Rio Grande River, flooding the unit.

There are eighteen x-ray units used for fluoroscopy only -- predominantly older units -- and nine modern x-ray units used exclusively for mass chest examinations.

Table 5-N contains technical specifications of the x-ray units, year of installation, and other relevant data characterizing the performance of the x-ray unit. These data are not only indicative of the quality of the radiography to be obtained by means of the particular x-ray unit, but also of the associated gonadal dose. This is so because the aperture of the x-ray beam is determined by collimation. If the unit has no variable collimator, every radiography is obtained by a large aperture irrespective of the film size, even though from the diagnostic point of view only that portion of the beam is useful which affects the film, or the screen. Thus, if an x-ray unit is not equipped with a variable collimator, all radiographies are done with a large aperture thus placing the testes into the direct beam, at certain positionings such as Abdomen, Flat, Lumbar Spine and I.V.P., even though the part of the direct beam that goes through the testes does not arrive to the film and is therefore superfluous from the diagnostic point of view. The role of the variable collimator is to cut down the aperture to the minimum size compatible with the diagnostic objective and thus exclude the testes from the direct beam whenever possible from the diagnostic point of view. Most modern x-ray units are equipped with variable collimators and thus their use tends to decrease the average gonadal dose. The ovaries are less likely to be excluded from direct beam than the testes. This is the most probable reason for the testical doses to be smaller than the ovarial doses in Puerto Rico[1]. In comparison, in the United States where the proportion of variable collimator equipped x-ray units is smaller than in Puerto Rico, it was found that the testical doses are in general greater than the ovarial doses.

A recent report of the U.S. Public Health Service, Oct. 1969, stated "It was estimated that restriction of the x-ray beam to an area no larger than the film size would result in a reduction of the genetically significant dose from 55 to 19 millirads per person per year."

Most x-ray units installed in public institutions in Puerto Rico after 1960 are equipped with variable collimators and in the last few years variable collimators have been installed on many older units. As may be seen from Table 5-N, in the last few years the following changes in operating x-ray equipment have occurred in the Surveyed Areas of the Northern Region:

1) a total of 51 new x-ray units with variable collimators, installed in public or private offices,
2) 17 variable collimators were added to previously installed x-ray units,
3) 9 modern x-ray units for mass chest examinations installed since 1966.

Other x-ray units in this Region include:

1) 55 x-ray units with cones,
2) 18 x-ray units for fluoroscopy only, which were predominantly older units.

The total number of x-ray units in the Surveyed Areas of the Northern Region is 150.

[1] Miller, James W.: Activities in the Division of Radiological Health Medical X-ray Program. X-ray in Medicine and Industry, Proceedings of a Public Health Conference, Univ. of Miami, Bur. of Radiol. Health, March 1970.

Table 6-N shows that in all the Surveyed Areas of the Northern Region, the nine abdominal examinations considered "genetically hazardous" represent approximately 25% of the total number of diagnostic x-ray examinations performed in 1968.

TABLE - 6 N

NUMBER OF ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS BY TYPE OF EXAMINATION AND BY SEX.
SURVEYED AREAS OF THE NORTHERN REGION
PUERTO RICO—1968.

AREA	TOTAL X-RAY EXAMS.	SEX	TYPE OF EXAMINATION: ABDOMEN	CHOLE-CYSTO-GRAPHY	LUMBAR SPINE	GASTRO-INTESTINAL SERIES	BARIUM ENEMA	I.V.P.	PELVIS	HIP JOINT	PELVI-METRY	TOTAL ABDOMINAL EXAMS.
CAGUAS	164,507	MALE	4,282	1,409	5,169	3,220	1,395	2,369	967	3,678	—	22,489
		FEMALE	3,752	1,721	2,898	3,245	1,043	2,240	1,079	2,734	1,000	19,712
		TOTAL	8,034	3,130	8,067	6,465	2,438	4,609	2,046	6,412	1,000	42,201
FAJARDO	48,803	MALE	903	521	932	862	252	574	589	501	—	5,134
		FEMALE	1,069	590	943	1,079	346	612	752	404	401	6,196
		TOTAL	1,972	1,111	1,875	1,941	598	1,186	1,341	905	401	11,330
ARECIBO	168,666	MALE	3,993	729	8,123	3,286	534	2,181	1,362	724	—	20,932
		FEMALE	3,289	1,253	3,763	3,926	604	2,271	764	645	125	16,640
		TOTAL	7,282	1,982	11,886	7,212	1,138	4,452	2,126	1,369	125	37,572
BAYAMON	80,027	MALE	2,060	558	2,000	1,378	686	1,365	689	572	—	9,309
		FEMALE	1,700	884	1,953	1,820	836	1,644	745	616	594	10,792
		TOTAL	3,760	1,442	3,953	3,199	1,522	3,009	1,434	1,188	594	20,101
SURVEYED AREA OF THE NORTHE-RN REGION	462,003	MALE	11,238	3,217	16,224	8,747	2,867	6,489	3,607	5,475	—	57,864
		FEMALE	9,810	4,448	9,557	10,070	2,829	6,767	3,340	4,399	2,120	53,340
		TOTAL	21,148	7,665	25,781	18,817	5,696	13,256	6,947	9,874	2,120	111,204

Table 7-N shows that thoracical x-ray examinations amounted to 59.6% of the total number of x-ray examinations performed in the Surveyed Areas of the Northern Region in 1968.

TABLE - 7 N

NUMBER OF THORACICAL X-RAY DIAGNOSTIC EXAMINATIONS, BY TYPE OF EXAMINATION AND BY SEX

SURVEYED AREA OF THE NORTHERN REGION
PUERTO RICO - 1968

AREA	NUMBER OF DIAGNOSTIC THORACICAL X-RAY EXAMS BY TYPE									TOTAL		GRAND TOTAL
	CHEST RADIOGRAPHY			PHOTOFLUOROGRAPHY			CHEST TOMOGRAPHY					
	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	
CAGUAS	26,713	28,961	55,674	16,286	17,342	33,628	187	165	352	43,186	46,468	89,654
FAJARDO	4,200	4,482	8,682	1,900	2,038	3,938	8	10	18	6,108	6,530	12,638
ARECIBO	16,620	16,973	33,593	18,527	26,089	44,616	—	—	—	35,147	43,062	78,209
BAYAMON	13,117	13,337	26,454	3,350	13,399	16,749	150	140	290	16,617	26,876	43,493
SURVEYED AREAS OF THE NORTHERN REGION	60,650	63,753	124,403	40,063	58,868	98,931	345	315	660	101,058	122,936	223,994

TABLE-8 N

NUMBER OF ABDOMINAL X-RAY EXAMINATIONS BY TYPE OF FACILITY AND BY TYPE OF EXAMINATION. SURVEYED AREAS OF THE NORTHERN REGION. PUERTO RICO-1968.

TYPE OF EXAMINATION	TYPE OF FACILITY					
	HOSPITALS	CLINICS	PUB HEALTH UNITS AND HEALTH CENTERS	RADIOLOGISTS OFFICES	PRIVATE OFFICES	TOTAL
ABDOMEN	5,816	3,837	1,432	3,212	6,252	20,549
CHOLECYSTO-GRAPHY	3,938	940	1,348	859	670	7,755
LUMBAR SPINE	6,067	4,053	1,725	3,469	10,557	25,871
GASTRO INTEST. SERIES	9,238	1,642	2,044	2,052	3,649	18,625
BARIUM ENEMA	2,664	594	618	726	1,196	5,798
I.V.P.	6,759	1,062	931	1,404	3,029	13,185
PELVIS	1,936	569	976	1,090	2,291	6,862
HIP JOINT	6,991	630	1,201	265	1,087	10,174
PELVIMETRY	1,491	85	75	182	552	2,385
TOTAL	44,900	13,412	10,350	13,259	29,283	111,204

The above Table 8-N shows that the largest number of abdominal x-ray examinations were performed in hospitals (44,900) and in private offices (29,283). In spite of the error in the data given by private offices, which is due to their records being kept on a weekly rather than a yearly basis, this information was included because it represents nearly 30% of the total abdominal examinations performed.

TABLE 9 N

NUMBER OF FILMS EXPOSED (EXPOSURES) IN ABDOMINAL RADIOGRAPHYC EXAMINATIONS, BY TYPE OF FACILITY AND BY TYPE OF EXAMINATION

SURVEYED AREAS OF THE NORTHERN REGION

PUERTO RICO - 1968

TYPE OF EXAMINATION	NUMBER & SIZE OF FILMS MOST COMMONLY USED PER EXAMINATION		TYPE OF FACILITY					TOTAL
	NO	SIZE	HOSPITALS	CLINICS	PUB. HEALTH UNITS AND HEALTH CENTERS	RADIOLOGISTS	PRIVATE OFFICES	
ABDOMEN	1	14 X17"	5,816	3,837	1,430	3,212	6,203	20,495
CHOLECYSTO-GRAPHY	4	8X10"	15,752	3,760	5,392	3,436	2,680	31,020
LUMBAR SPINE	2	2-11X14"	12,134	8,106	3,450	6,938	21,114	51,742
GASTRO INTEST. SERIES	6	4-10X12" 2-8X10"	55,428	9,852	12,264	12,312	21,894	111,750
BARIUM ENEMA	5	1-11X14" 4-14X17"	13,320	2,970	3,090	3,630	5,980	28,990
I.V.P.	4	14X17"	27,036	4,248	3,724	5,616	12,116	52,740
PELVIS	1	14X17"	1,936	569	976	1,090	2,291	5,862
HIP JOINT	2	11X14"	13,982	1,260	2,402	530	2,174	20,348
PELVIMETRY	2	14X17"	2,982	170	150	364	1,104	4,770
TOTAL			147,386	34,772	32,878	37,128	75,556	327,720

In some medical facilities, technicians perform G. I. Series using six 14x17" films.

TABLE 10-N

NUMBER OF FILMS EXPOSED (EXPOSURES) IN RADIOGRAPHIC EXAMINATIONS OF THE ABDOMEN AND THORAX BY TYPE OF FACILITY

SURVEYED AREAS OF THE NORTHERN REGION PUERTO RICO-1968.

TYPE OF FACILITY	NUMBER OF X-RAY EXAMINATIONS BY THE AREA OF THE BODY		
	ABDOMINAL***	THORACICAL*	TOTAL
HOSPITALS	44,900	57,169	102,069
CLINICS	13,412	10,074	23,486
HEALTH CENTERS AND PUBLIC HEALTH UNITS	10,350	108,765**	119,115
RADIOLOGISTS OFFICES	13,259	11,396	24,655
PRIVATE OFFICES	29,283	36,590	65,873
TOTAL	111,204	223,994	335,198

TYPE OF FACILITY	NUMBER OF EXPOSED FILMS BY THE AREA OF THE BODY		
	ABDOMINAL	THORACICAL	TOTAL
HOSPITALS	147,386	57,169	204,555
CLINICS	34,772	10,074	44,846
HEALTH CENTERS AND PUBLIC HEALTH UNITS	32,878	112,065	144,943
RADIOLOGISTS OFFICES	37,128	11,396	48,524
PRIVATE OFFICES	75,556	36,590	112,146
TOTAL	327,720	227,294	555,014

* This number included 660 tomographies with usually six exposures for each examination. Tomograms (Laminograms, Body-Section Films) are radiographies at a selected plane or level in the body. Other tissues above or below the selected level are blurred out by intentional motion of the x-ray equipment while the exposure is being made.

** Including 98,931 photofluorographies. Photofluorography: A method whereby a photography is taken of an image which appears on a fluorescent screen.

*** Abdominal x-ray diagnostic examinations termed "Genatically Hazardous".

TABLE - II N

EVALUATION OF THE MEAN GONADAL DOSE DUE TO A SELECTED SET OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS IN SURVEYED AREAS OF THE NORTHERN REGION

PUERTO RICO - 1968.

AREAS	SEX	MEAN ABSORBED DOSE PER EXAMINATION MILLIRADS	TOTAL NUMBER OF EXAMINATIONS	GLOBAL IRRADIATION DOSE TO ALL EXAMINED PATIENTS MILLIRADS
CAGUAS	M	460.5	22,489	10,356,184
	F	582.0	19,712	11,472,384
FAJARDO	M	446.2	5,134	2,290,790
	F	566.3	6,196	3,508,794
ARECIBO	M	429.5	20,932	8,990,294
	F	620.2	16,640	10,320,128
BAYAMON	M	471.9	9,309	4,392,917
	F	619.5	10,792	6,685,644
TOTAL	M	449.1	57,864	26,030,185
	F	598.8	53,340	31,986,950
GRAND TOTAL		521.7+	111,204	58,017,135

(COMPILED FROM TABLE II-C, II-F, II-A AND II-B.)

TABLE - 12 N

EVALUATION OF THE MEAN GONADAL DOSE DUE TO THORACICAL X-RAY DIAGNOSTIC EXAMINATIONS IN SURVEYED AREAS OF THE NORTHERN REGION.

PUERTO RICO - 1968.

AREAS	SEX	MEAN ABSORBED DOSE PER EXAMINATION MILLIRADS	TOTAL NUMBER OF EXAMINATIONS	GLOBAL IRRADIATION DOSE TO ALL EXAMINED PATIENTS MILLIRADS
CAGUAS	M	1.29	43,186	55,709
	F	0.60	46,468	27,880
FAJARDO	M	1.40	6,108	8,607
	F	0.68	6,530	4,457
ARECIBO	M	1.01	35,147	35,506
	F	0.44	43,062	19,267
BAYAMON	M	1.83	16,617	30,409
	F	.55	26,876	14,858
TOTAL	M	1.29	101,058	130,231
	F	.54	122,936	66,462
GRAND TOTAL		.88	223,994	196,693

(COMPILED FROM TABLE 9-C, 9-F, 9-A AND 9-B.)

TABLE - 13 N

TOTAL NUMBER OF DIAGNOSTIC X-RAY EXAMINATION IN PUBLIC INSTITUTIONS AND IN PRIVATE OFFICES AS COMPARED TO THE POPULATION BY AREAS.

SURVEYED AREAS OF THE NORTHERN REGION, PUERTO RICO - 1968.

AREAS	TOTAL NUMBER OF EXAM.	POPULATION	NUMBER OF EXAM PER 100 POPULATION
CAGUAS	166,933	369,000	45.2
FAJARDO	48,803	116,100	42.0
ARECIBO	166,596	342,800	48.5
BAYAMON	77,102	340,600	22.6
TOTAL	459,434	1,168,500	39.3

TABLE – 14 N

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL X-RAY EXAMINATIONS.

SURVEYED AREAS OF THE NORTHERN REGION.

PUERTO RICO - 1968

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION SURVEYED AREAS OF THE NORTHERN REGION PUERTO-RICO 1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	26,030,185	572,565	45.5
FEMALE	31,986,950	595,935	53.8
TOTAL	58,017,135	1,168,500	49.7

TABLE-15 N

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL THORACICAL X-RAY EXAMINATIONS

SURVEYED AREAS OF THE NORTHERN REGION

PUERTO RICO – 1968

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION SURVEYED AREAS OF THE NORTHERN REGION. PUERTO RICO-1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	130,231	572,565	.227
FEMALE	66,462	595,935	.111
TOTAL	196,693	1,168,500	.168

TABLE - 16N

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL AND THORACICAL X-RAY EXAMINATIONS.

SURVEYED AREAS OF THE NORTHERN REGION
PUERTO RICO - 1968

	GLOBLAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION SURVEYED AREAS OF THE NORTHERN REGION PUERTO RICO-1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	26,160,416	572,565	45.6
FEMALE	32,053,412	595,935	53.7
TOTAL	58,213,828	1,168,500	49.8

The per capita per annum gonadal dose in the Surveyed Areas reached 49.8 mrads in 1968.

In the Southern Region-1968 - 43.6 mrads.

In the Western Region-1968 - 56.4 mrads.

These numbers probably reflect existing differences in the economical level, social structure and in technological development between Surveyed Areas of the Northern Region and the other Regions mentioned above.

The comparison between the Western, Southern and Northern Region will be possible only after the completion of the entire Northern Region including the San Juan Metropolitan Area.

LIST OF FIGURES

FIGURE 1-N

GEOGRAPHICAL DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNITS SURVEYED AREAS OF THE NORTHERN REGION PUERTO RICO-1968.

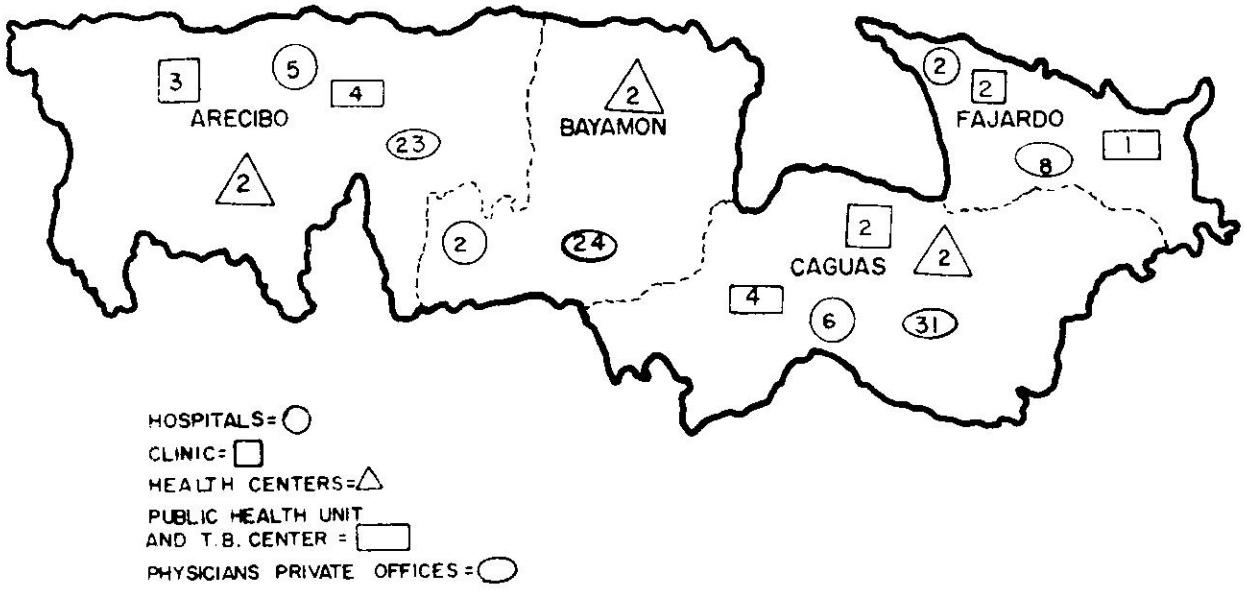
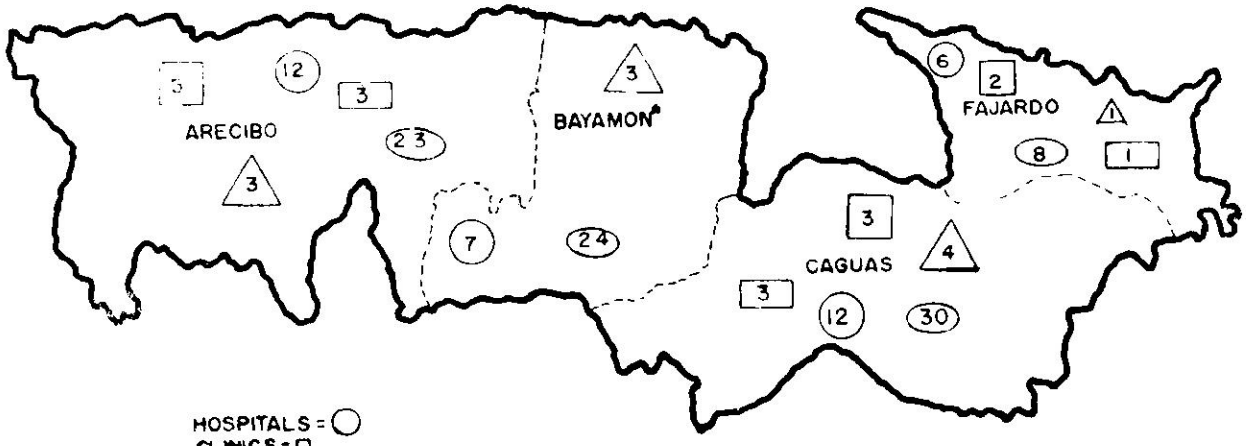


FIGURE 2N

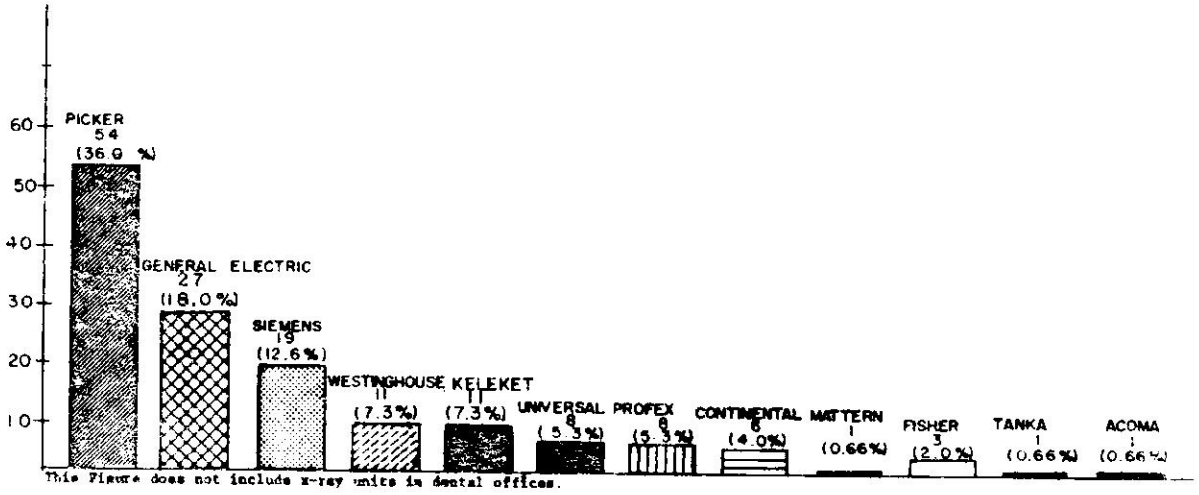
DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS SURVEYED AREAS OF THE NORTHERN REGION PUERTO RICO — 1968.



* Four radiologists use the same office.

FIGURE 3-N

DISTRIBUTION OF X-RAY UNITS BY MANUFACTURER
SURVEYED AREAS OF THE NORTHERN REGION
PUERTO RICO - 1968

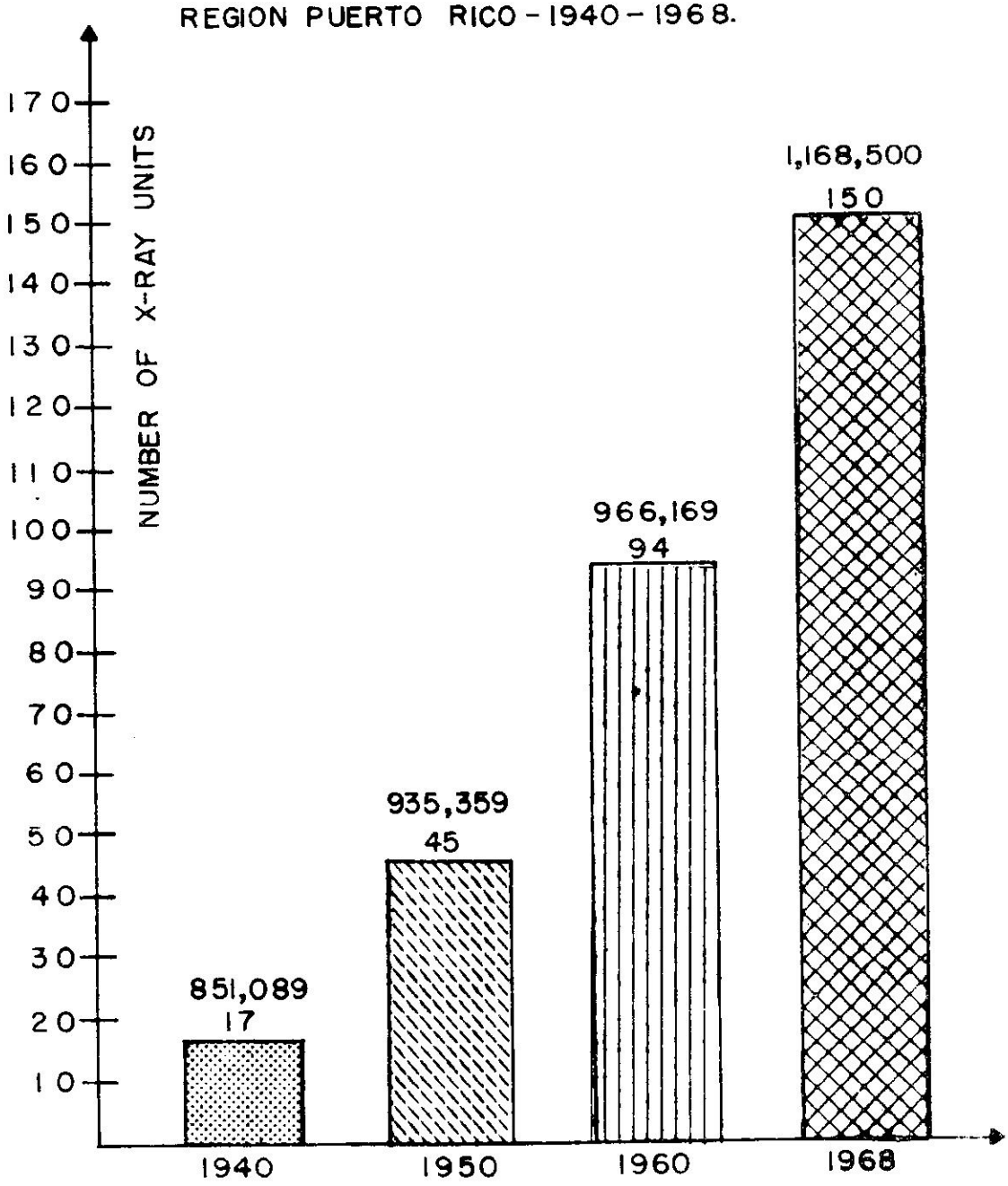


This Figure does not include x-ray units in dental offices.

FIGURE - 4 N

VARIATION OF POPULATION AND NUMBER OF X-RAY DIAGNOSTIC UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS

SURVEYED AREAS OF THE NORTHERN REGION PUERTO RICO - 1940 - 1968.



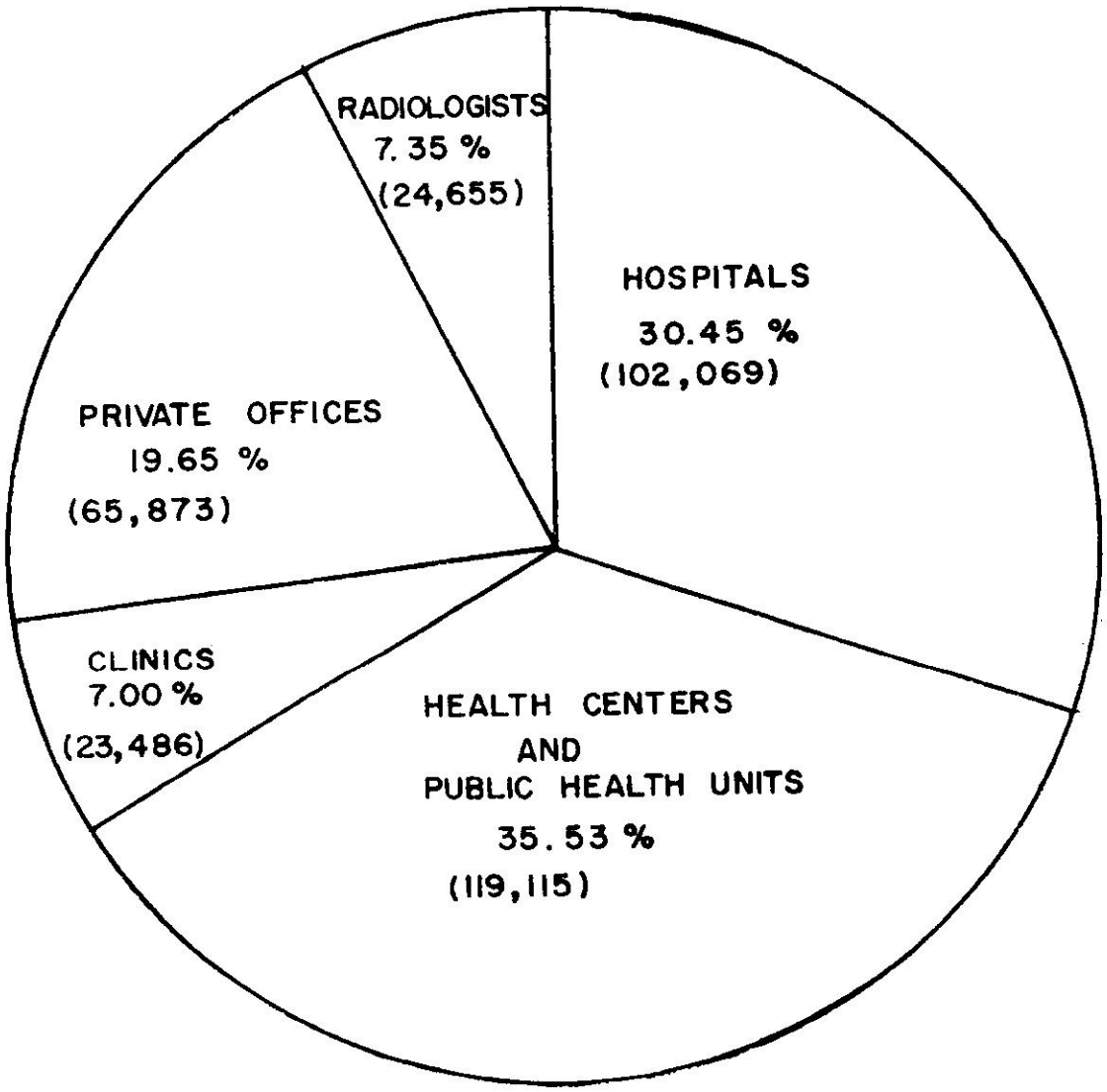
The small difference in population between 1950-1960 (30,810) can probably be accounted for by a large emigration to the mainland during this decade.

Figure 4N shows that the number of x-ray units in the Surveyed Areas of the Northern Region has increased within the period of 1960-68 from 94 to 150, a growth corresponding to 63%. This growth is primarily due to the expansion of the x-ray program in public institutions. In the course of this expansion most obsolete x-ray units were replaced by modern units equipped with variable collimators. This feature is of extreme significance from the point of view of radiation protection since the collimator reduces the beam size to the size of the film, thus putting the testes out of the direct beam in the diagnostic procedures termed Lumbar Spine, Abdomen, and I.V.P. For accuracy's sake it should be noted that the ovaries will remain in the direct beam in spite of collimation.

During the period 1940-1968, the number of diagnostic x-ray units within the surveyed Areas increased from seventeen to one hundred fifty. These figures do not include dental x-ray units. Since, however, the population of the Surveyed Areas increased during the same period from 851,089 to 1,168,500, the figure may be presented in a form standardized for population. Thus, in 1940 there were 1.99 units per 100,000 population and by 1968 this figure had risen to 12.8 units, representing close to a seven-fold increase.

FIGURE 5-N

PERCENT* DISTRIBUTION OF DIAGNOSTIC ABDOMINAL** AND THORACICAL X-RAY EXAMINATIONS IN MEDICAL INSTITUTIONS BY THE TYPE OF FACILITY.
SURVEYED AREAS NORTHERN REGION.
PUERTO RICO-1968.



* Reference to Table 10-N.

** Abdominal diagnostic x-ray examinations termed "genetically Hazardous".

The above figures clearly indicate the vital role of the Health Centers and Public Health Units in Health Services administered to the population of Puerto Rico.

Among other services Health Centers and Public Health Units administer mass-chest-examinations.

Another important role of Health Centers and Public Health Units is to make a diagnosis on the first visit of the patient and in case of necessity to refer him to the regional hospital.

Health Centers and Public Health Units are the primary nucleus for Health Services to the population - administering their services free of charge.

Figure 5-N shows, that the largest portion of x-ray examinations (thoracical and abdominal) in the Surveyed Areas were performed by Health Centers and Public Health Units, the second largest portion by hospitals. As a comparison there are quoted herewith the parallel figures for the Surveyed Areas of the Northern Region, Southern Region and Western Region.

Percentage of Abdominal* and Thoracical Examinations by Geographic Location and by Facility

Geographic Location	Health Centers and Public Health Units	Hospitals
Surveyed Areas of the		
Northern Region	35.5%	30.4%
Southern Region	33.58%	33.1%
Western Region	33.4%	51.6%

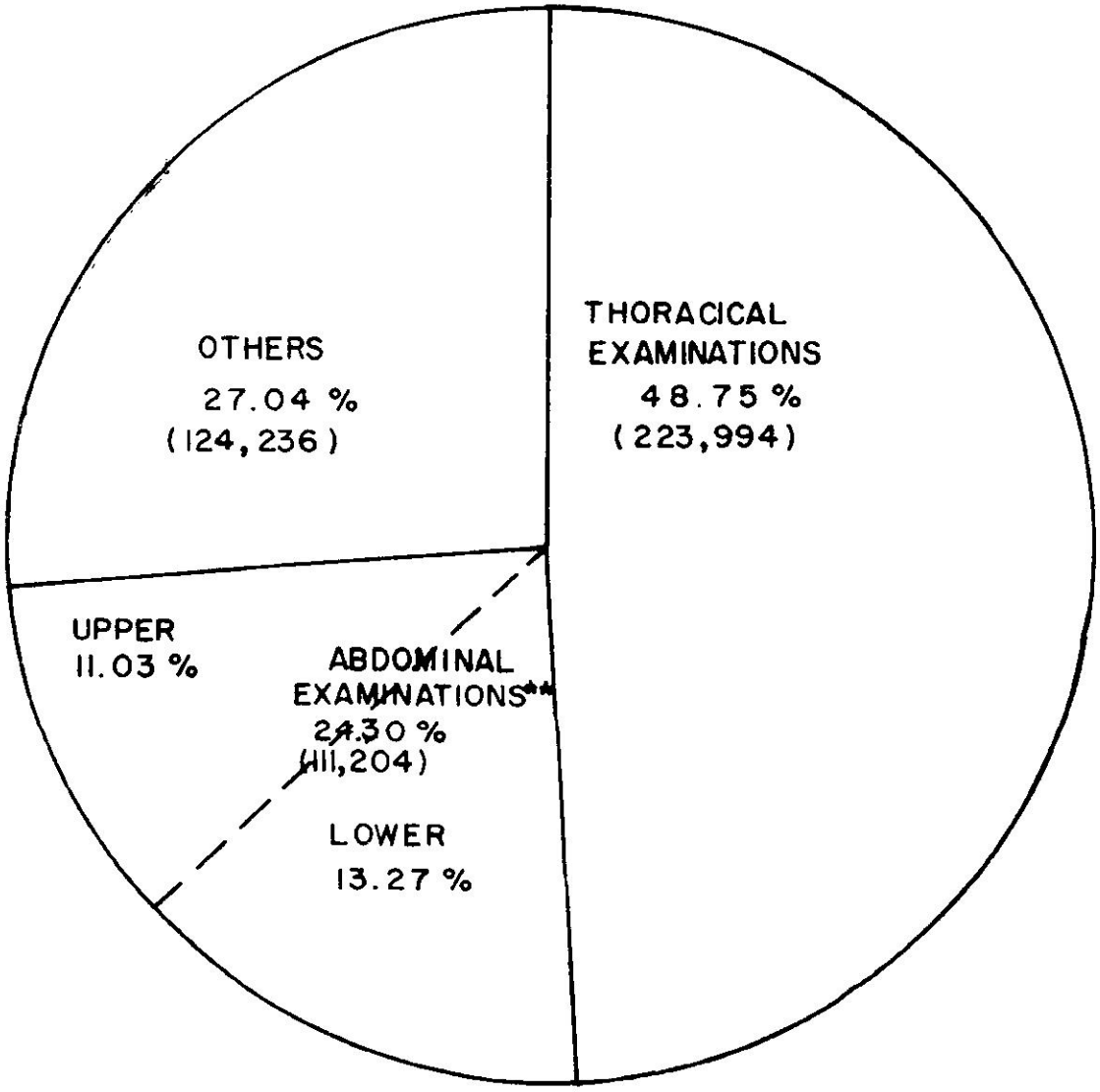
* Abdominal examinations termed genetically hazardous.

The concept of Health Centers in Puerto Rico includes small General Hospital units. The Public Health Units are serving only outpatients and their main field is preventive medicine.

FIGURE - 6 N

DISTRIBUTION OF X-RAY DIAGNOSTIC EXAMINATIONS BY TYPE OF EXAMINATION*

SURVEYED AREAS OF THE NORTHERN REGION.
PUERTO RICO - 1968.



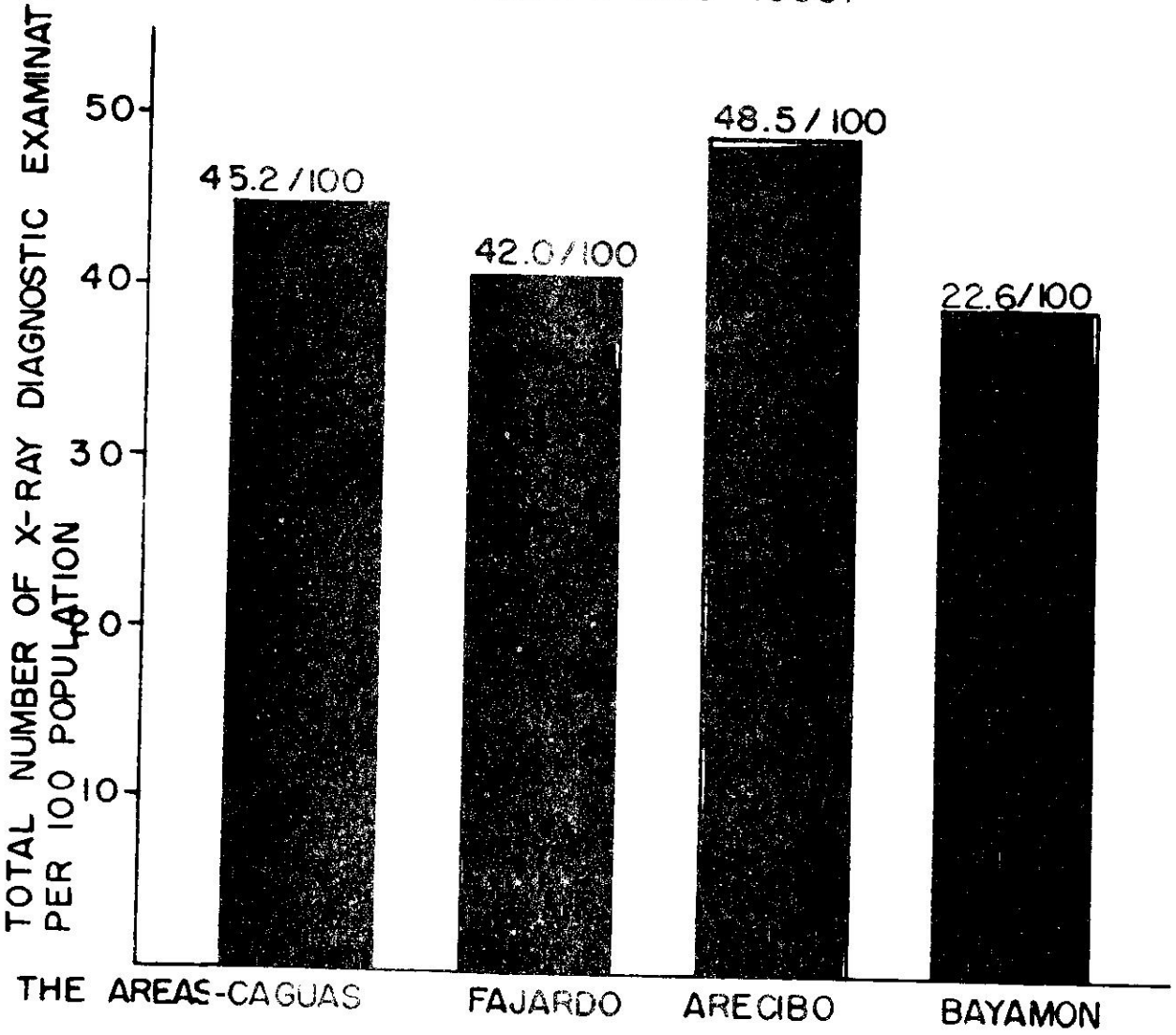
* See Table, 8-C, 8-F, 8-A, 8-B.

** The number of x-ray procedures in the Upper Abdomen include: Cholecystography, Lumbar Spine and Gastrointestinal Series. The lower Abdomen include: Abdomen, Barium Enema, I.V.P., Pelvis, Hip Joint and Pelvimetry.

FIGURE - 7N

NUMBER OF X-RAY EXAMINATIONS PER 100 POPULATION PER ANNUM BY GEOGRAPHIC LOCATION.

SURVEYED AREAS OF THE NORTHERN REGION
PUERTO RICO - 1968.



DOSE MEASUREMENTS

Surveyed Areas of the Northern Region

Accurate and reliable dose measurements are an indispensable requirement for evaluating the quantifiers used to characterize the radiation hazards.

In the framework of this part of the survey dose measurements were carried out using x-ray units typical of the area as irradiation sources. Such typical x-ray units were the Siemens 300 MA x-ray unit in the Arecibo Regional Hospital and the Picker 200 MA unit in the Health Center of Bayamón.

Measurements were carried out both in vivo and using a Rando phantom in lieu of the patient, always accurately simulating positioning and collimating techniques used in actual procedures.

For a detailed description of the method and the instrumentation used for accurate and reproducible dose measurements as well as the computational method used for evaluating the relevant quantifiers, the reader is referred to Report II of the Joint Radiation Survey pp. 53-56.

Based on the census of x-ray units in the Surveyed Areas, dose rates measured at the Siemens 300 MA unit were used to evaluate the quantifiers in the Arecibo area, while for the same reasons in the Caguas-Fajardo and Bayamón areas dosimetric data measured on Picker 200 MA x-ray unit were used.

Table 1D and Figure 1D are instrumental in evaluating the half value layer and effective energy of the Siemens 300 MA x-ray unit.

Tables 2D-4D and the corresponding figures 2D-4D present intercalibration data pertaining to the Siemens 300 MA unit. Figure 5D shows the relationship of dose rates as measured in vivo and on a Rando phantom in identical x-ray diagnostic procedures.

LIST OF TABLES

TABLE I-D

DETERMINATION OF H.V.L. IN X-RAY UNIT SIEMENS - 300 M.A (PLEOPHOS 4). VARIABLE COLLIMATOR, TOTAL FILTRATION 3.5mm AL, TEMP. 72° F. ARECIBO DISTRICT HOSPITAL PUERTO RICO

ABSORBER THICKNESS mm AL	VICTOREEN 228 READING mR	EFFECTIVE ENERGY
0	520	$\mu = \frac{.693}{0.425} = 1.63\,cm^{-1}$
0.5	480	
1.0	450	$\rho = 2.7\ \frac{gr}{cc}$ DENSITY OF AL
1.5	390	
2.0	360	TOTAL MASS AL. COEFFICIENT
2.5	340	$\mu/\rho = \frac{1.63\,cm^{-1}}{2.7\ \frac{gr}{cc}} = 0.603\ \frac{cm^2}{gr}$
3.0	320	
3.5	290	Kev. EFF=38.6 Kev
4.0	270	
4.5	250	

TUBE VOLTAGE 76 K.V

TABLE 2D

LIF-TLD POWDER AND VICTOREEN 228 IONCHAMBER INTERCALIBRATION DATA. HVL 4.25 m/m AL.

EXPOSURES MEASURED ON THE SURFACE OF SKIN. SIEMENS - 300 X-RAY UNIT, TUBE DYNAMAX 40, 100 MAS, TFD = 90 cm. DIRECT BEAM. DISTRICT HOSPITAL, ARECIBO P.R.

TUBE VOLTAGE KV	VICTOREEN 228 READING mR	CORRECTION FACTOR	TRUE EXPOSURE ① mR	LIF-TLD POWDER ① READING	RATIO OF VICTOREEN READING TO LIF
60	2,100	1.075	2,257.5	3,600	.627
70	2,350	1.070	2,514.5	3,950	.636
80	3,387	1.065	3,607.9	5,590	.645
90	4,000	1.060	4,240.0	6,580	.644

① BACKGROUND CORRECTION SUBTRACTED

TABLE 3 D

LIF – TLD POWDER AND VICTOREEN - 227 IONCHAMBER INTERCALIBRATION DATA EXPOSURES MEASURED AT LOCATION OF THE TESTES 20cm CAUDAL FROM CENTRAL BEAM INCIDENCE USING 100 MAS AT A TFD=90cm

SURVEYED AREAS OF THE NORTHERN REGION

PUERTO RICO

A. IRRADIATION SOURCE USED TO OBTAIN DATA:		SIEMENS – 300 MA		TUBE DYNAMAX – 40 FILTR. 3.5 AL H.V.L 2.25 (DISTRICT HOSPITAL ARECIBO)	
TUBE VOLTAGE KV	VICTOREEN 227 READING mR	CORRECTION FACTOR	TRUE EXPOSURE* mR	LIF-TLD POWDER READINGS*	RATIO OF VICTOREEN READING TO LIF – TLD.
60	340	1.185	368.9	520	0.70
70	480	1.163	558.2	650	0.85
80	570	1.136	647.5	740	0.87
90	630	1.098	691.7	780	0.88

* Background correction subtracted.

TABLE 4 – D

LIF – TLD POWDER AND VICTOREEN - 228 IONCHAMBER INTERCALIBRATION DATA

EXPOSURES MEASURED AT DEPTH OF 12.5 cm. ON THE PHANTOM AT THE LOCATION OF THE OVARIES* SOURCE OF RADIATION: SIEMENS – 300 M.A. USING 100 M.A.S AT T.F.D. = 90 cm. ARECIBO DISTRICT HOSPITAL. SURVEYED AREAS OF THE NORTHERN REGION. PUERTO RICO

K.V.	READING VICTOREEN 228 (5R)			CORRECTION FACTOR	TRUE EXPOSURE mR.	LIF – TLD POWDER READING			RATIO OF VICTOREEN READING TO LIF
	LEFT OVARY	RIGHT OVARY	MEAN			LEFT OVARY	RIGHT OVARY	MEAN	
60	440	460	450	1.075	483.7	1.100	1.340	1.270	.38
70	530	560	545	1.070	583.1	1.690	1.740	1.715	.34
80	640	690	665	1.065	708.2	2.190	2.260	2.225	.32
90	830	870	850	1.060	901.0	2.860	3.020	2.940	.30

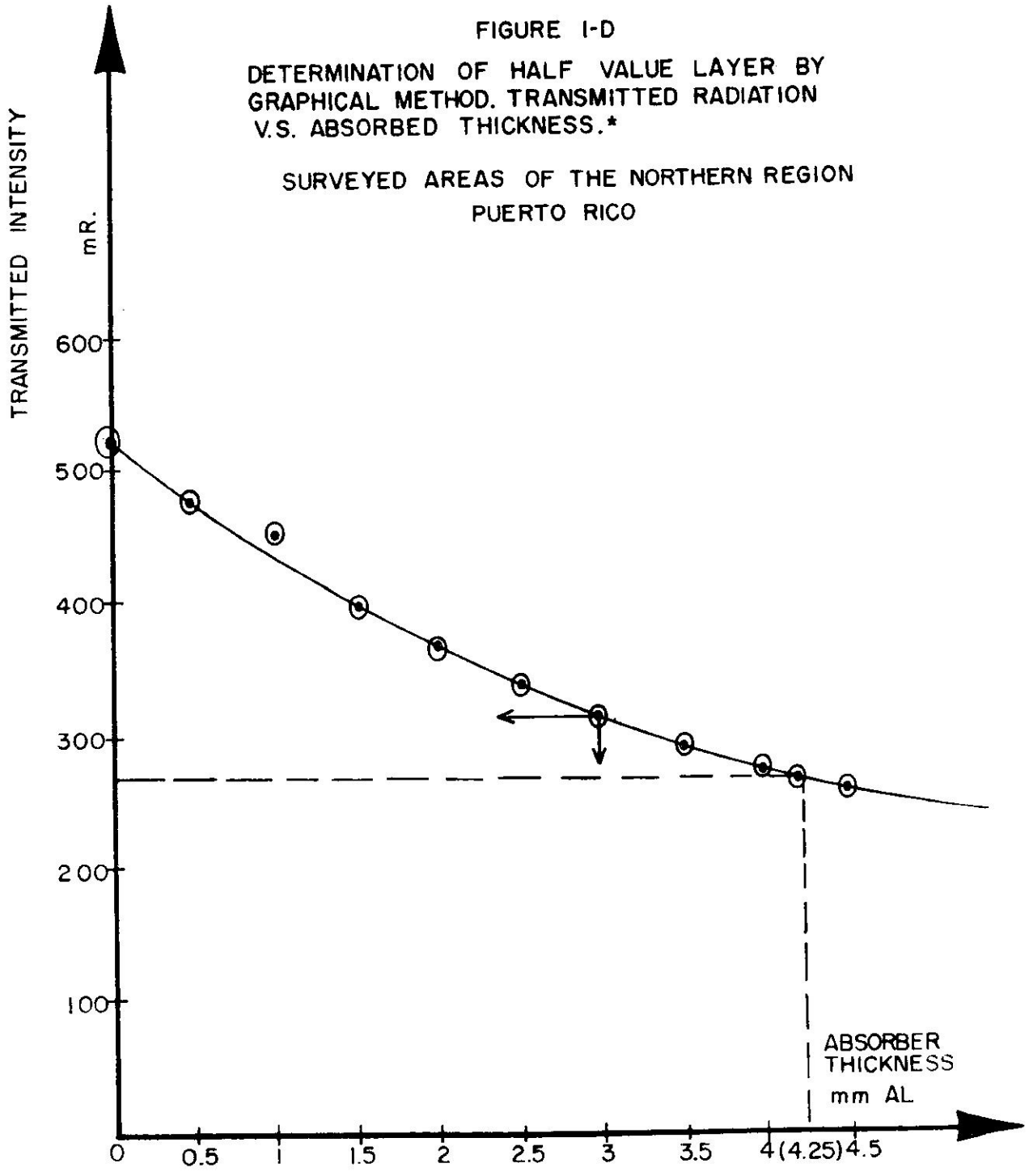
* Total thickness of the Phantom in this location is 25 cm.

LIST OF FIGURES

FIGURE I-D

DETERMINATION OF HALF VALUE LAYER BY GRAPHICAL METHOD. TRANSMITTED RADIATION V.S. ABSORBED THICKNESS.*

SURVEYED AREAS OF THE NORTHERN REGION
PUERTO RICO



* See Table I-D.

FIGURE – 2D

LIF – VICTOREEN INTERCALIBRATION CURVE.

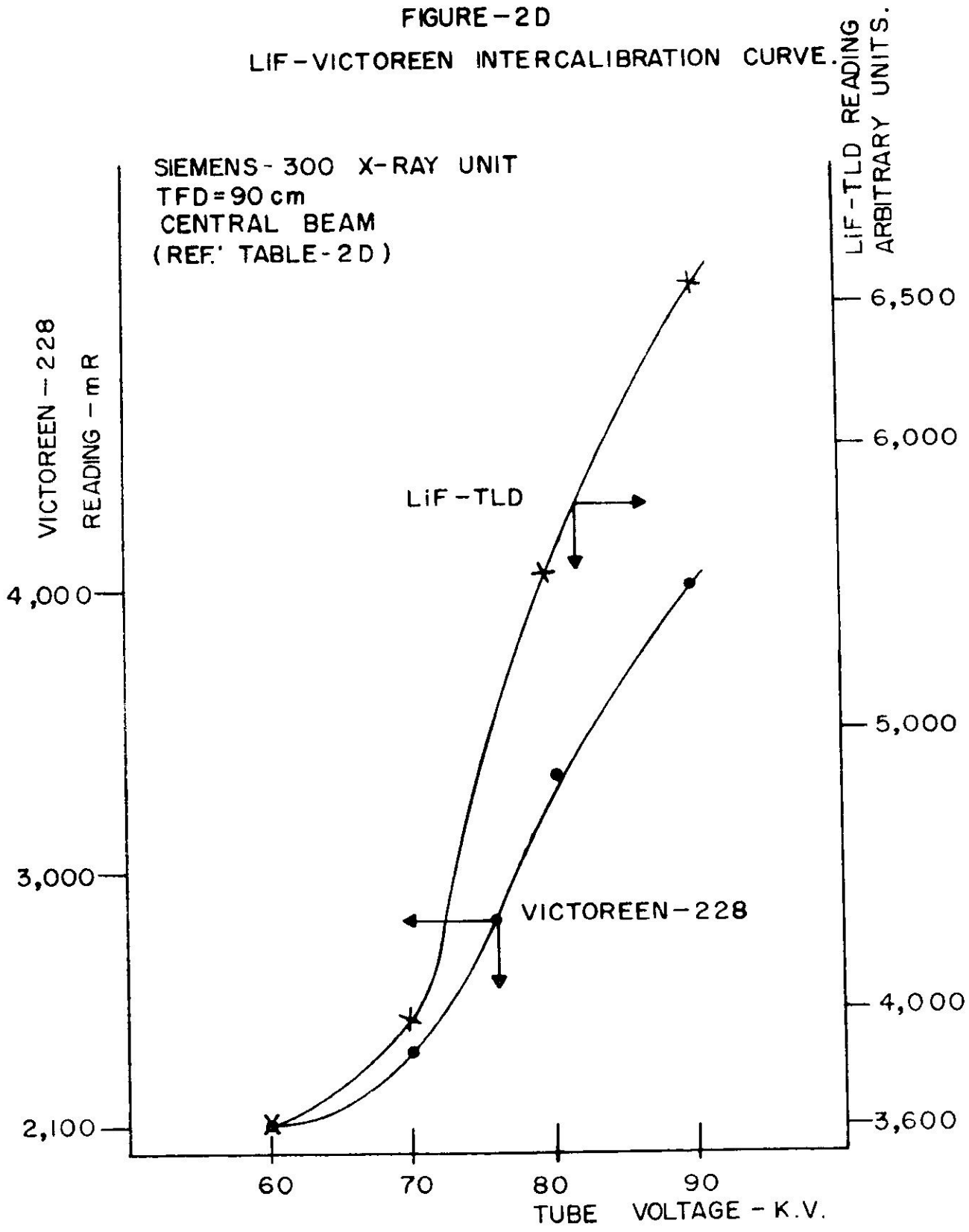


FIGURE - 3 D

LiF-TLD POWDER DOSIMETER AND VICTOREEN 228 INTERCALIBRATION CURVES.

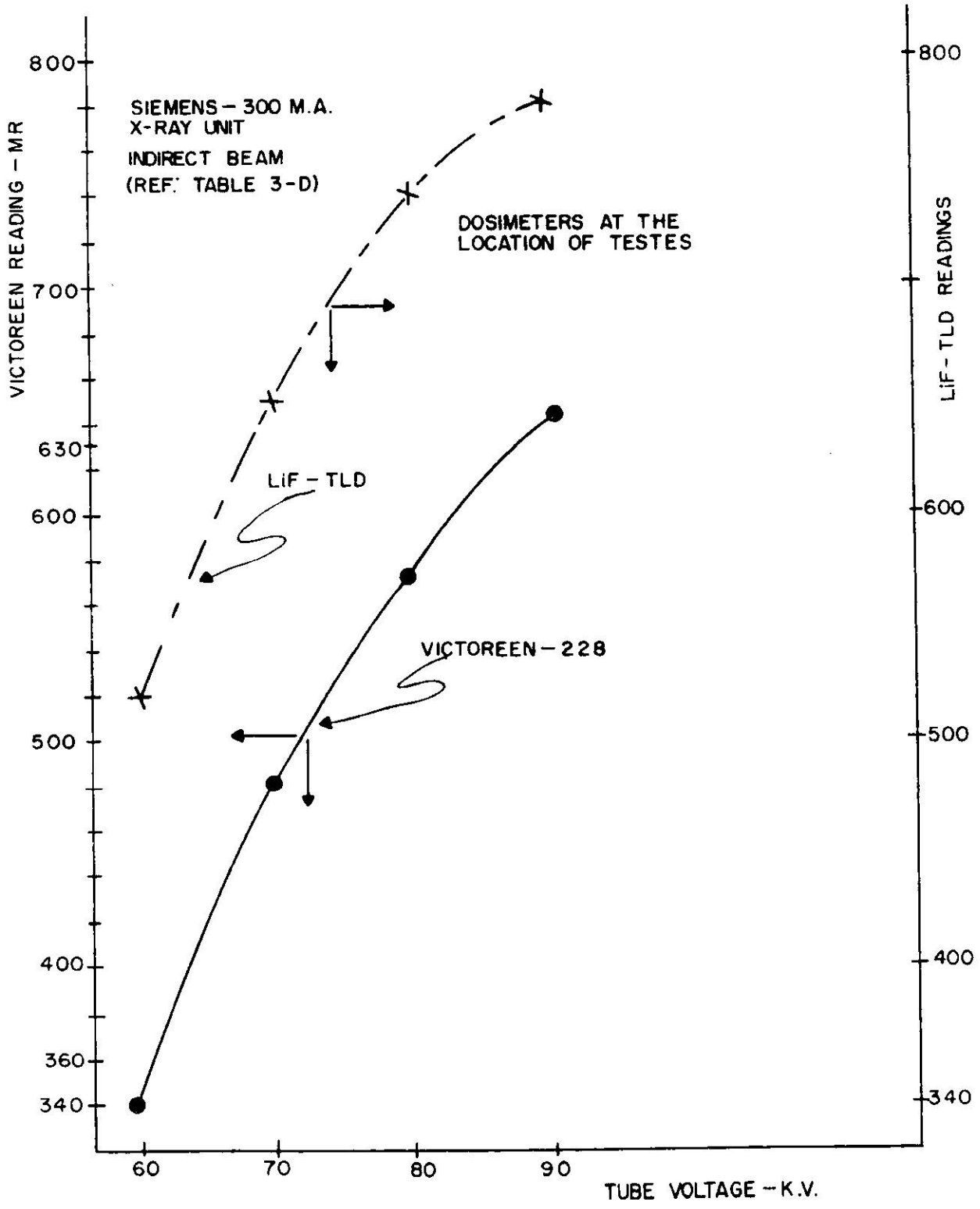


FIGURE-4D

LiF-TLD POWDER DOSIMETER AND VICTOREEN 228 IONCHAMBER INTERCALIBRATION DATA.

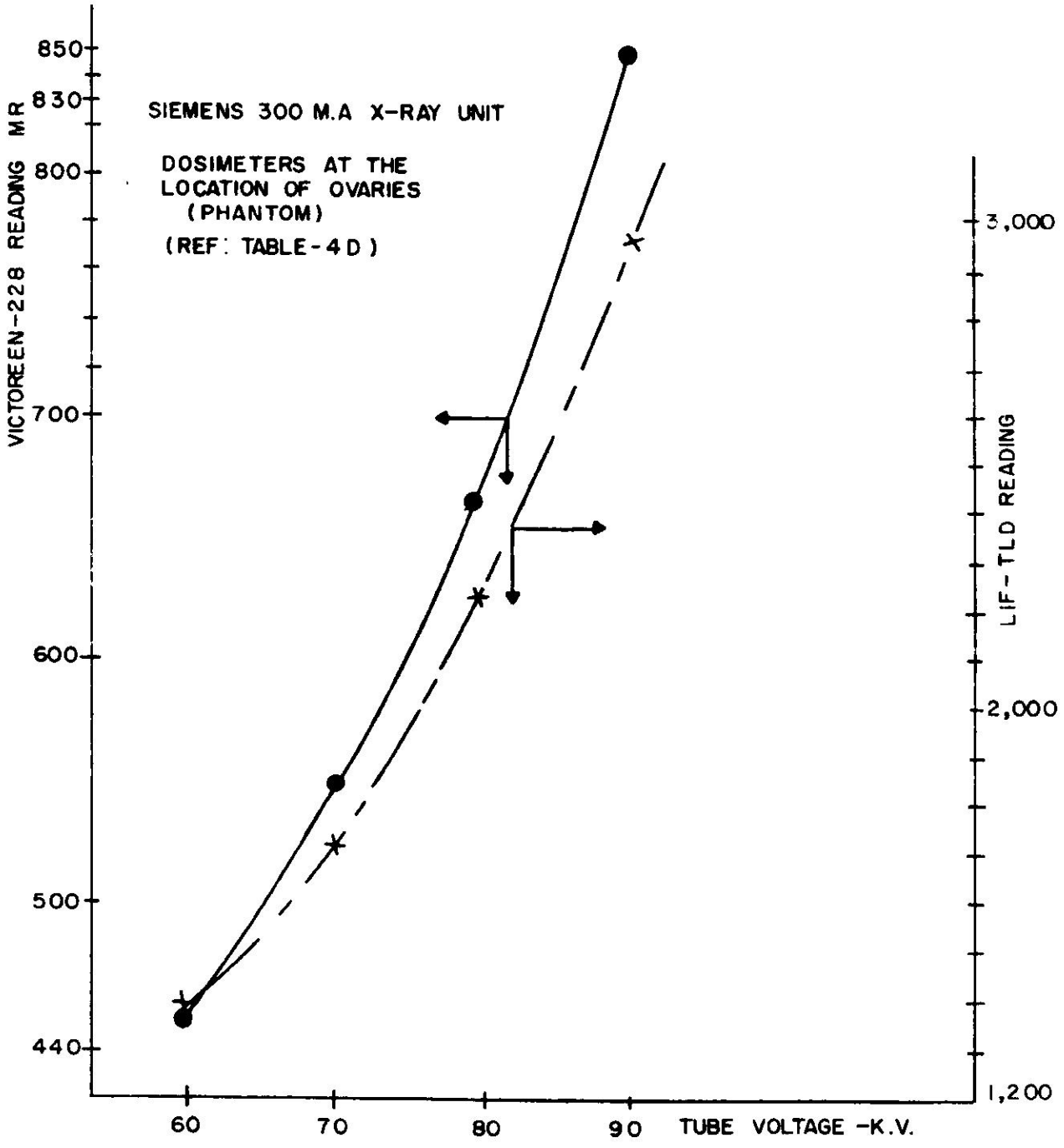
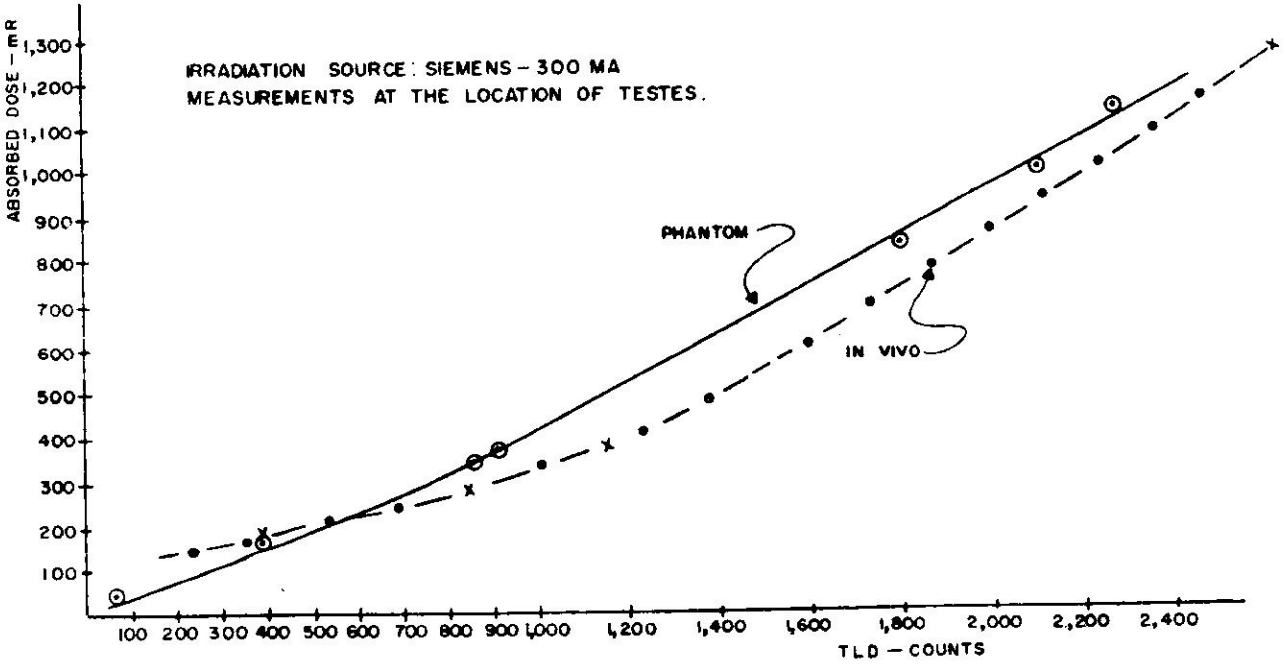


FIGURE – 5 D

INTERCALIBRATION CURVES OF TLD AND VICTOREEN – DOSIMETERS IN PHANTOM AND IN VIVO.



MANUFACTURERS CALIBRATION REPORTS

FOR

VICTOREEN - 227 and VICTOREEN - 228

IONIZATION CHAMBERS

VICTOREEN

VICTOREEN INSTRUMENT DIVISION • 10101 WOODLAND AVE., CLEVELAND, OHIO
PHONE (216) 795-9200 • TWX (810) 421-8287 • TELEX 098-9349

Calibration Report

To: Electronic of Puerto Rico Date MAY 7 1968

Register # 11530 Mode 227 #158; 633 #167

X-ray Technique

Lightly Filtered X-ray

kv cp	Inherent filter (mm Be)	Added Filter (mm Al)	hvl (cm Al)	(kev)
8.2	1.0	0	.0029	6.45
23.0	1.0	0	.0073	9.05
✓ 40.6	1.0	1.03	.079	20.0
50.0	1.0	3.25	.194	28.2

Correction Factors (multiply by)

kv	8.2	23.0	40.6	50.0
Item				
227 #158	-	1.250 ✓	1.225 ✓	-
633 #167	-	-	1.175	-

Other -

Calibrated by J. L.
Radiation Lab.

The Victoreen Instrument Co.
Cleveland, Ohio

VICTOREEN

VICTOREEN INSTRUMENT DIVISION 10101 WOODLAND AVE., CLEVELAND, OHIO 44104
PHONE [illegible] • WX (216) 421 9207 • TELEX 098 5365

CALIBRATION REPORT

To: Electronics of Puerto Rico Date MAY 7 1968

Register # 115-30C Serial # 158 151 167 Model # 227 228 633

X-RAY TECHNIQUE
(Moderately Filtered X-Rays)

Technique	KVCP	Total Filtration		Kev. Eff.	hvl	
		mm Al	mm Cu		mm Cu	mm Al
H	60	4	0	32	0.09	2.8
I	76	4	0	34.5 ✓	0.11	3.4
J**	100	5	0	42	0.20	5.1
K	150	5	0.25	64	0.66	10
L	200	5	0.5	84	1.3	13
M**	250	5	1.0	111	2.2	16
M1	250	5	3.2	140	3.2	18
Cs^{137}*	—	—	—	660	—	—
Co^{60}*	—	—	—	1250	—	—

Correction factors for these techniques are obtained by intercomparison with instruments whose calibrations are traceable to the U.S. National Bureau of Standards and are accurate to within ±3%.

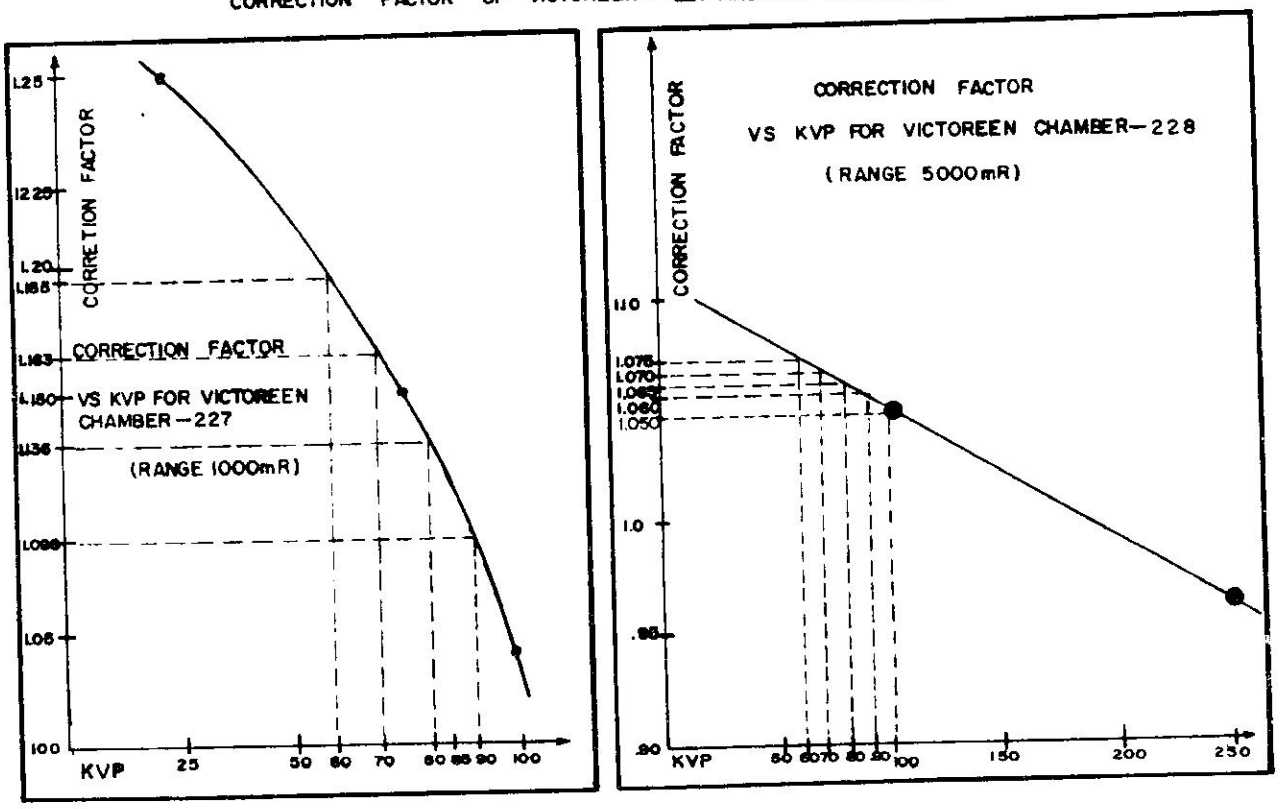
Model and Serial No.	Correction Factor (Multiplier) for Technique (J)	(M)	(H)	(I)	(K)
R-Chambers					
227 1c # 158	1.04 ✓			1.150	
228 .5c " 151	1.05	.97			
633 2.5c " 167	1.01		1.07	1.085	1.04

*Standard Calibration Points for High Energy Chambers and Probes, No Extra Charge.
**Standard Calibration Points, No Extra Charge on New or Repair Instruments.

Calibrated By: A.H.V.
(X-Ray Lab.)

Form: 9064A-1-68

CORRECTION FACTOR OF VICTOREEN—227 AND 228 CHAMBERS.



See the calibration report of the manufacturer, which is attached.

PRESENTATION OF STATISTICAL DATA

CAGUAS AREA

The Area of Caguas includes twelve municipalities in the Northeastern part of the Island, with a total population of 360,000. Caguas, founded in 1775, is the largest city in the area with a population of 76,000.

The entire area and especially the city of Caguas, is a growing industrial and commercial section. There are six community hospitals—Aibonito, Caguas, Gurabo, Juncos, San Lorenzo and Yabucoa.

There are accredited private schools such as Colegio Católico de Caguas, Notre Dame High School, Colegio Bautista and public vocational schools.

This area needs more general hospital beds. As in the Mayagüez Area (see Report Number One) this results in a migration of patients to the areas of San Juan and Fajardo for medical services. Many films exposed in private and public institutions are sent to Fajardo for interpretation.

An Area Sub-Regional Hospital is in the final stages of preparation for full operation; it will have six stationary Westinghouse x-ray units, and four mobile units with special grid control.

LIST OF TABLES

TABLE 1-C

MUNICIPALITIES OF THE CAGUAS AREA AND THEIR POPULATION
PUERTO RICO-1968*

MUNICIPALITIES	POPULATION
Aguas Buenas	19,200
Aibonito	22,100
Caguas	77,000
Cayey	43,400
Cidra	23,400
Gurabo	20,100
Humacao	34,200
Juncos	28,500
Las Piedras	17,800
Naguabo	20,900
San Lorenzo	30,500
Yabucoa	31,900
CAGUAS AREA TOTAL	369,000

* The above data are quoted from the Annual Vital Statistics Report, Commonwealth of Puerto Rico Department of Health, 1968.

TABLE 2-C

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION
BY MEDICAL FACILITY, BY GEOGRAPHIC LOCATION AND POPULATION PER X-RAY UNIT
CAGUAS AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
Aguas Buenas	Health Center	-		
	Private Offices	1	19,200	19,200
Aibonito	Municipal Hospital	-		
	Mennonite Hospital	2	22,100	11,050
Caguas	Municipal Hospital	1		
	San Rafael Hospital	4		
	Public Health Unit & T.B. Center	2		
	Private Offices	10		
Caguas Total		17	77,000	4,529
Cayey	T.B. Hospital & T.B. Center	2		
	Font Clinic	1		
	Health Center	1		
	Private Offices	4		
Cayey Total		8	43,400	5,425
Cidra	Health Center	-		
	Private Offices	1		
Cidra Total		1	23,400	23,400
Gurabo	Municipal Hospital	-		
	San Jose Clinic	1	20,100	20,100
Humacao	Oriente Clinic	1		
	Health Center and T.B. Center	3		
	Font Martelo Hospital	1		
	Ryder Memorial Hospital	2		
	Private Offices	3		
Humacao Total		10	34,200	3,420
Juncos	T.B. Center	1		
	Private Offices	5		
Juncos Total		6	28,500	4,750
Las Piedras	Health Center	-	17,800	No x-ray unit
Naguabo	Municipal Hospital	-	20,900	" " "
San Lorenzo	Municipal Hospital	-		
	Private Offices	4	30,500	7,625
Yabucoa	Municipal Hospital	-		
	Private Offices	2	31,900	15,950
CAGUAS AREA TOTAL		52	369,000	7,096

Note: Only x-ray units in operative condition were included in this table.

TABLE 3-C

TOTAL NUMBER OF X-RAY EXAMINATIONS IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
CAGUAS AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
Aguas Buenas	Health Center	114,540	-	-
Aibonito	Municipal Hosp.	72,306	-	-
	Mennonite Hosp.	26,981	7,000	25.9
Aibonito Total		99,287	7,000	7.0
Caguas	Municipal Hosp.	139,982	6,304	4.5
	San Rafael Hosp.	9,065	29,705	327.6
	Public Health Unit & T.B. Center	15,167	15,792*	104.1
Caguas Total		164,214	51,801	31.5
Cayey	T.B. Hosp. & T.B.Center	8,618	11,026	127.9
	Font Clinic	26,173	15,600	59.6
	Health Center	35,481	1,734	4.8
Cayey Total		70,272	28,360	40.3
Cidra	Health Center	9,993	-	-
Gurabo	Municipal Hosp.	25,720	-	-
	San Jose Clinic	800	624	78.0
Gurabo Total		26,520	624	2.3
Humacao	Health Center & T.B. Center	47,741	10,678**	22.3
	Oriente Clinic	2,554	7,105	278.1
	Font Martelo Hosp.	6,627	9,158	138.1
	Ryder Memorial Hosp.	48,905	5,596	11.4
Humacao Total		105,827	32,537	30.7
Juncos	Health Center	41,330	-	-
	Public Health Unit & T.B. Center	10,501	11,388	108.4
Juncos Total		51,831	11,388	21.9
Las Piedras	Health Center	10,549	-	-
Naguabo	Health Center	25,385	-	-
San Lorenzo	Hosp. Municipal	2,189	-	-
Yabucoa	Hosp. Municipal	41,010	-	-
GRAND TOTAL		721,617**	131,710	18.2

* Including 12,459 Photofluorographies.
** Including 8,310 Photofluorographies.

A correction in the total number of x-ray examinations was received from the Mennonite Hospital, Aibonito, after part of this report was in final preparation for printing. The correction will be included in the Island-wide Summary Report.

TABLE 4-C

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION, BY MEDICAL FACILITY AND BY MANUFACTURER
CAGUAS AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER		GENERAL ELECTRIC		WESTING-HOUSE		KELEKET		PROFEX-RAY		SIEMENS		UNIVERSAL		ACOMA		TOTAL
		MA		MA		MA		MA		MA		MA		MA		MA		
Aguas Buenas	Private Offices									1	100							1
Aibonito	Mennoite Hospital	1 1	200 200 Mob.															2
Caguas	Municipal Hospital					1	300											1
	San Rafael Hosp.	1 1 1	200 300 300 Mob.									1	300					4
	Public Health Unit & T.B. Center	1	100	1	200 (Odel-ca)													2
	Private Offices	2 1	100 200	1	30 (Fluor) 100			1	100	2	100	1	65	1	75			10
Caguas Total		7		3		1		1		2		2		1				17
Cayey	T.B. Hosp. & T.B.Center	1	100	1	200 (Odel-ca)													2
	Font Clinic	1	200															1
	Health Center	1	200															1
	Private Offices	1 1	100 200	1	30 (Fluor)			1	100									4
Cayey Total		5		2				1										8
Cidra	Private Offices															1	50	1
Gurabo	San Jose Clinic									1	300							1
Humacao	Oriente Clinic							1	300									1
	Health Center & TB Center			1	200	1 1	300 30											3
	Font Martelo Hosp.									1	300							1
	Ryder Memorial Hospital	1	200											1	100 (Mob)			2
	Private Offices	2 1	35 (Fluor) 300															3
Humacao Total		4		1		2		1		1		0		1		0		10
Juncos	T.B. Center	1	200															1
	Private Offices	1 1	30 (Fluor) 100	2	100									1	75			5
Juncos Total		3		2										1				6
San Lorenzo	Private Offices	1	100	1	100			1	100			1	12 (Fluor)					4
Yabucoa	Private Offices			1	300					1	300							2
TOTAL in Caguas Area		22		10		3		4		6		3		3		1		52

TABLE 5-C

CENSUS OF DIAGNOSTIC X-RAY UNITS
CAGUAS AREA OF PUERTO RICO-1968

Geographic Location	Name of Facility	Manufacturer and Model (MA)	Year of Mfg. or Purchase	Tubes, Mfg. & Model	Collimation	Total Filtration mm. Al.	Comments
Aguas Buenas	Private Office	Profex-ray 100 150KVP	1963	DX-10 (1 tube)	Variable Collimator Videx	2.5	
Aibonito	Mennonite Hospital	Picker 200 Picker Mobile 200 120 KVP	1946 1968	Dynamax 40 (2 tubes) Dynamax 40 (1 tube)	Cone Variable Collimator	2.5 4.0	Anatomatic.
Caguas	Municipal Hospital	Westinghouse 200 100 kVp (Daytona)	1964	Dynamax 40 (2 tubes)	Variable Collimator	3.5	Radiation measurement badges werenot used by X-ray personnel, nor by students at time of our visit.
	San Rafael Hospital	Picker 200 " 300 Siemens 500 Picker 200 Mobile	1968 1968 1968 1968	PX-10 PX-10A Dynamax 40 PX-10	V. Coll. " " " " Cone	3.0 3.0 3.0 2.5	Gonadal shielding only used on children occasionally.
	Public Health Unit	Picker 100 140 KVP	1968	PX-10E (2 tubes)	V. Collimator, Videx	3.0	
	T.B. Center	G.E. 200 KXE-225	1966	(2 tubes) G.E.-LWRT	Odelca Photo	3.5	Mass chest exams.Minograph
Caguas	Private Offices	G.E. 30	1946	PX-1B (1 tube)	No collima.	.5	G.P., Fluoroscopy only.
		Siemens 65 72 KVP	1968	Roentgen-kugel (1 T.)	Variable Collimator	2.5	General Practitioner.
		Picker 100	1946	PX-8E (1 tube)	No collimator	.5	G.P., Not in use since Jan.1970.
		Picker 100 120 KVP	1940	PX-8E (1 tube) D-32099	No collimator	.5	Only used for lung fluoroscopy Chest-spec.
		Universal 75	1928		Cone		Cardiology.
		Profex-ray 100 100 KVP	1966	Picker PX-8(1 T.)	Cone	1.5	G. P.
		Profex-ray 100 100 KVP	1966	Dynamax 40	Variable Collimator Mascot	3.5	G. P.
		Kelaket 100 100 KVP	1955	Dynamax 20 (1 tube)	None	.5	G. P.

Cont. on following page

TABLE 5-C Cont.

Geographic Location	Name of Facility	Manufacturer and Model (MA)	Year of Mfg. or Purchase	Tubes, Mfg. and Model	Collimation	Total Filtration mm. Al.	Comments
Caguas cont.	Private Offices cont.	G.E. 100	1945	DXC (1 T., Coolidge)	None	.5	G. P.
		Picker 200	1962	Dynamax 25	Variable Collimator	3.0	G. P.
Cayey	Health Center	Picker 200	1962	Dynamax-25	Variable Collimator	3.0	No radiologist's supervision. Films sent to Fajardo District Hospital for interpretation.
	Font Clinic	Picker 200 140 KVP	1945	Dynamax 25 (2 tubes)	Variable Collimator	3.5	
	T.B. Hospital and T.B. Health Center	Picker 100 100 KVP	1962	PX-18	Variable Collimator	4.0	Connected with tomography.
		G.E. E-225	1966	G.E. L.W.R.T.	Photo Odelca	3.5	Mass chest examinations.
	Private Offices	Picker 100	1958	PX-10A	Cone	1.5	G. P.
		Picker 100 100 KVP	1958	PX-10A	None	.5	T.B. Specialist
		G.E. 30	1950	DX	None	.5	Fluoroscopy only
		Keleket 100	1955	Dynamax 40 2 tubes	Cone	1.5	For radiology. G. P.
Cidra	Private Office	Acoma 50	1958	1 tube	Cone	.5	G. P.
Gurabo	Municipal Hospital	-	-	-	-	-	Vertical Fluoro. Out of order.
	San Jose Clinic	Profex-ray 300 100 KVP	1966	Profex (1 tube)	V.Collimator Videx	3.5	Mobile
Humacao	Health Center & T.B. Center (Same location)	Westinghouse 300	1966	Eureka RA-71	Cone	.5	
		G.E. 200	1966	G.E.- L.W.R.T.	Photo-Odelca	3.5	Mass chest exam.
		Westinghouse 30	1937	-	-	.5	Not in use.
	Oriente Clinic	Keleket 300 120 KVP	1955	Dynamax 40	Variable Collimator	3.5	
	Font Martelo Hospital	Profex-ray 300 100 KVP	1947	Eureka DX25-1(2 T.)	Cone	2.5	
	Ryder Memorial Hospital	Picker 200 90 KVP	1959	Dynamax 25	Variable Collimator	3.8	
		Universal 50		-	Cone	2.0	Mobile
	Private Offices	Picker 300 140 KVP	1968	PX-10A (2 tubes)	Variable Collimator	3.5	Radiologist.
		Picker 35 100 KVP	1940	PX-1B	None	.5	Fluoroscopy only.

Cont. on following page

TABLE 5-C Cont.

Geographic Location	Name of Facility	Manufacturer and Model (MA)	Year of Mfg. or Purchase	Tubes, Mfg. & Model	Collimation	Total Filtration mm. Al.	Comments
Humacao Cont.	Private Office	Picker 35 100 KVP	1940 Mfg.	PX-1B	-	.5	Fluoroscopy only.
Juncos	T.B. Center	Picker 200 120 KVP	1960	Eureka RA (1 T.)	Odelca Camera	3.5	Mass chest exams G.P., Adjustment for Photofluorography with Odelca camera.
	Private Offices	Universal 75	1961	Dynamax	Cone	.5	Fluoro. only.
		G.E. 100 90 KVP	1961	Eureka RA-51(1 T.)	Cone	1.5	G.P.
		G.E. 100 60 KVP	1958	G.E. R-2 (1 tube)	None	).7	Chest exams. only.
		Picker 30	1940 Mfg.	PX-1B	None	0.5	Fluoros. only. Fluoroscopy was performed without gloves until our inspection.
		Picker 100	1946	PX-8E	Cone	2.5	Not in use since 1969.
San Lorenzo	Private Offices	Picker 100	1960	PX-8E	Cone	.5	General Practitioner
		Siemens 12 72 kVp	1968	Siemens Kugel Heliosphere	Collimator	2.5	Portable. Chest examinations only.
		G.E. 100	1959	L.W.R.T.	Cone	1.5	G. P.
		Kalekat 100	1955		Cone	2.0	G. P.
Yabucoa	Municipal Hospital	G.E. 30 RB-3	1950	-	-	-	Out of order.
	Private Offices	G.E. 200 100 KVP	1955	L.W.R.T.	Variable Collimator	3.0	G. P.

Note: Out of the 54 diagnostic x-ray units in the Caguas Area-1968, 2 units were not in operative condition.

TABLE 6-C

NUMBER OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS BY MEDICAL FACILITY, BY TYPE OF EXAMINATION AND BY SEX
CAGUAS AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Sex	Type of Abdominal Examination									
			Abdomen	Cholecystography	Lumbar Spine	Gastrointest. Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Aguas Buenas	Private * Offices	Male	52	-	-	-	-	-	-	-	-	52
		Fem.	52	-	-	-	-	-	-	-	-	52
		Total	104	-	-	-	-	-	-	-	-	104
Aibonito	Mennonite Hospital**	Male	452	213	587	300	200	400	50	50	-	2,252
		Fem.	400	300	350	500	200	424	100	120	50	2,444
		Total	852	513	937	800	400	824	150	170	50	4,696
Caguas	Municipal Hospital	Male	92	92	51	203	60	107	70	55	-	730
		Fem.	94	95	83	180	45	68	58	45	114	782
		Total	186	187	134	383	105	175	128	100	114	1,512
	San Rafael Hospital	Male	468	520	624	624	208	364	118	3,200	-	6,126
		Fem.	416	520	156	572	104	260	190	2,156	156	4,430
		Total	884	1,040	780	1,196	312	624	208	5,356	156	10,556
	Public Health Unit & T.B. Hlth. Center	Male	-	-	-	-	-	-	-	-	-	-
		Fem.	-	-	-	-	-	-	-	-	-	-
		Total	-	-	-	-	-	-	-	-	-	-
	Private Offices	Male	515	-	355	70	20	286	172	-	-	1,418
		Fem.	513	-	330	50	30	410	160	-	200	1,693
		Total	1,028	-	685	120	50	696	332	-	200	3,111
Caguas Total		Male	1,075	612	1,030	897	288	757	358	3,200	-	8,217
		Fem.	1,023	615	569	802	179	738	308	2,156	470	6,860
		Total	2,098	1,227	1,599	1,699	467	1,495	666	5,356	470	15,077
Cayey	T.B. Hospital	Male	-	-	-	25	-	-	-	-	-	25
		Fem.	-	-	-	15	-	-	-	-	-	15
		Total	-	-	-	40	-	-	-	-	-	40
	Font Clinic	Male	724	160	1,742	140	108	40	54	-	-	2,968
		Fem.	420	152	650	120	100	72	50	-	-	1,564
		Total	1,144	312	2,392	260	208	112	104	-	-	4,532

Cont. on following page

TABLE 6-C Cont.

Geographic Location	Medical Facility	Sex	Type of Abdominal Examination									
			Abdomen	Cholecystography	Lumbar Spine	Gastrointest. Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Cayey cont.	Health Center	Male	15	15	24	20	9	9	17	11	-	120
		Fem.	24	15	26	28	11	8	31	9	7	159
		Total	39	30	50	48	20	17	48	20	7	279
	Private Offices	Male	152	-	150	100	-	150	50	50	-	652
		Fem.	150	52	152	150	-	100	50	50	100	804
		Total	302	52	302	250	-	250	100	100	100	1,456
Cayey Total		Male	891	175	1,916	285	117	199	121	61	-	3,765
		Fem.	594	219	828	313	111	180	131	59	107	2,542
		Total	1,485	394	2,744	598	228	379	252	120	107	6,307
Cidra	Private Offices	Male	52	-	-	-	-	-	-	-	-	52
		Fem.	104	-	-	-	-	-	-	-	-	104
		Total	156	-	-	-	-	-	-	-	-	156
Gurabo	San Jose Clinic	Male	52	52	-	52	-	52	-	-	-	208
		Fem.	52	52	-	52	-	52	-	-	-	208
		Total	104	104	-	104	-	104	-	-	-	416
Humacao	Health Center	Male	16	13	37	43	9	5	11	7	-	141
		Fem.	43	30	29	65	16	13	12	9	4	221
		Total	59	43	66	108	25	18	23	16	4	362
	Oriente Clinic	Male	95	62	312	179	82	57	74	118	-	979
		Fem	193	100	224	223	126	49	72	106	52	1,145
		Total	288	162	536	402	208	106	146	224	52	2,214
	Font Martelo Hospital	Male	71	74	197	284	79	75	21	26	-	827
		Fem.	149	197	202	263	93	80	30	24	-	1,038
		Total	220	271	399	547	172	155	51	50	-	1,865
	Ryder Memorial Hospital	Male	156	52	416	156	104	312	52	52	-	1,300
		Fem.	104	104	260	52	-	208	52	104	52	936
		Total	260	156	676	208	104	520	104	156	52	2,236
	Private Offices	Male	104	52	52	104	52	52	-	52	-	468
		Fem.	52	-	-	104	-	-	-	-	52	208
		Total	156	52	52	208	52	52	-	52	52	676

Cont. on following page

TABLE 6-C Cont.

Geographic Location	Medical Facility	Sex	Type of Abdominal Examination									TOTAL
			Abdomen	Cholecystography	Lumbar Spine	Gastrointest. Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	
Humacao Total		Male	479	243	1,074	691	348	496	188	345	-	3,864
		Fem.	503	531	595	592	213	405	146	253	161	3,399
		Total	982	774	1,669	1,283	561	901	334	598	161	7,263
Juncos	T.B. Health Center	Male	-	-	-	-	-	-	-	-	-	-
		Fem.	-	-	-	-	-	-	-	-	-	-
		Total	-	-	-	-	-	-	-	-	-	-
	Private Offices	Male	156	104	104	156	-	-	-	-	-	520
		Fem.	156	104	104	156	-	-	-	-	-	520
		Total	312	208	208	312	-	-	-	-	-	1,040
Juncos Total		Male	156	104	104	156	-	-	-	-	-	520
		Fem.	156	104	104	156	-	-	-	-	-	520
		Total	312	208	208	312	-	-	-	-	-	1,040
San Lorenzo	Private Offices	Male	330	-	50	400	150	200	20	-	-	1,150
		Fem.	310	-	20	455	162	80	10	-	80	1,117
		Total	640	-	70	855	312	280	30	-	80	2,267
Yabucoa	Private Offices	Male	780	-	468	364	314	260	260	112	-	2,558
		Fem.	520	-	312	260	156	416	364	156	133	2,317
		Total	1,300	-	780	624	470	676	624	268	133	4,875
Caguas Area Total		Male	4,282	1,409	5,169	3,220	1,395	2,369	967	3,678	-	22,489
		Fem.	3,752	1,721	2,898	3,245	1,043	2,240	1,079	2,734	1,000	19,712
		Total	8,034	3,130	8,067	6,465	2,438	4,609	2,046	6,412	1,000	42,201

* "Private Offices" include a) radiologists offices and b) all other private medical offices equipped with x-ray units with the exception of dental offices.

** A correction in the total number of x-ray examinations was received from the Mennonite Hospital, Aibonito, after parts of this report were in the final stages of preparation for printing. The correction will be included in the last summary report.

TABLE 7-C

NUMBER OF DIAGNOSTIC THORACICAL X-RAY EXAMINATIONS BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY AND BY SEX
CAGUAS AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Number of Diagnostic Thoracical X-ray Examinations by Type									Total		Grand Total
		CHEST RADIOGRAPHY			PHOTOFLUOROGRAPHY			CHEST TOMOGRAPHY					
		Male	Fem	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Aguas Buenas	Private Office	156	156	312	-	-	-	-	-	-	156	156	312
Aibonito	Mennonite Hospital	984	924	1,908	-	-	-	-	-	-	984	924	1,908
Caguas	Municipal Hospital	1,025	1,038	2,063	-	-	-	-	-	-	1,025	1,038	2,063
	San Rafael Hospital	5,668	7,540	13,208	-	-	-	-	-	-	5,668	7,540	13,208
	Public Hlth.Unit & T.B. Center	1,040	1,508	2,548	4,472	5,252	9,724	92	95	187	5,604	6,855	12,459
	Private Offices	2,796	3,028	5,824	-	-	-	-	-	-	2,796	3,028	5,824
Caguas Total		10,529	13,114	23,643	4,472	5,252	9,724	92	95	187	15,093	18,461	33,554
Cayey	T.B. Hosp & T.B. Health Center	750	550	1,300	3,500	3,150	6,650	95	70	165	4,345	3,770	8,115
	Font Clinic	1,300	988	2,288	-	-	-	-	-	-	1,300	988	2,288
	Health Center	818	539	1,357	-	-	-	-	-	-	818	539	1,357
	Private Offices	1,342	1,324	2,666	-	-	-	-	-	-	1,342	1,324	2,666
Cayey Total		4,210	3,401	7,611	3,500	3,150	6,650	95	70	165	7,805	6,621	14,426
Cidra	Private Offices	300	324	624	-	-	-	-	-	-	300	324	624
Gurabo	San Jose Clinic	104	52	156	-	-	-	-	-	-	104	52	156
Humacao	Oriente Clinic	435	400	835	-	-	-	-	-	-	435	400	835
	Font Martelo Hospital	2,240	3,222	5,462	-	-	-	-	-	-	2,240	3,222	5,462
	Health Center	1,176	830	2,006	4,310	4,000	8,310	-	-	-	5,486	4,830	10,316
	Ryder Memorial Hospital	1,360	1,000	2,360	-	-	-	-	-	-	1,360	1,000	2,360
	Private Offices	884	936	1,820	-	-	-	-	-	-	884	936	1,820
Humacao Total		6,095	6,388	12,483	4,310	4,000	8,310	-	-	-	10,405	10,388	20,793
Juncos	T.B. Center	1,092	1,352	2,444	4,004	4,940	8,944	-	-	-	5,096	6,292	11,388
	Private Offices	1,385	1,555	2,940	-	-	-	-	-	-	1,385	1,555	2,940
Juncos Total		2,477	2,907	5,384	4,004	4,940	8,944	-	-	-	6,481	7,847	14,328
San Lorenzo	Private Offices	810	1,140	1,950	-	-	-	-	-	-	810	1,140	1,950
Yabucoa	Private Offices	1,048	555	1,603	-	-	-	-	-	-	1,048	555	1,603
CAGUAS AREA TOTAL		26,713	28,961	55,674	16,286	17,342	33,628	187	165	352	43,186	46,468	89,654

TABLE 8-C

TOTAL NUMBER OF ALL X-RAY EXAMINATIONS, TOTAL NUMBER OF ABDOMINAL EXAMINATIONS AND TOTAL NUMBER OF THORACICAL X-RAY EXAMINATIONS BY MEDICAL FACILITY
Caguas Area, Puerto Rico - 1968

Geographic Location	Name of Facility	Total Number of X-ray Exams.	Total Number of Thoracical Exams.	Total Number of Abdominal Exams.
Aguas Buenas	Private Offices	520	312	104
Aibonito	Mennonite Hospital	7,000	1,908	4,696
Caguas	Municipal Hospital	6,304	2,063	1,512
	San Rafael Hospital	29,705	13,208	10,556
	Public Health Unit & T.B. Center	15,792	12,459*	-
	Private Offices	11,168	5,824	3,111
Caguas Total		62,969	33,554	15,077
Cayey	T.B. Hospital and T.B. Center	11,026	8,115	40
	Font Clinic	15,600	2,288	4,532
	Health Center	1,734	1,357	279
	Private Offices	4,824	2,666	1,456
Cayey Total		33,184	14,426	6,307
Cidra	Private Offices	975	624	156
Gurabo	San Jose Clinic	624	156	416
Humacao	Health Center	10,678	10,316	362
	Oriente Clinic	7,105	835	2,124
	Font Martelo Hospital	7,158	5,462	1,865
	Ryder Memorial Hosp.	5,596	2,360	2,236
	Private Offices	5,000	1,820	676
Humacao Total		35,706	20,793	7,263
Juncos	T.B. Health Center	11,388	11,388**	-
	Private Offices	5,130	2,940	1,040
Juncos Total		15,779	14,328	1,040
San Lorenzo	Private Offices	2,844	1,950	2,267
Yabucoa	Private Offices	7,332	1,603	4,875
Caguas Area Total		166,933	89,654	42,201

* Including 6,519 photofluorographies.
** Including 8,944 photofluorographies.

Total number of x-ray examinations include beside thoracical and abdominal, all other x-ray examinations.

TABLE 9-C

MEAN GONADAL DOSE PER PATIENT DUE TO THORACICAL X-RAY EXAMINATIONS, BY TYPE
CAGUAS AREA, PUERTO RICO-1968

	Chest			Photofluorographies			Tomographies			Total		Grand Total
	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Mean Exposure per Examination Milliroentgens	1.80	0.92	1.36	0.25	0.13	0.19	40.0	5.4	23.7	1.40	0.65	1.0
Mean Absorbed Dose per Examination Millirads	1.68	0.85	1.25	0.23	0.12	0.18	36.6	5.0	21.8	1.29	0.60	0.93
Total Number of Examinations	26,713	28,961	55,674	16,286	17,342	33,628	187	165	352	43,186	46,468	89,654
Global Irradiation Dose to all Examined Patients Millirads	45,106	24,628	69,734	3,745	2,427	6,172	6,858	825	7,683	55,709	27,880	83,589

Note: The data for the chest x-ray examinations was obtained by taking a few of the same exposures and dividing the sum of mR by the number of exposures.

TABLE 10-C

MEAN GONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX
CAGUAS AREA, PUERTO RICO-1968

Type of Examination	Millirads per Examination	
	Male	Female
Chest	1.68	.85
Photofluorograpic	.23	.12
Tomographic	36.6	5.0
Abdomen	335.0	433.0
Cholecystography	10.0	180.1
Lumbar Spine	170.5	950.6
Gastrointestinal Series	180.2	685.5
Barium Enema	1,210.0	750.4
I.V.P.	1,000.0	720.4
Pelvis	746.2	61.6
Hip Joint	700.0	283.5
Pelvimetry	-	1,100.4

TABLE 11-C

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS CAGUAS AREA, PUERTO RICO-1968

Type of Examination	Sex	Mean Exposure Per Examination Milli-roentgens	Mean Absorption Dose Per Examination Millirads	Total Number of Abdominal Diagnostic X-ray Examinations	Global Irradiation Dose to all Examined Patients Millirads
Abdomen	M.	364	335.0	4,282	1,434,470
	F.	470	433.0	3,752	1,624,616
Cholecysto-graphy	M.	11	10.0	1,409	14,090
	F.	196	180.1	1,721	309,780
Lumbar Spine	M.	185	170.5	5,169	881,314
	F.	1,033	950.6	2,898	2,754,838
Gastrointest. Series	M.	196	180.2	3,220	580,244
	F.	746	685.5	3,245	2,224,447
Barium Enema	M.	1,315	1,210.0	1,395	1,687,950
	F.	815.6	750.4	1,043	782,667
I.V.P.	M.	1,086	1,000.0	2,369	2,369,000
	F.	783	720.4	2,240	1,613,696
Pelvis	M.	810	746.2	967	721,575
	F.	66.9	61.6	1,079	66,466
Hip Joint	M.	760	700.0	3,678	2,574,600
	F.	309	283.5	2,734	775,089
Pelvimetry	F.	1,196	1,100	1,000	1,100,000
Total	M.	500.6	460.5	22,489	10,356,184
	F.	632.6	582.0	19,712	11,472,384
GRAND TOTAL		562.2	517.2	42,201	21,828,568

TABLE 12-C

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL AND THORACICAL X-RAY EXAMINATIONS

CAGUAS AREA PUERTO RICO-1968.

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION CAGUAS AREA PUERTO RICO 1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	10,411,893	180,810	57.5
FEMALE	11,500,264	188,190	61.1
TOTAL	21,912,157	369,000	58.3

Westinghouse Electric Company, S.A.

G P O BOX 3208
SAN JUAN P R 00936

TELEPHONE 765-5775
CABLE WECO P.R.

October 8, 1970

CAGUAS AREA HOSPITAL
Westinghouse X-Ray Equipment

Model	KVP	MA	Description	Location
C-30	125	300	Operating Room Double Tube, Explosion Safe, GU and Orthopedic	3rd Floor Room 3195 OR Room 3198
MO-110	100	200	Explosion Safe Mobile	3rd Floor OR
MO-120C	100	300	Capacitor Discharge Mobile	All Wards
MO-120C	100	300	Capacitor Discharge Mobile	All Wards
MO-120C	100	300	Capacitor Discharge Mobile	Emerg. Wards
MO-120C	100	300	Capacitor Discharge Mobile	Nursing Home
C-40	125	300	Rad / Fluor 2 Tubes	1st Floor X-Ray Room 1320
C-40	125	300	Rad / Fluor 2 Tubes	1st Floor X-Ray Room 1323
C-40	125	300	Rad / Fluor / Tomo / Stereo 2 Tubes	1st Floor X-Ray Room 1324
C-50	150	500	Rad / Fluor / Image Int. / Craneograph 3 Tubes	1st Floor X-Ray Room 1327
C-40	125	300	G-U Rad Only 1 Tube	1st Floor X-Ray Room 1316

Notes: Dynamax 40, 1-2 mm tubes used, with exception of Room 1327 (C-50) which uses Dynamax 50, 2 mm aluminum added filters in all.

MO-120-C, Mobile uses grid control tube.

LIST OF FIGURES

FIGURE I–C

DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNITS BY GEOGRAPHIC LOCATION CAGUAS AREA PUERTO RICO – 1968.

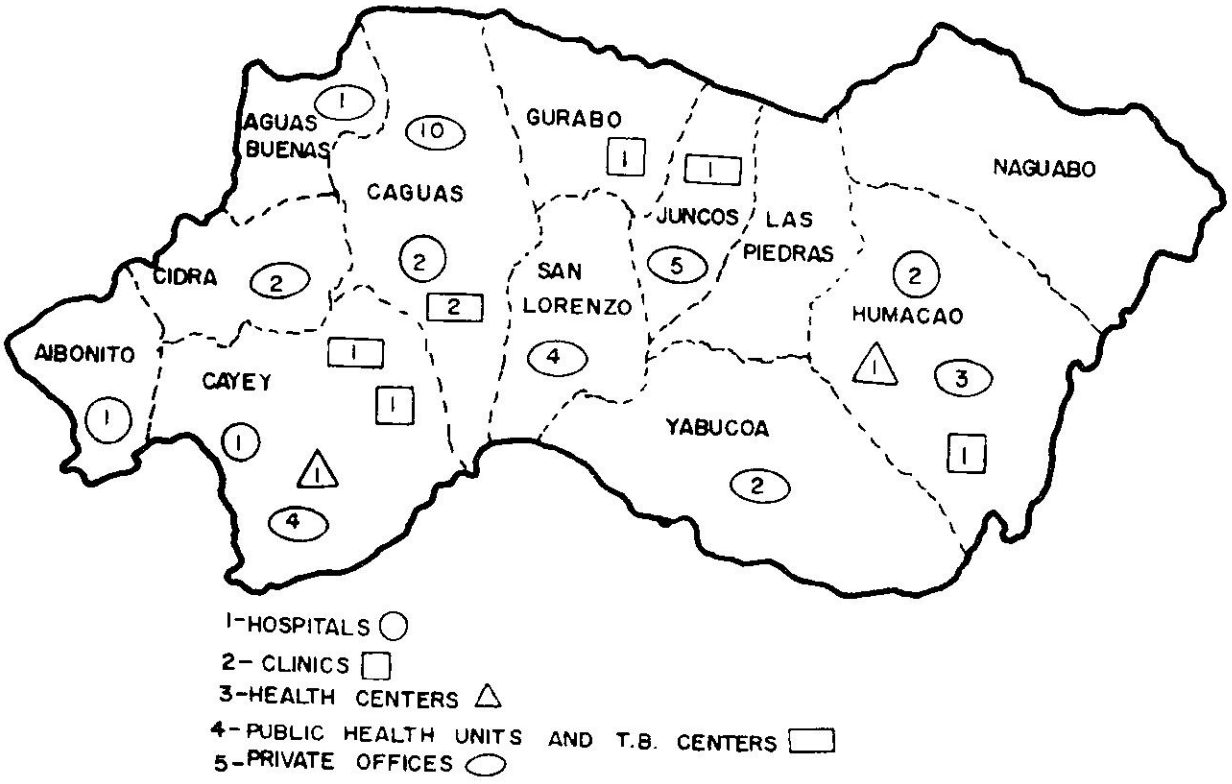


FIGURE - 2 C

DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS, BY GEOGRAPHIC LOCATION AND BY TYPE OF FACILITY.

CAGUAS AREA, PUERTO RICO - 1968.

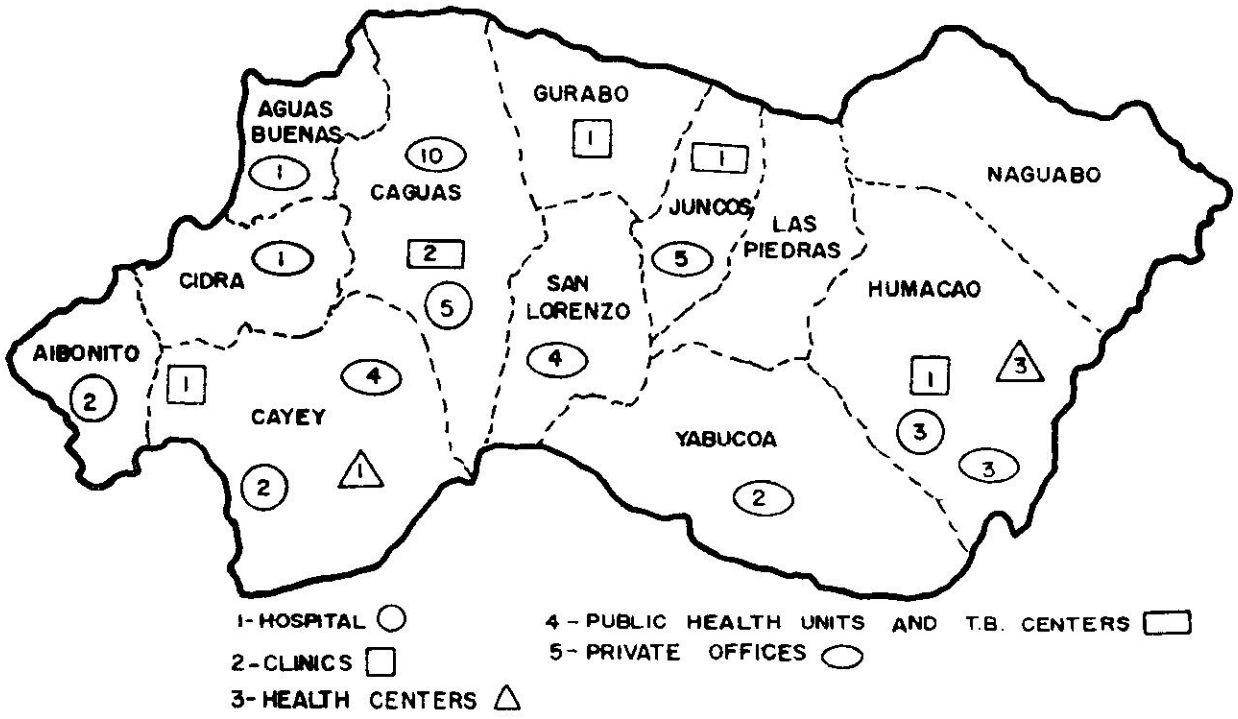
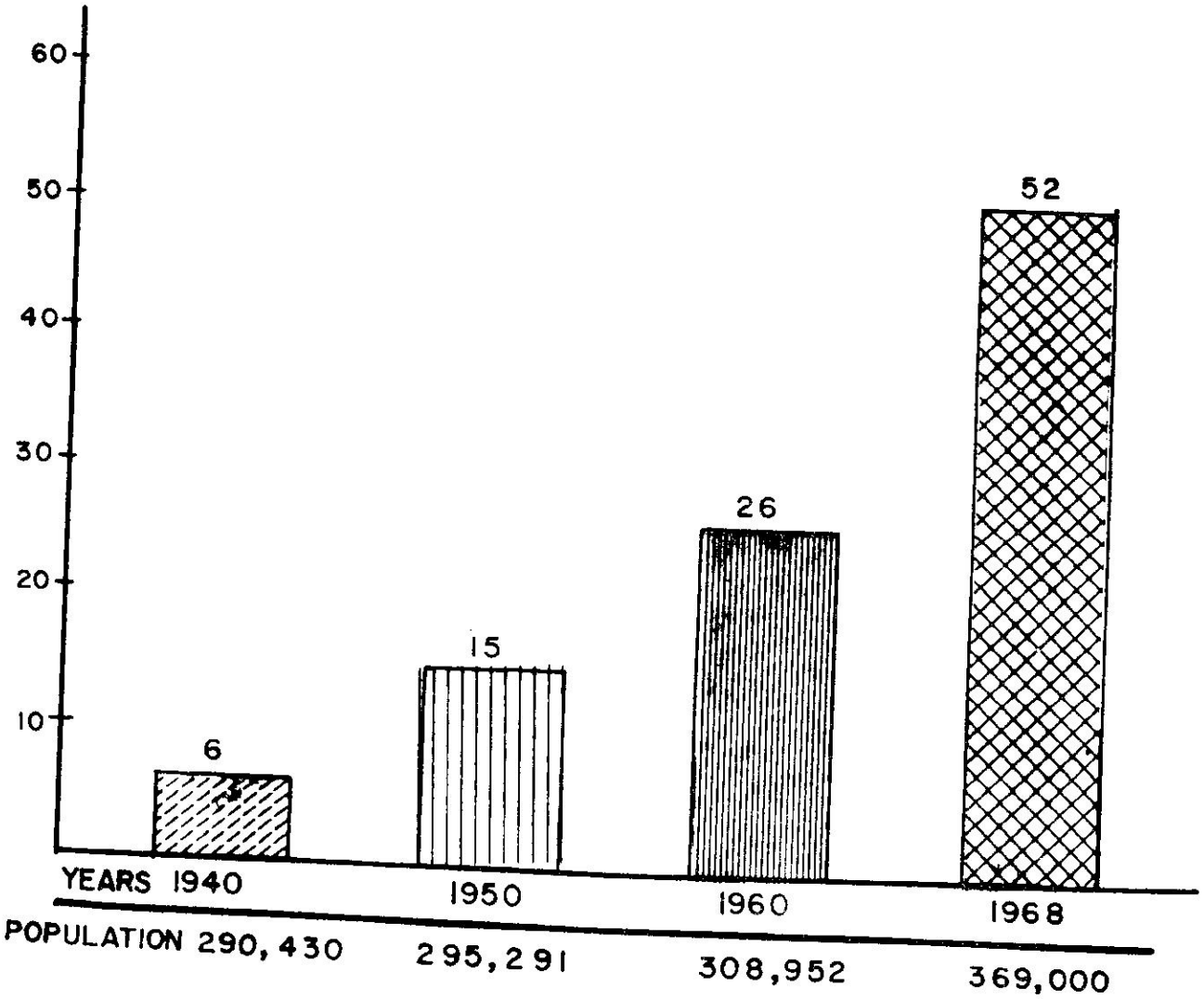


FIGURE- 3C

VARIATION OF POPULATION AND NUMBER OF DIAGNOSTIC X-RAY UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS.

CAGUAS AREAS, PUERTO RICO 1940 - 1968



PRESENTATION OF STATISTICAL DATA

FAJARDO AREA

The Fajardo Area consists of the municipalities of Fajardo, Ceiba, Culebra, Loiza, Luquillo, Rio Grande and Vieques. The present population of the area is 116,100. This area comprises the extreme northeast section of the island of Puerto Rico.

The municipality of Loiza is the most densely populated with 32,800 inhabitants but Fajardo, with a population of 24,700, is the cultural and medical center of the area.

Two of the seven municipalities of this area are small islands to the east of Puerto Rico, one of which, Culebra, is located seventeen miles off the coast to the east. Low altitudes and light rainfall give the island a vegetation sufficient to support large herds of white brahma cattle, the island's main industry. There are no medical facilities for the 900 inhabitants of Culebra, therefore, the facilities of the island of Vieques or the mainland facilities of Fajardo are used.

The island of Vieques is ten miles southeast of the Puerto Rico mainland and has a population of 8,400 inhabitants. The island has a Government Health Center equipped with an x-ray unit.

LIST OF TABLES

TABLE 1-F

MUNICIPALITIES OF THE FAJARDO AREA AND THEIR POPULATION
PUERTO RICO-1968*

MUNICIPALITIES	POPULATION
Ceiba	13,100
Culebra	900
Fajardo	24,700
Loiza	32,800
Luquillo	12,100
Rio Grande	24,100
Vieques	8,400
FAJARDO AREA TOTAL	116,100

* The above data are quoted from the Annual Vital Statistics Report, Commonwealth of Puerto Rico Department of Health, 1968.

TABLE 2-F

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION
BY MEDICAL FACILITY, BY GEOGRAPHIC LOCATION AND POPULATION PER X-RAY UNIT
FAJARDO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
Ceiba	Health Center	-	13,100	No x-ray unit.
Culebra	-	-	900	No x-ray unit.
Fajardo	Municipal Hospital	-		
	District Hospital	5		
	Fajardo Clinic	1		
	Public Health Unit & T.B. Center	1		
	Dr. Gubern's Hospital	1		
	Private Offices	6		
Fajardo Total		14	24,700	1,764
Loiza & Canovanas	Municipal Hospital	-		
	San Antonio Clinic	1		
	Health Center	-		
	Private Offices	1		
Loiza & Canovanas Total		2	32,800	16,400
Luquillo	Municipal Hospital	-	12,100	No x-ray unit.
Rio Grande	Health Center	-		
	Private Offices	1		
Rio Grande Total		1	24,100	24,100
Vieques	Health Center	1	8,400	8,400
FAJARDO AREA TOTAL		18	116,100	6,450

TABLE 3-F

TOTAL NUMBER OF X-RAY EXAMINATIONS IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS*
FAJARDO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
Ceiba	Health Center	8,186	-	-
Culebra	-	-	-	-
Fajardo	Municipal Hospital	54,138	-	-
	District Hospital	65,899	26,548	40.2
	Dr. Gubern Hospital	4,819	2,632	54.6
	Fajardo Clinic	1,215	3,185	262.1
	Public Health Unit & T.B. Center	3,884	4,361**	112
Fajardo Total		129,955	36,726	28.2
Loiza & Canovanas	Loiza Health Center	76,503	-	-
	Canovanas Municipal Hospital	53,735	-	-
	Canovanas San Antonio Clinic	5,475	2,735	49.9
Loiza & Canovanas Total		135,713	2,735	2.0
Luquillo	Municipal Hospital	16,392	-	-
Rio Grande	Health Center	50,211	-	-
	Public Health Unit	20,024	-	-
Rio Grande Total		70,235	-	-
Vieques	Health Center	41,674	3,750	8.9
TOTAL FAJARDO AREA PUBLIC INSTITUTIONS		410,341	43,211	10.5

* This table was limited to public institutions since the total number of patients in private offices was not available.

** Including 3938 photofluorographies.

TABLE 4-F

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION, BY MEDICAL FACILITY AND BY MANUFACTURER
FAJARDO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER		GENERAL ELECTRIC		WESTING-HOUSE		CONTINENTAL		FISHER		KELEKET		TANKA		SIEMENS		TOTAL
			MA		MA		MA		MA		MA		MA		MA		MA	
Ceiba	-		-		-		-		-		-		-		-		-	-
Culebra	-		-		-		-		-		-		-		-		-	-
Fajardo	District Hospital			1	100 Urology											1 1 1 1	200 300 100-Mob. 1,000	5
	Fajardo Clinic															1	320	1
	Pub. Hlth. Unit & T.B. Center	1	200 with Minogr.															1
	Dr. Gubern Hospital			1	100													1
	Private Offices	1	30			1	30	1	60	1	60			1	40	1	300	6
Fajardo Total		3		1		1		1		1		0		1		6		14
Loiza & Canovanas	San Antonio Clinic			1	200													1
	Private Offices			1	30													1
Loiza & Canovanas Total				2														2
Rio Grande	Priv. Off.	1	200															1
Vieques Island	Health Center	1	100															1
GRAND TOTAL		5		3		1		1		1		0		1		6		18

TABLE 5-F

CENSUS OF DIAGNOSTIC X-RAY UNITS
FAJARDO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER, AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	NUMBER OF TUBES AND TYPE OF TUBES	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
Fajardo	District Hospital	Siemens 1,000 Siemens 200 Siemens 300 Siemens 100 G.E. 100	1965 1964 1964 1964 Mfg. 1946	2 Super Dynamax 1 Dynamax 40 2 Eureka 1 Siemens 1 PX-8E	Variable Collimation " " " No collimation	4.5 " " " 0.5	Routine. I.V.P. Routine. Mobile. Urology, has foot switch.
	Public Health Unit & T.B. Center	Picker 200	1956	1 Eureka	Cone	2.5	Unit has minograph camera for mass chest examinations.
	Fajardo Clinic	Siemens 320	1964	1 Eureka	Variable Collimation	4.5	
	Dr. Gubern Hospital	General Electric 100	1952	2 Eureka	Cone	2.5	
	Private Offices	Siemens 300 Picker 30	1965 Mfg. 1940	2 Dynamax 40 PX-1B	Variable Collimation	4.5 0.5	Radiologist. Fluoroscopy only.
		Westinghouse 30	1950	_	No collimator	0.5	Fluoroscopy, Chest & pulmonary disease
		Tanks 40	1958	Info. not available.	Cone	-	No gloves. Chest exams.
		Fisher 60	1940		Cone	1.5	Fluoroscopy, chest.
		Continental 60	1949	1 Eureka	Cone	1.0	Out of order since 1969.
Loiza & Canovanas	San Antonio Clinic	General Electric 200	1955	1 L.W.R.T.	Cone	1.0	
	Private Office	General Electric 30	Mfg. 1956	DX	Cone	0.5	Fluoros. of fracturesonly.
Rio Grande	Private Office	Picker 200	1956	1 Px-10	Cone	2.0	
Vieques Island	Health Center	Picker 100	1961	1 Eureka PX-1B	Cone	2.5	

TABLE 6-F

NUMBER OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS BY MEDICAL FACILITY, BY TYPE OF EXAMINATION AND BY SEX
FAJARDO AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Sex	Type of Abdominal Examination									
			Abdomen	Cholecystography	Lumbar Spine	Gastrointest. Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Fajardo	District Hospital	Male	270	-	80	304	69	161	81	50	-	1,015
		Fem.	348	12	175	350	111	188	94	60	273	1,611
			618	12	255	654	180	349	175	110	273	2,626
	Fajardo Clinic	Male	52	52	260	104	-	156	52	-	-	676
		Fem.	52	-	-	104	52	156	104	-	-	468
			104	52	260	208	52	312	156	-	-	1,144
	Dr. Gubern Hospital	Male	20	8	6	12	6	48	8	2	-	110
		Fem.	60	24	12	20	6	12	8	4	24	170
			80	32	18	32	12	60	16	6	24	280
	Private Offices*	Male	156	156	106	208	156	156	208	-	-	1,146
		Fem.	156	416	208	312	156	156	208	-	104	1,716
			312	572	314	520	312	312	416	-	104	2,862
Fajardo Total		Male	498	216	452	628	231	521	349	52	-	2,947
		Fem.	616	452	395	786	325	512	414	64	401	3,965
			1,114	668	847	1,414	556	1,033	763	116	401	6,912
Loiza & Canovanas	San Antonio Clinic	Male	301	15	39	34	21	53	40	149	-	652
		Fem.	307	38	78	36	21	48	45	102	-	675
			608	53	117	70	42	101	85	251	-	1,327
Rio Grande	Private Offices	Male	104	-	196	-	-	-	-	-	-	300
		Fem.	146	-	270	52	-	52	-	-	-	520
			250	-	466	70	42	101	85	251	-	820
Vieques Island	Health Center	Male	-	290	245	200	-	-	200	300	-	1,235
		Fem.	-	100	200	205	-	-	293	238	-	1,036
			-	390	445	405	-	-	493	538	-	2,271
FAJARDO AREA TOTAL		Male	903	521	932	862	252	574	589	501	-	5,134
		Fem.	1,069	590	943	1,079	346	612	752	404	401	6,196
			1,972	1,111	1,875	1,941	598	1,186	1,341	905	401	11,330

*Private Offices" includes a) radiologists offices and b) all other private medical offices equipped with x-ray units with the exception of dental offices.

TABLE 7-F

NUMBER OF DIAGNOSTIC THORACICAL X-RAY EXAMINATIONS BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY AND BY SEX
FAJARDO AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Number of Diagnostic Thoracical X-ray Examinations by Type									Total		Grand Total
		CHEST RADIOGRAPHY			PHOTOFLUOROGRAPHY			CHEST TOMOGRAPHY					
		Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Fajardo	District Hospital	1,610	1,960	3,570	-	-	-	8	10	18	1,618	1,970	3,588
	Fajardo Clinic	520	884	1,404	-	-	-	-	-	-	520	884	1,404
	Public Health Unit & T.B. Center	220	203	423	1,900	2,038	3,938	-	-	-	2,120	2,241	4,361
	Dr. Gubern Hospital	52	116	168	-	-	-	-	-	-	52	116	168
	Private Offices	562	364	926	-	-	-	-	-	-	562	364	926
Fajardo Total		2,964	3,527	6,491	1,900	2,038	3,938	8	10	18	4,872	5,575	10,447
Loiza & Canovanas	San Antonio Clinic	402	399	801	-	-	-	-	-	-	402	399	801
Vieques Island	Health Center	834	556	1,390	-	-	-	-	-	-	834	556	1,390
Fajardo Area Total		4,200	4,482	8,682	1,900	2,038	3,938	8	10	18	6,108	6,530	12,638

TABLE 8-F

TOTAL NUMBER OF ALL X-RAY EXAMINATIONS, TOTAL NUMBER OF ABDOMINAL EXAMINATIONS AND TOTAL NUMBER OF THORACICAL X-RAY EXAMINATIONS BY MEDICAL FACILITY
Fajardo Area, Puerto Rico - 1968

Geographic Location	Medical Facility	Total Number of X-ray Exams.	Total Thoracical X-ray Exams.	Total Abdominal X-ray Exams.
Fajardo	District Hospital	26,548	3,588	2,626
	Fajardo Clinic	3,185	1,404	1,144
	Public Health Unit & T.B. Center	4,361	4,361	-
	Dr. Gubern Hospital	2,632	168	280
	Private Offices*	4,487	926	2,862
Fajardo Total		41,213	10,447	6,912
Loiza & Canovanas	San Antonio Clinic	2,660	801	1,327
Rio Grande	Private Offices	1,180	-	820
Vieques Island	Health Center	3,750	1,390	2,271
Fajardo Area Total		48,803	12,638	11,330

* Including one radiologist's private office.

TABLE 9-F

MEAN GONADAL DOSE PER PATIENT DUE TO THORACICAL X-RAY EXAMINATIONS, BY TYPE
FAJARDO AREA, PUERTO RICO-1968

	Chest*			Photofluorography			Tomography			Total		Grand
	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total
Mean Exposure Per Examination Milliroentgens	2.0	1.0		0.25	0.15		37.2	5.3	19.5	1.53	0.74	1.12
Mean Absorbed Dose Per Examination Millirads	1.88	0.92		0.23	0.14		34.2	4.9	17.9	1.40	0.68	1.03
Total Number of Examinations	4,200	4,482	8,682	1,900	2,038	3,938	8	10	18	6,108	6,530	12,638
Global Irradiation Dose to all Examined Patients Millirads	7,896	4,123	12,019	437	285	722	274	49	323	8,607	4,457	13,064

* The data for the chest x-ray examinations was obtained by taking a few of the same exposures and dividing the sum of mR by the number of exposures.

TABLE 10-F

MEAN GONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX*
FAJARDO AREA, PUERTO RICO-1968

Type of Examination	Millirads per Examination	
	Male	Female
Chest	1.88	.92
Photofluorographic	.23	.14
Tomographic	34.2	4.9
Abdomen	335.0	433.0
Cholecystography	10.0	180.1
Lumbar Spine	170.5	950.6
Gastrointestinal Series	180.2	685.5
Barium Enema	1,210.0	750.4
I.V.P.	1,000.0	720.4
Pelvis	746.2	61.6
Hip Joint	700.0	283.5
Pelvimetry	-	1,100.4

* Mean gonadal doses were used as measured in the Bayamon Health Center on Picker 200 MA x-ray unit with Px-10 tube.

TABLE 11-F

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS FAJARDO DISTRICT HOSPITAL, FAJARDO AREA, PUERTO RICO-1968

Type of Examination	Sex	Mean Exposure Per Examination Milli-roentgens	Mean Absorption Dose Per Examination Millirads	Total Number of Abdominal X-ray Diagnostic Examinations	Global Irradiation Dose to all Examined Patients Millirads
Abdomen	M.	364	335	903	302,505
	F.	471	433	1,069	462,877
Cholecysto-graphy	M.	11	10	521	5,210
	F.	196	180.1	590	106,259
Lumbar Spine	M.	184	170.5	932	158,906
	F.	1,033	950.6	943	896,415
Gastrointest. Series	M.	195	180.2	862	155,332
	F.	746	685.5	1,079	739,654
Barium Enema	M.	1,315	1,210.0	252	304,920
	F.	815	750.4	346	259,638
I.V.P.	M.	1,086	1,000	574	574,000
	F.	783	720.4	612	440,884
Pelvis	M.	810	746.2	589	439,511
	F.	67	61.6	752	46,323
Hip Joint	M.	761	700	501	350,700
	F.	308	283.5	404	114,534
Pelvimetry	F.	1,195.6	1,100	401	442,704
Total	M.	485.0	446.2	5,134	2,290,790
	F.	615.6	566.3	6,196	3,508,794
GRAND TOTAL		556.3	511.8	11,330	5,799,584

TABLE-12 F

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL AND THORACICAL X-RAY EXAMINATIONS.

FAJARDO AREA, PUERTO RICO-1968.

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION FAJARDO AREA PUERTO RICO-1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	2,299,397	56,889	40.4
FEMALE	3,513,251	59,211	59.3
TOTAL	5,813,436	116,100	50.0

LIST OF FIGURES

FIGURE - 1-F

DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNITS BY GEOGRAPHIC LOCATION. FAJARDO AREA, PUERTO RICO - 1968

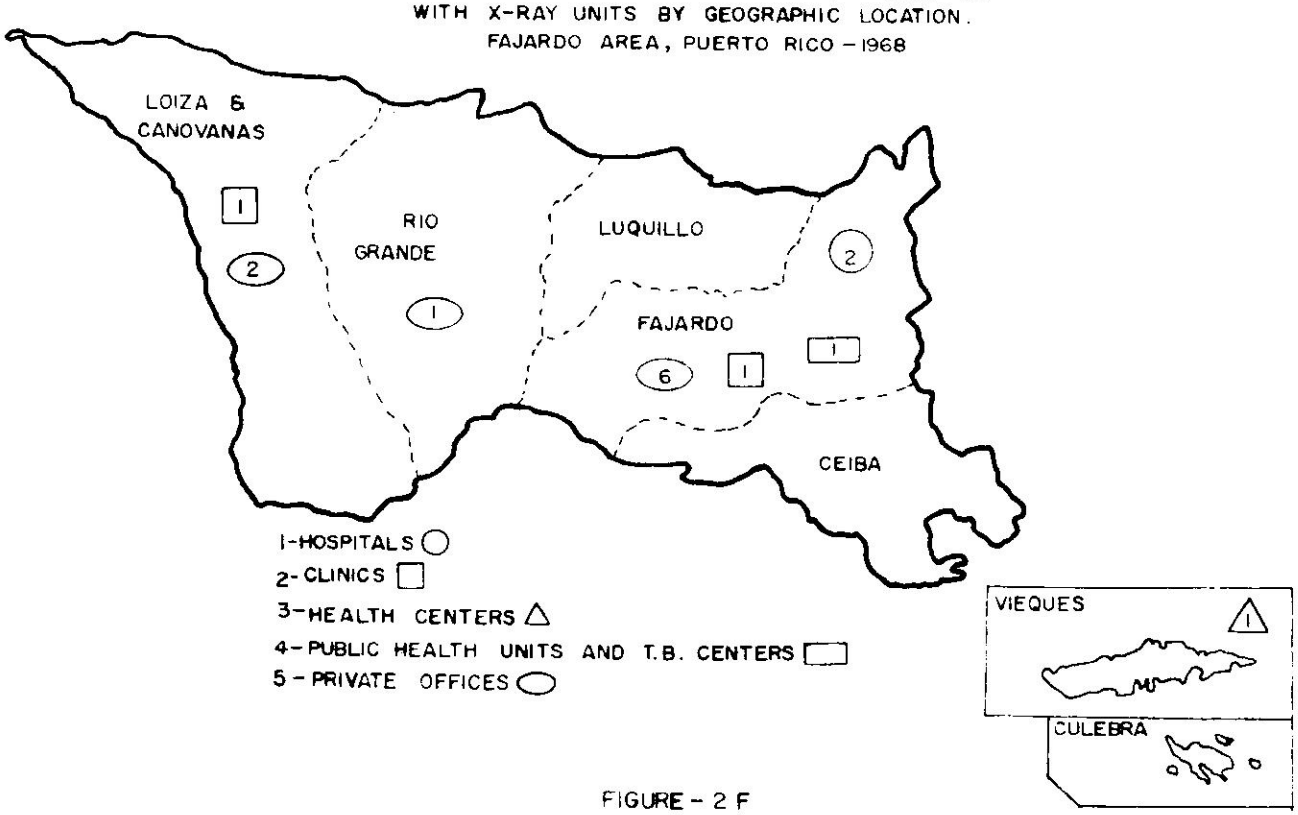


FIGURE - 2 F

DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS, BY GEOGRAPHIC LOCATION AND BY TYPE OF FACILITY

FAJARDO AREA, PUERTO RICO - 1968.

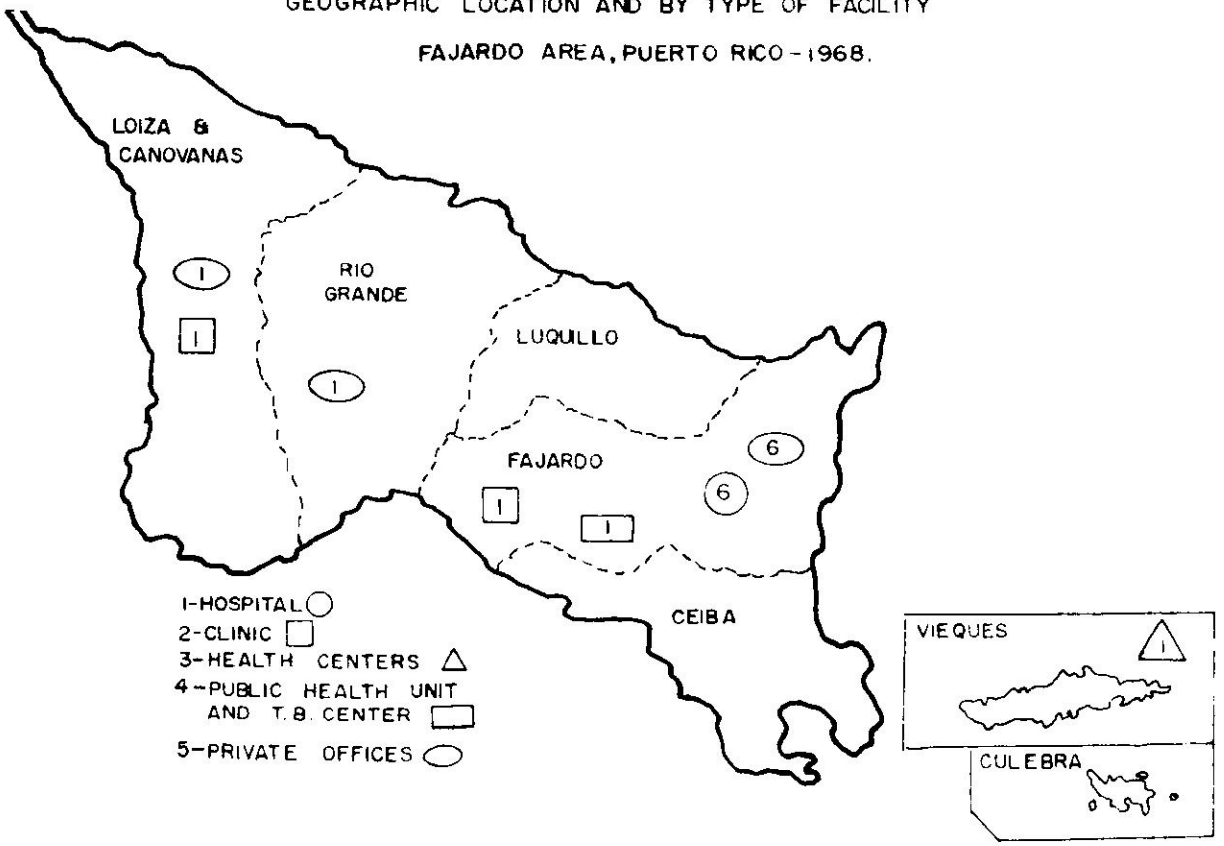
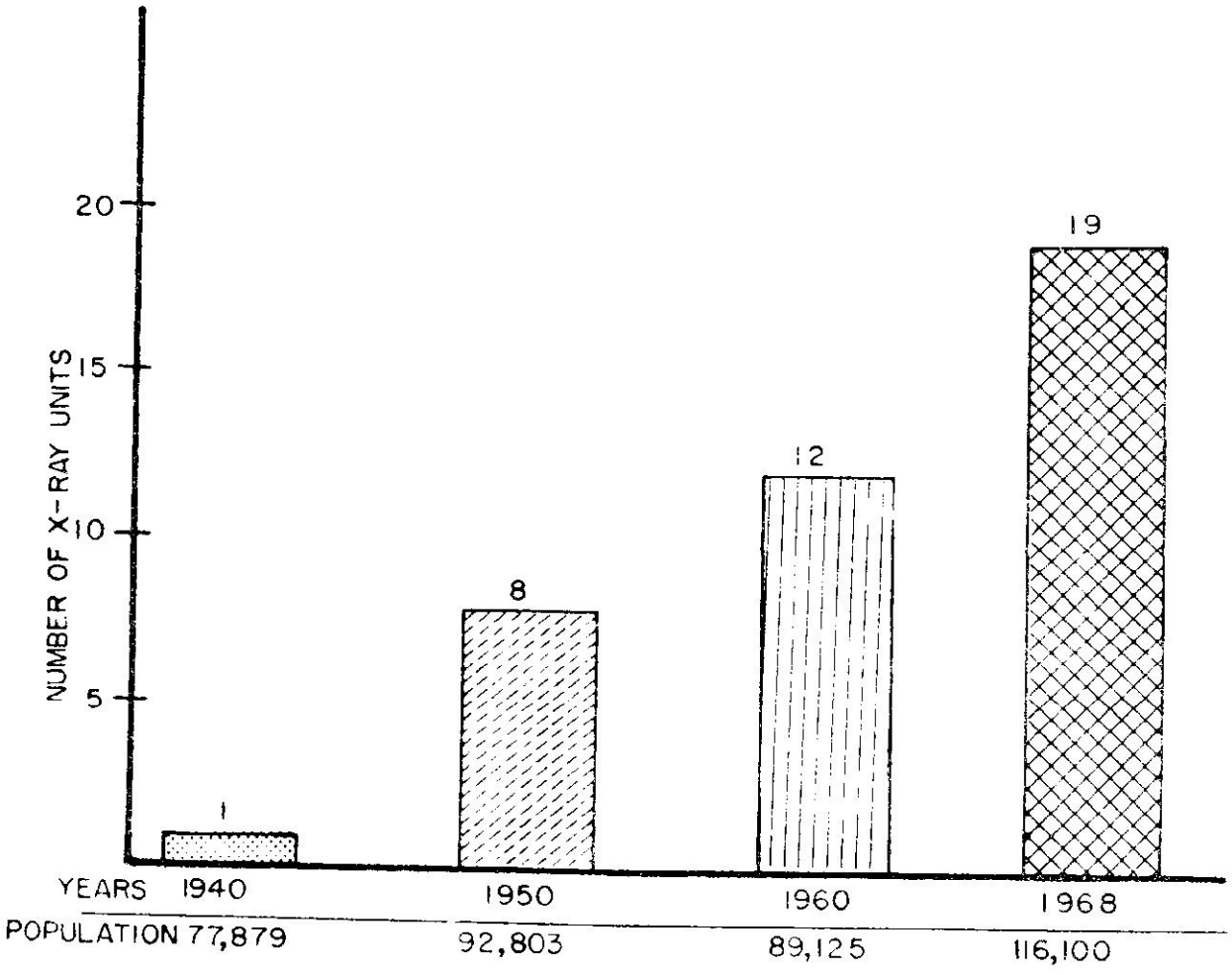


FIGURE 3-F

VARIATION OF POPULATION AND NUMBER OF DIAGNOSTIC X-RAY UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS. FAJARDO AREA, PUERTO RICO 1940-1968



PRESENTATION OF STATISTICAL DATA

ARECIBO AREA

The Arecibo Area is part of the San Juan Region. This area includes eleven municipalities on the north central coast of the Island. Arecibo is the largest city of the area; an important industrial and commercial center with a population of 83,400 in 1968.

In the Arecibo Area there are four Health Centers and five Municipal Hospitals and in the city of Arecibo, a District Hospital with a School of Nursing, a Municipal Hospital, a Public Health Unit and two private Hospitals.

LIST OF TABLES

TABLE 1-A

MUNICIPALITIES OF THE ARECIBO AREA AND THEIR POPULATION

PUERTO RICO-1968*

MUNICIPALITIES	POPULATION
Arecibo	83,400
Barceloneta	25,600
Camuy	20,000
Ciales	16,200
Hatillo	24,900
Lares	24,600
Manatí	33,300
Morovis	20,100
Quebradillas	14,500
Utuado	47,700
Vega Baja	32,500
ARECIBO AREA TOTAL	342,800

* The above data are quoted from the Annual Vital Statistics Report, Commonwealth of Puerto Rico Department of Health, 1968.

TABLE 3-A

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS BY MEDICAL FACILITY, BY GEOGRAPHIC LOCATION AND POPULATION PER X-RAY UNIT ARECIBO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
Arecibo	District Hospital	6		
	Health Center (Municipal Hosp.)	2		One unit not in use.
	Public Health Unit & TB Mob. Unit	1		Two units not in use.
	El Buen Pastor Clinic	1		
	Dr. Susoni Hospital	1		
	Private Offices	9		
Arecibo Total		20	342,800	17,140
Barceloneta	Municipal Hospital	-		-
	Private Offices	2		
Barceloneta Total		2	25,600	12,800
Camuy	Health Center	-		(Unit unused-1968 Good condition.)
	Private Offices	1		
Camuy Total		1	20,000	20,000
Hatillo	Health Center	-		
	Private Offices	1		
Hatillo Total		1	24,900	24,900
Lares	Public Health Unit	1		
	Castañer General Hospital	1		
Lares Total		2	24,600	12,300
Manatí	Municipal Hospital	-		No x-ray unit.
	Public Health Unit	1		
	San Agustín Hospital	2		
	Doctors Center Hospital	1		
	Private Offices	3		
Manatí Total		7	33,300	4,757
Morovis	Municipal Hospital	-		
	Private Offices	2		
Morovis Total		2	20,100	10,050

Cont. on following page

TABLE 2-A (Cont.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
Quebradillas	Health Center	-		
	Private Offices	2		
Quebradillas Total		2	14,500	7,250
Utuado	Health Center	1		
	San Miguel Clinic	1		
	Dr. E. Cintrón Clinic	2		
	Private Offices	2		
Utuado Total		6	47,700	7,950
Vega Baja	Health Center	-		
	Sanchez Castaño Clinic	1		
	Private Offices	2		
Vega Baja Total		3	32,500	10,833
Arecibo Area Total		46	342,800	7,452

Note: Only x-ray units in operative condition were included in this table.

TABLE 3-A

TOTAL NUMBER OF X-RAY EXAMINATIONS IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS, AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
ARECIBO AREA, PUERTO RICO-1968

GEOGRPAHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMS.	NO. OF X-RAY EXAMS. PER 100 PATIENTS
Arecibo	District Hospital	50,124	33,800	67.4
	Health Center (Municipal Hosp.)	26,820	14,163	52.8
	Public Health Unit & TB Mob. Unit*	23,611	15,979	67.6
	El Buen Pastor Clinic	2,138	3,484	162.9
	Dr. Sumoni Hospital	28,617	3,795	13.2
Arecibo Total		131,310	71,221	54.2
Barceloneta	Municipal Hospital	60,337	-	-
Camuy	Health Center	28,228	-	-
Ciales	Health Center	26,080	-	-
Lares	Castañer General Hospital	25,026	4,847	19.3
	Public Health Unit	12,766	6,073	47.5
Lares Total		37,792	10,920	28.8
Manatí	Public Health Unit**	18,892	20,734	109.0
	San Agustín Hospital	8,036	5,389	67.0
	Doctors Center Hospital	9,843	7,800	79.2
	Municipal Hospital	49,462	-	-
Manatí Total		86,233	33,923	39.3
Morovis	Municipal Hospital	30,012	-	-
Quebradillas	Health Center	11,378	-	-
Utuado	Health Center &T.B. Center ***	100,265	11,893	11.8
	Dr. E. Cintrón Clinic	7,865	3,011	38.2
	San Miguel Clinic	3,379	2,080	61.5
Utuado Total		111,509	16,984	15.2
Vega Baja	Health Center	27,376	-	-
	Sanchez Castaño Clinic	6,194	868	14.0
Vega Baja Total		33,570	868	2.5
GRAND TOTAL		556,449	133,916	24.0

* Including 14,869 photofluorographies.
** Including 18,562 photofluorographies.
*** Including 8,060 photofluorographies.

TABLE 4-A

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION, BY MEDICAL FACILITY AND BY MANUFACTURER
ARECIBO AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Picker		General Electric		Westinghouse		Keleket		Siemens		Standard		Min-X-ray Corp.		Continental		Universal		Mattern		Fisher		TOTAL
			MA		MA		MA		MA		MA		MA		MA		MA		MA		MA		MA	
Arecibo	District Hospital					1	60 Mob.			1 1 1 1 1	125 320 700 300 100 Mob.													6
	Health Center (Muni.Hosp.)									2	300													2
	Pub. Health Unit & TB Mob. Unit	1	200																					1
	El Buen Pastor Clinic	1	200																					1
	Dr. Susoni Hospital			1	500																			1
	Private Offices	1	200	1	300	2	300			1	60					1	60	1	100	1	15	1	30	9
Arecibo Total		3		2		3		0		8		0		0		1		1		1		1		20
Barceloneta	Private Offices	1 1	100 200																					2
Barceloneta Total		2		0		0		0		0		0		0		0		0		0		0		2
Camuy	Health Center																							0
	Private Offices															1	60							1
Camuy Total		0		0		0		0		0		0		0		1		0		0		0		1
Hatillo	Health Center																							0
	Private Offices	1	200																					1
Hatillo Total		1		0		0		0		0		0		0		0		0		0		0		1
Lares	Castañer Hospital			1	300																			1
	Public Health Unit									1	300													1
Lares Total		0		1		0		0		1		0		0		0		0		0		0		2

Cont. on following page

TABLE 4-A (Cont.)

Geographic Location	Medical Facility	Picker	MA	General Electric	MA	Westinghouse	MA	Keleket	MA	Siemens	MA	Standard	MA	Min-X-ray Corp.	MA	Continental	MA	Universal	MA	Hattern	MA	Fisher	MA	TOTAL
Manatí	Municipal Hospital																							0
	Public Health Unit									1	500													1
	San Agustín Hospital			1	30	1	100																	2
	Doctor's Hospital															1	100							1
	Private Offices	1	100					1	300									1	75					3
Manatí Total		1		1		1		1		1		0		0		1		1		0		0		7
Morovis	Private Offices	1	100	1	200																			2
Quebradillas	Health Center																							0
	Private Offices					1	60											1	60					2
Quebradillas Total		0		0		1		0		0		0		0		0		1		0		0		2
Utuado	Health Center	1	200*																					1
	Dr. Cintrón Clinic	1	100					1	300															2
	San Miguel Clinic							1	200															1
	Private Offices			1	100											1	100							2
Utuado Total		2		1		0		2		0		0		0		1		0		0		0		6
Vega Baja	Sanchez Castaño Clinic			1	200																			1
	Private Offices	2	100																					2
Vega Baja Total		2		1		0		0		0		0		0		0		0		0		0		3
ARECIBO AREA TOTAL		12		7		5		3		10		0		0		4		3		1		1		46

* Minograph

TABLE 5-A

CENSUS OF DIAGNOSTIC X-RAY UNITS
ARECIBO AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER, AND MODEL (MA)	YEAR OF MANU-FACTURE OR PURCHASE	TUBES, MODEL & MANUFACTURER	COLLIMATION	TOTAL FIL-TRA-TION mm. Al.	COMMENTS
Arecibo	District Hospital	Siemens 700, kVp 125	1964	2 Dynamax 40/50	Var.	3.5	
		Siemens 300, kVp 125	1966	1 Dynamax 40	" "	3.5	
		Siemens 320, kVp 125	1966	1 Dynamax 40	" "	3.5	
		Siemens 100, kVp 125	1966	Siemens .8 f	" "	3.5	Mobile
		Siemens 100, kVp 125	1968	Siemens .8 f	" "	3.5	Mobile
		Westinghouse 60, kVp 100	1950	-		1.5	Out of order. The first x-rav unit in this hospital was installed in 1938.
	Municipal Hospital (Health Center)	Siemens 300, kVp 125	1967	2 Dynamax	Var. Collima.	3.5	
		Siemens 300 kVp 125	1967	1 Dynamax	" "	3.5	
		Standard 30	1940	-	-	.5	Mobile, out of order.
	Public Health Unit	Siemens 320, kVp 125	1966	Dynamax 40	Var. Collima.	3.5	This unit is in good condition but not in use, due to frequent overflow of Arecibo Rio Grande River, when water covers the unit (2 meters high).
	T.B. Mobile Unit (same location as Health Center)	Min-x-ray 25	1960		Cone	2.71	Portable x-ray. Photofluorography and chest pictures.
		Odelca 70					
		Picker 200 Minograph	1968	Eureka	Cone	3.5	The mobile unit has been loaned from the Tuberculosis Assoc. Photofluorography. Transported in car.
	El Buen Pastor Clinic	Picker 200, kVp 100	Mfg.1946	Px-8E	Picker Collimator	3.5	A new Picker 200 MA unit was installed in 1969.
	Dr. Susoni Hospital	G.E. 500, kVp 130	1950	H.R.T.	Picker Var. Collima.	3.0	Old unit.
	Private Offices	Picker 200	1946	-	-	-	
		Continental 60, kVp 100	1952		Cone	2.5	
		Universal 100	1964	UX-20H	Cone	2.5	Used for Fondo del Seguro only.
		Westinghouse 300, kVp 125	1964	2 Dynamax 40/50	Var. Collima.	3.5	Duoflex model.
		Westinghouse 300, kVp 125	1968	2 Dynamax 40/50	Var. Collima.	3.5	
		Mattern 15	1940		No collima.	.5	Fluoroscopy only.
		Fisher 30	1940		" "	.5	" "
		Siemens 60 kVp 85	1968	-	Cone	-	Head self-rectifier.

(Cont. on following page)

TABLE 5-A Cont.

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER, AND MODEL (MA)	YEAR OF MANU-FACTURE OR PURCHASE	TUBES, MODEL & MANUFACTURER	COLLIMATION	TOTAL FIL-TRA-TION mm Al.	COMMENTS
Barcelo-neta	Private Offices	Picker 100 Picker 200	1965 1961	Px-10 Px-25	Var. Collima. " "	3.5 3.5	
Camuy	Health Center	Standard 40 Fluoroscopy	1965	1 tube	-	.5	Good condition-1968. Never used
	Private Offices	Continental 60	1952		Variable Collimator	3.5	
Hatillo	Health Center	G.E. 15	Mfg.1940 Pur'd1950	E-1.7	No Collima.	.5	Out of order.
	Private Offices	Picker 200	1956	Px-10	Cone	.5	Anatomatica
Lares	Public Health Unit	Siemens 300, kVp 125	1966	Eureka	Var. Collima.	3.5	Minograph added for photofluorographies.
	Castañer General Hospital	G.E. 300 Aristocrat Universal 15	1960	2 tubes H.R.T.-Rad. H.R.T.-Fl.	Var. Collima.	3.5	Universal 15 is not in operating condition.
	Private Office	Continental 100	1959	Eureka	Cone	1.5	G.P.
Manatí	Public Health Unit	Siemens 500, kVp 125 with 70 mm. camera	1967	Eureka	Var. Collima.	3.5	Minograph added for photofluoroscopy.
	Municipal Hospital	Keleket 30	1940	-	-	.5	For fluoroscopy Out of order 10 yrs.
Manatí (Cont.)	San Agustín Hospital	Westinghouse 300, kVp 150 G.E. 30	1964 Mfg. 1950	2 Dynamax 40/50 G.E. DX	Var. Collima. Cone	3.5 .5	Portable
	Doctors Center Hospital	Continental 100, kVp 100	1959	Eureka Eureka	Var. Collima.	2.5	
	Private Offices	Picker 100 Keleket 200 Universal 75, kVp 100	1960 1956 1968	Px-8E G.E. tube H.R.T. UX-20H	Cone Cone No collima.	1.5 2.5 .5	
Morovis	Private Offices	Picker 100 G.E. 200	1954 1964	Px-8E G.E.-L.W.R.T.	Cone Var. Collima.	1.0 2.5	
Quebra-dillas	Health Center	Picker 35	Mfg. 1940	Px-1B	No collima.	.5	Good condition but not in use Fluoroscopy only.
	Private Offices	Westinghouse 60, kVp 100 Universal 60	1954 1960	Eureka UX-20H	Var. Collima. Cone	2.5 .5	
Utuado	Health Center	Picker 200 & Picker Minograph	1957	Dynamax 50	Cone	3.5	Mass chest exams. Pictronic and 70mm camera for photofl.
	San Miguel Clinic	Keleket 200	1957	Eureka Dx-20	Var. Collima. Videx	3.5	
Utuado (Cont.)	Dr. E. Cintrón Clinic (Private)	Picker 100	Mfg.1956	Picker Dx-8E	Cone	2.5	
	Private Offices	G.E. 100 Continental 100	Mfg.1945 1950	DXC Eureka	Cone -	.5 .5	
Vega Baja	Sanchez Castaño Clinic	G.E. 200	1958	2 L.W.R.T.	Cone	2.5	
	Private Offices	Picker 100 Picker 100	1960 1965	Picker Px-8E " "	Cone Var. Collima.	2.5 3.5	

Note: Out of the 54 diagnostic x-ray units in the Arecibo Area-1968, 8 were not in operative condition.

TABLE 6-A

NUMBER OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS BY MEDICAL FACILITY, BY TYPE OF EXAMINATION AND BY SEX
ARECIBO AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Sex	Abdomen	Cholecystography	Lumbar Spine	Gastro-intestinal Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Arecibo	District Hospital	Male	416	104	260	1,040	-	624	-	-	-	2,444
		Fem.	364	156	260	1,560	-	780	-	-	-	3,120
		Total	780	260	520	2,600	-	1,404	-	-	-	5,564
	Public Health Unit & T.B. Mobile Unit		-	-	-	-	-	-	-	-	-	-
	Health Center	Male	200	163	160	162	53	181	39	199	-	1,157
		Fem.	209	299	89	298	38	277	83	210	47	1,550
		Total	409	462	249	460	91	458	122	409	47	2,707
	El Buen Pastor Clinic	Male	624	-	-	-	-	-	-	-	-	624
		Fem.	728	-	-	-	-	-	-	-	-	728
		Total	1,352	-	-	-	-	-	-	-	-	1,352
Arecibo cont.	Dr. Susoni Hospital	Male	74	60	200	365	92	290	5	74	-	1,160
		Fem.	130	250	220	610	100	220	68	70	12	1,680
		Total	204	310	420	975	192	510	73	144	12	2,840
	Private Offices	Male	260	52	5,304	468	156	468	416	156	-	7,280
		Fem.	156	156	1,872	312	156	416	208	156	-	3,432
		Total	416	208	7,176	780	312	884	624	312	-	10,712
Arecibo Total		Male	1,574	379	5,924	2,035	301	1,563	460	429	-	12,665
		Fem.	1,587	861	2,441	2,780	294	1,693	359	436	59	10,510
		Total	3,161	1,240	8,365	4,815	595	3,256	819	865	59	23,175
Barceloneta	Private Offices	Male	104	-	260	208	-	-	-	-	-	572
		Fem.	-	-	468	156	-	-	-	-	-	624
		Total	104	-	728	364	-	-	-	-	-	1,196
Camuy	Private Offices	Male	-	-	104	-	-	-	104	52	-	260
		Fem.	-	-	52	-	-	-	52	-	-	104
		Total	-	-	156	-	-	-	156	52	-	364

Cont. on following page

TABLE 6-A (Cont.)

Geographic Location	Medical Facility	Sex	Abdomen	Cholecystography	Lumbar Spine	Gastrointestinal Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Hatillo	Private Offices	Male	780	-	520	-	-	-	312	-	-	1,612
		Fem.	-	52	-	-	-	-	-	-	-	52
		Total	780	52	520	-	-	-	312	-	-	1,664
Lares	Public Health Unit & Municipal Hospital	Male	15	3	33	6	3	-	3	-	-	63
		Fem.	51	9	15	12	-	-	3	6	-	96
		Total	66	12	48	18	3	-	6	6	-	159
	Castañer General Hospital	Male	113	190	82	160	40	126	26	35	-	772
		Fem.	90	96	25	165	45	63	23	19	16	542
		Total	203	286	107	325	85	189	49	54	16	1,314
Lares Total		Male	128	193	115	166	43	126	29	35	-	835
		Fem.	141	105	40	167	45	63	26	25	16	628
		Total	269	298	155	333	88	189	55	60	16	1,463
Manatí	Doctor's Center Hospital	Male	300	50	450	200	80	200	80	40	-	1,400
		Fem.	240	40	320	225	65	180	80	50	-	1,200
		Total	540	90	1,070	425	145	380	160	90	-	2,600
Manatí cont.	San Agustin Hospital	Male	84	16	74	62	12	60	20	17	-	345
		Fem.	74	26	47	51	14	66	44	18	-	340
		Total	158	42	121	113	26	126	64	35	-	685
	Private Offices	Male	364	-	104	-	-	-	-	52	-	520
		Fem.	312	-	52	-	-	-	-	52	-	416
		Total	676	-	156	-	-	-	-	104	-	936
Manatí Total		Male	748	66	628	262	92	260	100	109	-	2,265
		Fem.	626	66	419	276	79	246	124	120	-	1,956
		Total	1,374	132	1,047	276	171	506	224	229	-	4,221
Quebradillas	Private Offices	Male	52	-	208	-	-	-	208	-	-	468
		Fem.	156	-	52	-	-	104	104	-	-	416
		Total	208	-	260	-	-	104	312	-	-	884
Utuado	Health Center	Male	216	-	134	216	44	60	108	72	-	850
		Fem.	312	-	166	348	156	60	72	36	17	1,167
		Total	528	-	300	564	200	120	180	108	17	2,017

Cont. on following page

TABLE 6-A (Cont.)

Geographic Location	Medical Facility	Sex	Abdomen	Cholecystography	Lumbar Spine	Gastrointestinal Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Utuado cont.	San Miguel Clinic	Male	42	30	45	114	21	81	18	-	-	351
		Fem.	59	72	39	99	18	39	6	-	-	332
		Total	101	102	84	213	39	120	24	-	-	683
	Dr. Cintron Clinic	Male	105	61	135	265	33	71	23	27	-	720
		Fem.	244	97	76	100	12	66	21	28	33	677
		Total	349	158	211	365	45	137	44	55	33	1,397
Utuado Total		Male	363	91	314	595	98	212	149	99	-	1,921
		Fem.	615	169	281	547	186	165	99	64	50	2,176
		Total	981	262	615	1,033	297	361	328	267	50	4,097
Vega Baja	Sanchez Castaño Clinic	Male	80	-	50	20	-	20	-	-	-	170
		Fem.	60	-	10	-	-	-	-	-	-	70
		Total	140	-	60	20	-	20	-	-	-	240
	Private Offices	Male	156	-	-	-	-	-	-	-	-	156
		Fem.	104	-	-	-	-	-	-	-	-	104
		Total	260	-	-	-	-	-	-	-	-	260
Vega Baja Total		Male	236	50	20	-	-	20	-	-	-	326
		Fem.	164	10	-	-	-	-	-	-	-	174
		Total	400	60	20	-	-	20	-	-	-	500
Arecibo Area Total		Male	3,993	729	8,123	3,286	534	2,181	1,362	724	-	20,932
		Fem.	3,289	1,253	3,763	3,926	604	2,271	764	645	125	16,640
		Total	7,282	1,982	11,886	7,212	1,138	4,452	2,126	1,369	125	37,572

TABLE 7-A

NUMBER OF DIAGNOSTIC THORACICAL X-RAY EXAMINATIONS BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY AND BY SEX
ARECIBO AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Number of Diagnostic Thoracical X-ray Examinations by Type											
		Chest Radiography			Photofluorography*			Chest Tomography**			Total		Grand Total
		Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Arecibo	District Hospital	312	468	780	-	-	-	-	-	-	312	468	780
	Health Center	1,300	1,713	3,013	-	-	-	-	-	-	1,300	1,713	3,013
	Public Health Unit & TB MobileUnit	400	710	1,110	6,056	8,813	14,869	-	-	-	6,456	9,523	15,979
	El Buen Pastor Clinic	1,248	936	2,184	-	-	-	-	-	-	1,248	936	2,184
	Dr. Susoni Hospital	156	208	364	-	-	-	-	-	-	156	208	364
	Private Offices	5,375	3,276	8,651	-	-	-	-	-	-	5,375	3,276	8,651
Arecibo Total		8,791	7,311	16,102	6,056	8,813	14,869	-	-	-	14,847	16,124	30,971
Barceloneta	Private Offices	316	416	732	-	-	-	-	-	-	316	416	732
Camuy	Private Offices	108	108	216	-	-	-	-	-	-	108	108	216
Hatillo	Private Offices	260	260	520	-	-	-	-	-	-	260	260	520
Lares	Public Health Unit	785	795	1,580	2,000	1,120	3,120	-	-	-	2,785	1,915	4,700
	Castañer General Hospital	590	1,209	1,799	-	-	-	-	-	-	590	1,209	1,799
Lares Total		1,375	2,004	3,379	2,000	1,120	3,120	-	-	-	3,375	3,124	6,499
Manatí	Public Health Unit	686	1,486	2,172	5,679	12,888	18,567	-	-	-	6,365	14,374	20,739
	San Agustín Hospital	380	163	543	-	-	-	-	-	-	380	163	543
	Doctors Center Hospital	2,080	2,600	4,680	-	-	-	-	-	-	2,080	2,600	4,680
	Private Offices	228	172	400	-	-	-	-	-	-	228	172	400
Manatí Total		3,374	4,421	7,795	5,679	12,888	18,567	-	-	-	9,053	17,309	26,362
Morovis	Private Offices	52	52	104	-	-	-	-	-	-	52	52	104
Quebradillas	Private Offices	416	624	1,040	-	-	-	-	-	-	416	624	1,040

Cont. on following page

TABLE 7-A (Cont.)

Geographic Location	Medical Facility	Number of Diagnostic Thoracical X-ray Examinations by Type									Total		Grand Total
		Chest Radiography			Photofluorography			Chest Tomography					
		Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Utuado	Health Center & Anti-T.B. Center	343	332	675	4,792	3,268	8,060	-	-	-	5,135	3,600	8,735
	San Miguel Clinic	156	104	260	-	-	-	-	-	-	156	104	260
	Dr. E. Cintrón Clinic	765	843	1,608	-	-	-	-	-	- -	765	843	1,608
Utuado Total		1,264	1,279	2,543	4,792	3,268	8,060	-	-	-	6,056	4,547	10,603
Vega Baja	Sanchez Castaño Clinic	300	238	538	-	-	-	-	-	-	300	238	538
	Private Offices	364	260	624	-	-	-	-	-	-	364	260	624
Vega Baja Total		664	498	1,162	-	-	-	-	-	-	664	498	1,162
Arecibo Area Total		16,620	16,973	33,593	18,527	26,089	44,616	-	-	-	35,147	43,062	78,209

* Photofluorography: A method whereby a photograph is taken of an image which appears on a fluorescent screen.

** Tomography: Tomograms (Laminograms, Body-section Films) are radiographies of a selected plane or level in the body. Other tissues above or below the selected level are blurred out by intentional motion of the x-ray equipment while the exposure is being made.

TABLE 8-A

TOTAL NUMBER OF ALL X-RAY EXAMINATIONS, TOTAL NUMBER OF ABDOMINAL EXAMINATIONS AND TOTAL NUMBER OF THORACICAL X-RAY EXAMINATIONS BY MEDICAL FACILITY

Arecibo Area, Puerto Rico - 1968

Geographic Location	Name of Facility	Total Number of X-ray Exams.	Total Number of Thoracical Exams.	Total Number of Abdominal Exams.
Arecibo	District Hospital	33,800	780	5,564
	Health Center	14,163	3,013	2,707
	Public Health Unit & T.B. Mobile Unit	15,979	15,979	-
	El Buen Pastor Clinic	3,484	2,184	1,352
	Dr. Susoni Hospital	3,795	364	2,840
	Private Offices*	22,308	8,651	10,712
Arecibo Total		93,529	30,971	23,175
Barceloneta	Private Offices	2,652	732	1,196
Camuy	Private Offices	1,153	216	364
Hatillo	Private Offices	2,795	520	1,664
Lares	Public Health Unit (Municipal Hospital)	6,073	4,700	159
	Castañer General Hospital	4,847	1,799	1,314
Lares Total		10,920	6,499	1,463
Manatí	Public Health Unit	20,739	20,739	-
	San Agustín Hospital	5,389	543	685
	Doctors Center Hospital	7,800	4,680	2,600
	Private Offices	2,340	400	936
Manatí Total		36,268	26,362	4,221
Morovis	Private Offices	130	104	-
Quebradillas	Private Offices	2,392	1,040	884
Utuado	Health Center	11,893	8,735	2,017
	Dr. E. Cintrón Clinic	3,011	1,608	1,397
	San Miguel Clinic	2,080	260	683
Utuado Total		16,984	10,603	4,097
Vega Baja	Sanchez Castaño Clinic	868	538	240
	Private Offices	1,205	624	260
Vega Baja Total		2,165	1,162	500
ARECIBO AREA TOTAL		166,596	78,209	37,572

Total number of x-ray examinations include beside thoracical and abdominal, all other x-ray examinations.

* Including three radiologists' private offices.

TABLE 9-A

MEAN GONADAL DOSE PER PATIENT DUE TO THORACICAL X-RAY EXAMINATIONS, BY TYPE
ARECIBO AREA, PUERTO RICO-1968

	Chest*			Photofluorography			Tomography			Total		Grand
	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total
Mean Exposure per Examination Milliroentgens	2	1	1.51	0.25	0.15	0.19	-	-	-	1.09	0.48	0.76
Mean Dose per Examination Millirads	1.88	0.92	1.39	0.23	0.14	0.17	-	-	-	1.01	0.44	0.70
Total Number of Examinations	16,620	16,973	33,593	18,527	26,089	44,616	-	-	-	35,147	43,062	78,209
Global Irradiation Dose to all Examined Patients Millirads	31,245	15,615	46,860	4,261	3,652	7,913	-	-	-	35,506	19,267	54,773

* The data for the chest x-ray examinations was obtained by taking a few of the same exposures and by dividing the sum of mR by the number of exposures.

TABLE 10-A

MEAN GONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX
ARECIBO AREA, PUERTO RICO-1968

Type of Examination	Millirads per Examination	
	Male	Female
Chest	1.88	.92
Photofluorographic	.23	.14
Tomographic	37.2	6.0
Abdomen	340.4	533.6
Cholecystography	46.0	202.4
Lumbar Spine	161.0	1,104.0
Gastrointestinal Series	450.0	828.0
Barium Enema	1,288.0	971.5
I.V.P.	1,158.0	763.6
Pelvis	754.0	64.0
Hip Joint	791	285.2
Pelvimetry	-	920.0

TABLE 11-A

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP OD GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS ARECIBO AREA, PUERTO RICO-1968

Type of Examination	Sex	Mean Exposure Per Examination Milli-roentgens	Mean Absorption Dose Per Examination Millirads	Total Number of Examinations	Global Irradiation Dose to all Examined Patients Millirads
Abdomen	M.	370	340	3,993	1,357,620
	F.	580	534	3,289	1,756,326
Cholecysto-graphy	M.	50	46	729	33,534
	F.	220	202	1,253	253,106
Lumbar Spine	M.	175	161	8,123	1,307,803
	F.	1,200	1,104	3,763	4,154,352
Gastrointest. Series	M.	490	450	3,286	1,478,700
	F.	900	828	3,926	3,250,728
Barium Enema	M.	1,400	1,288	534	687,792
	F.	1,050	972	604	587,088
I.V.P.	M.	1,260	1,158	2,181	2,525,598
	F.	830	764	2,271	1,735,044
Pelvis	M.	820	754	1,362	1,026,948
	F.	70	64	764	48,896
Hip Joint	M.	860	791	724	572,684
	F.	310	285	645	183,825
Pelvimetry	F.	1,000	920	125	102,500
Total	M.	466.8	429.5	20,932	8,990,294
	F.	673.9	620.0	16,640	10,320,128
GRAND TOTAL		558.6	513.9	37,572	19,310,422

TABLE 12-A

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL AND THORACICAL X-RAY EXAMINATIONS

ARECIBO AREA, PUERTO RICO-1968

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION ARECIBO AREA PUERTO RICO-1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	9,025,800	167,972	53.7
FEMALE	10,339,395	174,828	59.1
TOTAL	19,365,195	342,800	56.4

LIST OF FIGURES

FIGURE I-A

DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNIT
BY GEOGRAPHIC LOCATION
ARECIBO AREA PUERTO RICO-1968

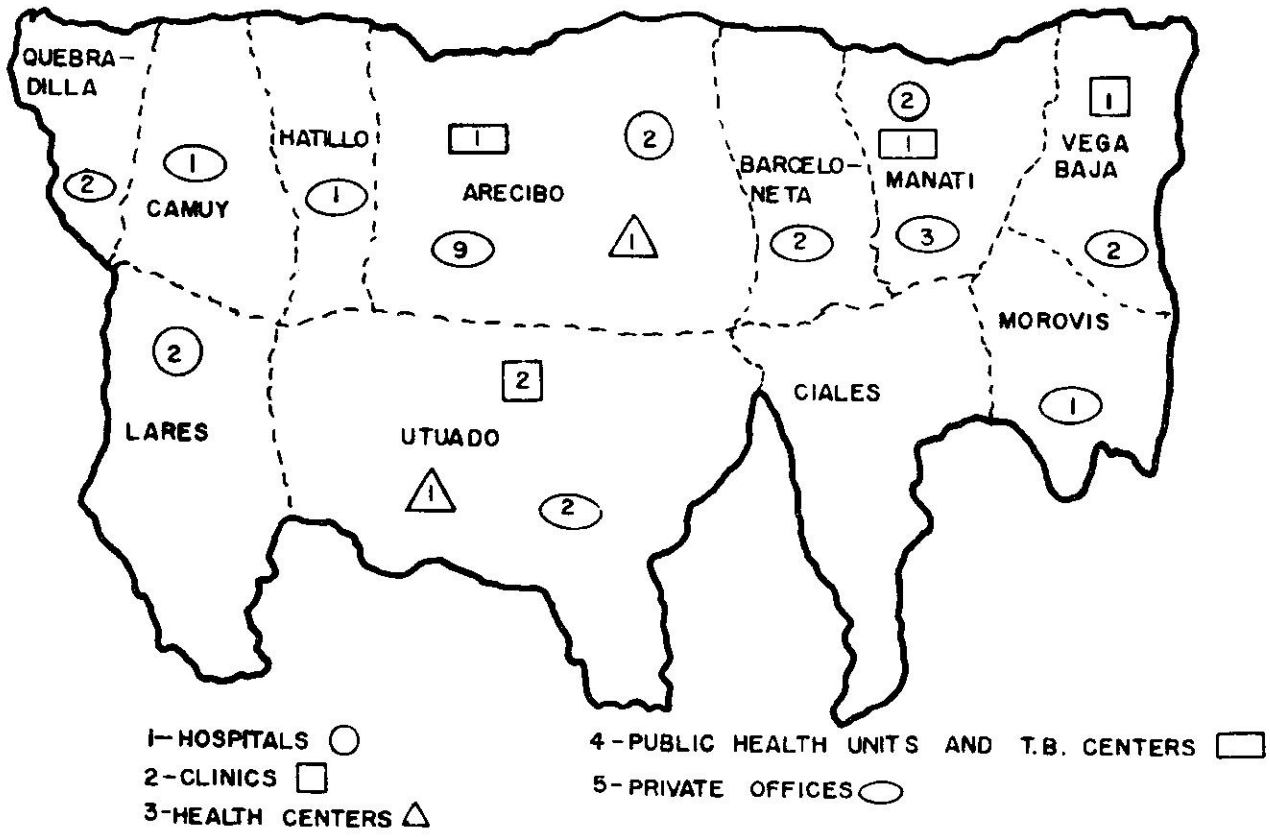


FIGURE - 2 A

DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS, BY GEOGRAPHIC LOCATION AND BY TYPE OF FACILITY,

ARECIBO AREA, PUERTO RICO-1968.

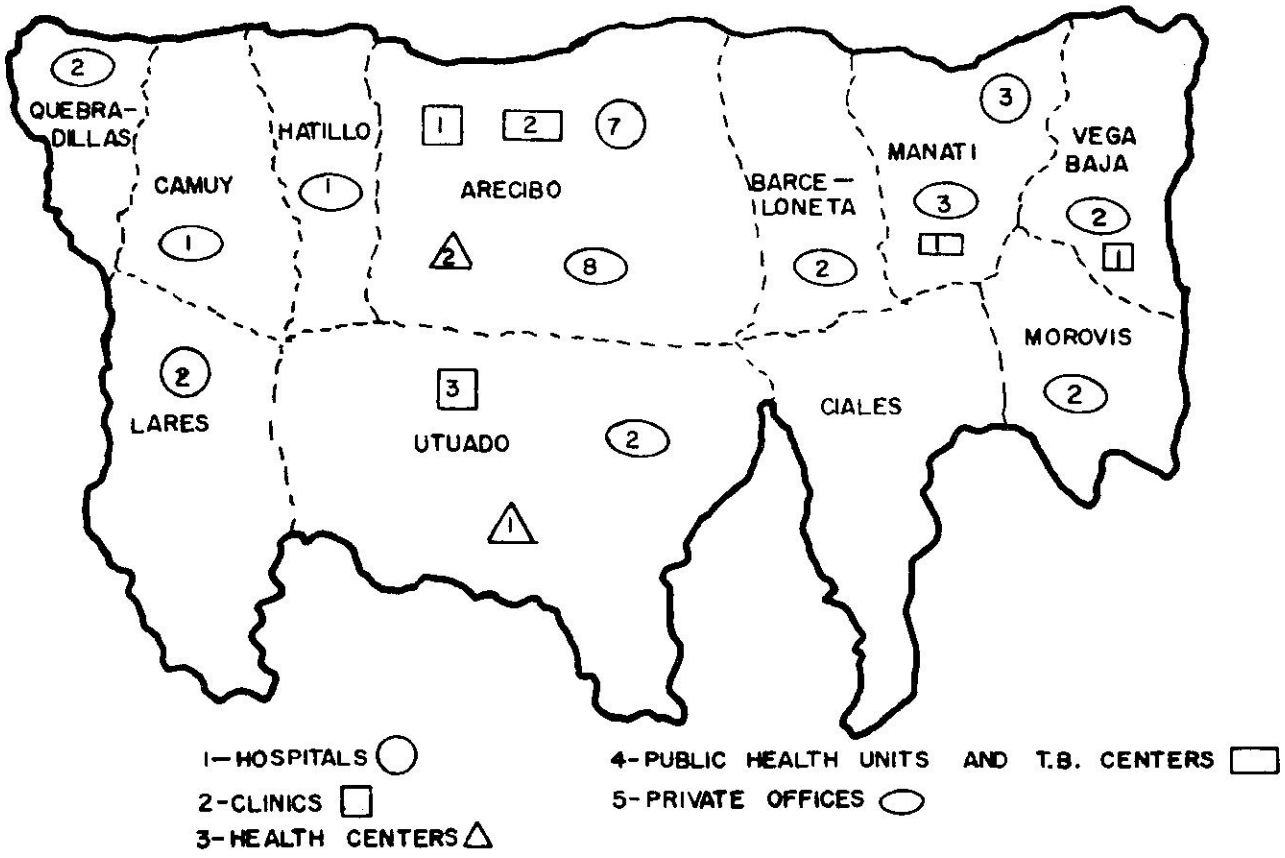
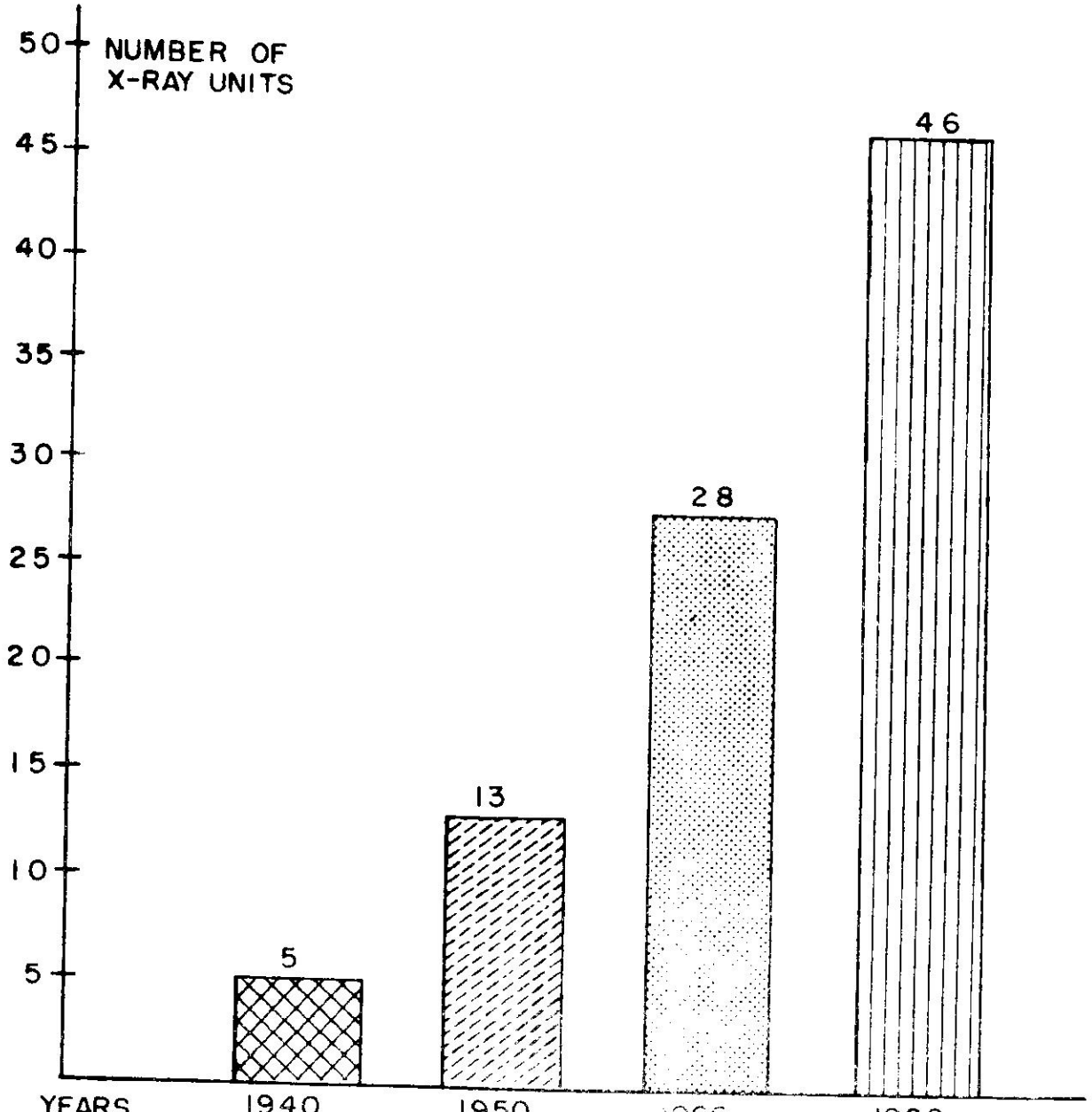


FIGURE – 3 A

VARIATION OF POPULATION AND NUMBER OF DIAGNOSTIC X-RAY UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS.

ARECIBO AREA PUERTO RICO – 1968.



* not including dental units.

PRESENTATION OF STATISTICAL DATA

BAYAMON AREA

The Bayamón Area, comprising eleven municipalities with a total population of 340,600, is part of the Northern Region.

The city of Bayamón, population 117,000, is highly industrialized and growing rapidly.

The lack of adequate general hospital and other medical facilities in the Bayamón area[1] forces a flow of patients to San Juan for medical services and is a contributing factor in the heavy traffic on the Bayamón-San Juan highway, which impedes the dispatch of emergency patients who need immediate medical attention.

LIST OF TABLES

[1] Based on the Plan for Hospital and Medical Facilities, Commonwealth of Puerto Rico Department of Health, 1969.

TABLE 1-B

MUNICIPALITIES OF THE BAYAMON AREA AND THEIR POPULATION
PUERTO RICO-1968*

Municipalities	Population
Barranquitas	19,000
Bayamon	117,000
Cataño	23,900
Comerio	21,100
Corozal	28,100
Dorado	18,600
Naranjito	19,600
Orocovis	21,200
Toa Alta	18,700
Toa Baja	30,500
Vega Alta	22,900
BAYAMON AREA TOTAL	340,600

* The above data are quoted from the Annual Vital Statistics Report, Commonwealth of Puerto Rico Department of Health, 1968.

TABLE 2-B

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION
BY MEDICAL FACILITY, BY GEOGRAPHIC LOCATION AND POPULATION PER X-RAY UNIT
BAYAMON AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
Barranquitas	Health Center	1		
	Private Offices	3		
Barranquitas Total		4	19,000	4,750
Bayamon	Health Center	2		
	Melendez Bros. Hosp.	4		
	Ruiz Soler Hospital	3		
	Private Offices	17		
Bayamon Total		26	117,000	4,500
Cataño	Health Center	-	23,900	No x-ray unit.
Comerio	Health Center	-	21,100	No operative x-ray unit.*
Corozal	Health Center	-	28,100	No x-ray unit.
Dorado	Health Center	-	18,600	No x-ray unit.
Naranjito	Private Offices	3	19,600	6,533
Orocovis	Health Center	-	21,200	No operative x-ray unit.
Toa Alta	Health Center	-	18,700	No operative x-ray unit.
Toa Baja	Health Center	-	30,500	No operative x-ray unit.
Vega Alta	Health Center	-		No operative x-ray unit.
	Private Office	1		
Vega Alta Total		1	22,900	22,900
BAYAMON AREA TOTAL		34	340,600	10,017

* "No operative x-ray unit" means the x-ray unit at the facility is out of order since more than one year.

Note: Only x-ray units in operative condition were included in this table.

TABLE 3-B

TOTAL NUMBER OF X-RAY EXAMINATION IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS BAYAMON AREA, PUERTO RICO-1968*

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMINATIONS	NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS
Barranquitas	Health Center	41.950	2,600	6.1
Bayamon	Health Center	254,104	23,400	9.2
	Hnos. Melendez Hosp.	6,174	9,360	151.6
	Ruiz Soler Hosp.	1,321	9,045	684.7
Bayamon Total		261,599	41,805	15.9
Cataño	Health Center	32,246	-	-
Comerio	Health Center	45,532	-	-
Corozal	Health Center	11,882	-	-
Dorado	Health Center	27,478	-	-
Naranjito	Health Center	77,880	-	-
Orocovis	Health Center	37,252	-	-
Toa Alta	Health Center	24,091	-	-
Toa Baja	Health Center	18,929	-	-
Vega Alta	Health Center	74,451	-	-
BAYAMON AREA TOTAL 1 *		547,981	44,405	8.1

1 Not including private offices.

* The number of x-ray examinations per 100 patients was calculated for the total number of patients in the Bayamon Area in public institutions -- including medical facilities having no x-ray unit.

TABLE 4-B

DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS IN OPERATIVE CONDITION BY MEDICAL FACILITY AND BY MANUFACTURER
BAYAMON AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Picker	MA	General Electric	MA	Standard	MA	Kelekat	MA	Universal	MA	Profex-ray	MA	Continental	MA	Westing-house	MA	Fisher	MA	TOTAL
Barranquitas	Health Center			1	300															
	Private Offices	1	100							1	60									1
										1	100									3
Barranquitas	Total	1		1		0		0		2		0		0		0		0		4
Bayamon	Health Center	1	200																	
		1	300																	2
	Melendez Bros. Hospital	1	100	1	300			1	300											
		1	200																	4
	Ruiz Soler Hospital	1	300	1	25															
		1	500																	3
	Private Offices	1	100	1	300			1	100			1	300	1	300	1	20	1	200	
		2	200	2	200			1	60			1	100			1	100			
		1	300																	
		1	500																	
		1	65																	17
Bayamon Total		12		5		0		3		0		2		1		2		1		26
Naranjito	Private Offices	1	100	1	15			1	100											3
Vega Alta	Private Offices	1	100																	1
Grand Total		15		7		0		4		2		2		1		2		1		34

TABLE 5-B

CENSUS OF DIAGNOSTIC X-RAY UNITS
BAYAMON AREA, PUERTO RICO-1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL (MA)	YEAR OF MANUFACTURE OR PURCHASE	TUBES, MODEL & MANUFACTURER	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
Barranquitas	Health Center (Muni.Hosp.)	G.E. 10	1940	E.1.7	-	-	Not operative.
		G.E. 300	1965	HRT-R,HRT-F	Var. Collima.	3.0	Radio. & fluoro. tubes
	Private Offices	Universal 60	1962	UX-20H	Cone	0.5	
		Universal 100	1946	UX-20H	Cone	1.5	
		Picker 100	1950	PX-10E	Cone	1.5	
Bayamon*	Health Center	Picker 200	1956	PX-10	Var. Collima.	3.5	
		Picker 300	1968	PX-10	Var. Collima.	3.5	Galaxy model.
		G.E. 30 Fluoros.	1950	DX	-	0.5	Not operative.
	Hermanos Meleudez Hospital	Kalekat 300	1958	PX-8	Var. Collima.	3.5	Routine.
		Picker 100	1956	PX-10	No collima.	0.5	Mobile unit.
		Picker 200	1965	HRT	Cone	0.5	Urology.
		G.E. 300			Var. collima.	3.5	Routine.
	Ruiz Soler Hospital	G.E. 25	1955	DX Coolidge	Var. Collima.	0.5	T.B. Hospital.
		Picker 300	1965	PX-10A	Var. collima.	3.5	Pictronic model.
		Picker 500	1964	17-B	Var. collima.	3.5	
	Private Offices	Picker 200	1968	PX-10	Var. collima.	3.5	
		G.E. 300	1963	HRT-F,HRT-R	Var. collima.	3.5	
		Profex-ray 300	1955	Dynamax 40	Var. collima.	3.5	
		Kalekat 100	1949	Eureka	Cone	1.5	
		Profex-ray 100	1966	Dynamax	Var. collima.	3.5	
		Continental 300	1965	UX-40H	Var. collima.	3.5	
		Westinghouse 20	1945		No collimator	.5	Fluoroscopy.
		Picker 500	1964	PX-17B	Var. collima.	3.5	
		Kalekat 60	1940	-	-	-	
		Picker 65	1933	-	No collimator	.5	Fluoroscopy.
		Picker 200	1955	PX-10	Cone	2.5	
		Picker 300	1964	PX-10	Var. Collima.	3.5	
		Fisher 200	1960	Dunlee Corp.	Var. collima.	3.5	
		Westinghouse 100	1954	Dynamax	Cone	2.0	
		Picker 100	1962	PX-8E	Cone	1.5	
		G.E. 300	1955	HRT	G.E. Field col	3.5	
Comerio	Health Center	Picker 200	1956	PX-10	Var. collima.		Not operative.
Naranjito	Private Offices	Kalekat 100	1949		Cone	1.5	
		Picker 100	1946	PX-8E	Cone	2.5	
		G.E. 15	1940	DX	No collimator	-	Not operative.
Orocovis	Health Center	Picker 100	1956	-	-	-	Not operative.
Toa Alta	Health Center	Mattern 200	1955	-	-	-	Not in use in 1968.
Toa Baja	Health Center	Picker 30	1940	PX-1B	No collimator	0.5	Not operative.
Vega Alta	Health Center	Standard 40	1946	-	Cone	0.5	Not operative.
	Private Office	Picker 100	Mfg. 1946	PX-8E	Cone	1.5	

Note: Out of the 40 diagnostic x-ray units in the Bayamon Area-1968, 6 units were not in operative condition.

* In 1970, a new private hospital, the Matilda Brenes Hospital, was opened in Bayamon with two x-ray units.

TABLE 6-3

NUMBER OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS BY MEDICAL FACILITY, BY TYPE OF EXAMINATION AND BY SEX
BAYAMON AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Sex	Type of Abdominal Examination									
			Abdomen	Cholecystography	Lumbar Spine	Gastro-intest. Series	Barium Enema	I.V.P.	Pelvis	Hip Joint	Pelvimetry	TOTAL
Barranquitas	Health Center	Male	45	17	87	76	9	23	-	-	-	257
		Fem.	76	30	64	55	10	35	-	-	-	270
		Total	121	47	151	131	19	58	-	-	-	527
	Private Offices*	Male	104	-	156	52	-	-	-	-	-	312
		Fem.	-	-	208	-	-	-	-	-	-	208
		Total	104	-	364	52	-	-	-	-	-	520
Barranquitas Total		Male	149	17	243	128	9	23	-	-	-	569
		Fem.	76	30	272	55	10	35	-	-	-	478
		Total	225	47	515	183	19	58	-	-	-	1,047
Bayamon	Health Center	Male	52	104	156	104	104	52	52	52	-	676
		Fem.	156	260	260	208	156	208	52	52	-	1,352
		Total	208	364	416	312	260	260	104	104	-	2,028
	Melendez Brothers Hospital	Male	480	370	355	400	400	800	320	300	-	3,425
		Fem.	300	312	200	500	500	600	425	400	580	3,815
		Total	780	680	555	900	900	1,400	745	700	580	7,240
	Ruiz Soler Hospital	Male	27	15	50	71	17	22	5	12	-	219
		Fem.	24	24	25	69	14	21	8	8	14	207
		Total	51	39	75	140	31	43	13	20	14	426
	Private Offices	Male	1300	52	1092	676	156	416	312	208	-	4,212
		Fem.	1092	260	1092	988	156	676	260	156	-	4,680
		Total	2392	312	2184	1664	312	1092	572	364	-	8,892
Bayamon Total		Male	1859	541	1653	1251	677	1290	689	572	-	8,532
		Fem.	1572	854	1577	1765	826	1505	745	616	594	10,054
		Total	3431	1395	3230	3016	1503	2795	1434	936	594	18,586
Naranjito	Private Offices	Male	-	-	104	-	-	52	-	-	-	156
		Fem.	-	-	104	-	-	104	-	-	-	208
		Total	-	-	208	-	-	156	-	-	-	364
Vega Alta	Private Offices	Male	52	-	-	-	-	-	-	-	-	52
		Fem.	52	-	-	-	-	-	-	-	-	52
		Total	104	-	-	-	-	-	-	-	-	104
Bayamon Area Total		Male	2,060	558	2,000	1,379	686	1,365	689	572	-	9,309
		Fem.	1,700	884	1,953	1,820	836	1,644	745	616	594	10,792
		Total	3,760	1,442	3,953	3,199	1,522	3,009	1,434	1,188	594	20,101

* "Private Offices" include a) radiologists offices and b) all other private medical offices equipped with x-ray units with the exception of dental offices.

TABLE 7-B

NUMBER OF DIAGNOSTIC THORACICAL X-RAY EXAMINATIONS BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY AND BY SEX
BAYAMON AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Number of Diagnostic Thoracical X-ray Examinations by Type									Total		TOTAL
		CHEST RADIOGRAPHY			PHOTOFLUOROGRAPHY			CHEST TOMOGRAPHY					
		Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	
Barranquitas	Health Center	425	476	901	-	-	-	-	-	-	425	476	901
	Private Offices	1,040	1,040	2,080	-	-	-	-	-	-	1,040	1,040	2,080
Barranquitas Total		1,465	1,516	2,981	-	-	-	-	-	-	1,465	1,516	2,981
Bayamon	Health Center*	248	323	571	3,350	13,399	16,749	-	-	-	3,598	13,722	17,320
	Melendez Bros.Hosp.	200	214	414	-	-	-	-	-	-	200	214	414
	Ruiz Soler Hospital	3,566	4,108	7,674	-	-	-	150	140	290	3,716	4,248	7,964
	Private Offices	7,326	6,968	14,294	-	-	-	-	-	-	7,326	6,968	14,294
Bayamon Total		11,340	11,613	22,953	3,350	13,399	16,749	150	140	290	14,840	25,152	39,992
Naranjito	Private Offices	104	104	208	-	-	-	-	-	-	104	104	208
Vega Alta	Private Offices	208	104	312	-	-	-	-	-	-	208	104	312
BAYAMON AREA TOTAL		13,117	13,337	26,454	3,350	13,399	16,749	150	140	290	16,617	26,876	43,493

* The preponderance of the female photofluorography cases is due to the fact that the Bayamon Health Center screens the working population, an approximate of 80% of which are primarily women.

TABLE 8-B

TOTAL NUMBER OF ALL X-RAY EXAMINATIONS, TOTAL NUMBER OF ABDOMINAL EXAMINATIONS AND TOTAL NUMBER OF THORACICAL X-RAY EXAMINATIONS BY MEDICAL FACILITY
BAYAMON AREA, PUERTO RICO-1968

Geographic Location	Medical Facility	Total Number of X-ray Exams.	Total Thoracical X-ray Exams.	Total Abdominal X-ray Exams.
Barranquitas	Health Center	2,600	901	527
	Private Offices	2,925	2,080	520
Barranquitas Total		5,525	2,981	1,047
Bayamon	Health Center	23,400	17,320	2,028
	Melendez Brothers Hospital	9,360	414	7,240
	Ruis Soler Hospital	9,045	7,964*	426
	Private Offices**	28,277	14,294	8,892
Bayamon Total		70,082	39,992	18,586
Naranjito	Private Offices	975	208	364
Vega Alta	Private Offices	520	312	104
Bayamon Area Total		77,102	43,493	20,101

* Including 290 tomographies.

** Including two private radiologists offices.

Total number of x-ray examinations include beside thoracical and abdominal, all other x-ray examinations.

TABLE 9-B

MEAN GONADAL DOSE PER PATIENT DUE TO THORACICAL X-RAY EXAMINATIONS, BY TYPE
BAYAMON AREA, PUERTO RICO-1968

	Chest*			Photofluorography			Tomography**			Total		Grand
	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total	Male	Fem.	Total
Mean Exposure Per Examination Milliroentgens	2.0	1.0	1.5	.25	.15	.16	37.2	5.4	21.7	1.98	.59	1.13
Mean Absorbed Dose Per Examination Millirads	1.88	.92	1.4	.23	.14	.15	34.2	4.9	20.0	1.83	.55	1.04
Total Number of Examinations	13,117	13.337	26,454	3,350	13,399	16,749	150	140	290	16,617	26,876	43,493
Global Irradiation Dose to all Examined Patients Millirads	24,659	12,270	36,929	770	1,875	2,645	5,130	686	5,816	30,409	14,858	45,267

* The data for the chest x-ray examinations was obtained by taking a few of the same exposures and dividing the sum of mR by the number of exposures.

** The exposure to the testes per film was 6.2 mR and to the ovaries .9 mR in tomographies. The average tomography consists of six exposures.

TABLE 10-B

MEAN GONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX
BAYAMON AREA, PUERTO RICO

Irradiated in the Bayamon Health Center with a Picker 200, Tube PX-10, Variable Collimator, Total Filtration 3.5 mm. Al.

Type of Examination	Millirads per Examination	
	Male	Female
Chest	1.88	.92
Photofluorographic	.23	.14
Tomographic	34.2	4.9
Abdomen	335.0	433.0
Cholecystography	10.0	160.1
Lumbar Spine	170.5	950.6
Gastrointestinal Series	180.2	685.5
Barium Enema	1,210.0	750.4
I.V.P.	1,000.0	720.4
Pelvis	746.2	61.6
Hip Joint	700.0	283.5
Pelvimetry	-	1,100.4

Picker x-ray units were the most common (15 out of the total of 34 x-ray units were Picker-made in the Bayamon Area, 1968).

TABLE 11-B

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS BAYAMON AREA, PUERTO RICO-1968

Type of Examination	Sex	Mean Exposure Per Examination Milli-roentgens	Mean Absorption Dose Per Examinations Millirads	Total Number of Examinations	Global Irradiation Dose to all Examined Patients Millirads
Abdomen	M.	364	335	2,060	690,100
	F.	471	433	1,700	736,100
Cholecysto-graphy	M.	11	10	558	5,580
	F.	196	180	884	159,120
Lumbar Spine	M.	184	170	2,000	340,000
	F.	1,033	951	1,953	1,857,303
Gastrointest. Series	M.	195	180	1,379	248,220
	F.	746	686	1,820	1,248,520
Barium Enema	M.	1,315	1,210	686	830,060
	F.	815	750	836	627,000
I.V.P.	M.	1,086	1,000	1,365	1,365,000
	F.	783	720	1,644	1,183,680
Pelvis	M.	810	746	689	513,994
	F.	67	62	745	46,190
Hip Joint	M.	761	700	572	400,400
	F.	308	284	616	174,944
Pelvimetry	F.	1,195	1,100	594	653,400
Total	M.	512.9	471.9	9,309	4,392,917
	F.	673.3	619.5	10,792	6,685,644
GRAND TOTAL		599.0	551.1	20,101	11,078,561

TABLE 12 – B

PER CAPITA, PER ANNUM MEAN GONADAL DOSE DUE TO ALL GENETICALLY HAZARDOUS ABDOMINAL AND THORACICAL X-RAY EXAMINATIONS.

BAYAMON AREA, PUERTO RICO-1968.

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION BAYAMON AREA PUERTO RICO-1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	4,423,326	166,894	26.5
FEMALE	6,700,502	173,706	38.5
TOTAL	11,124,998	340,600	32.6

LIST OF FIGURES

FIGURE I-B

DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNITS BY GEOGRAPHIC LOCATION.

BAYAMON AREA, PUERTO RICO—1968

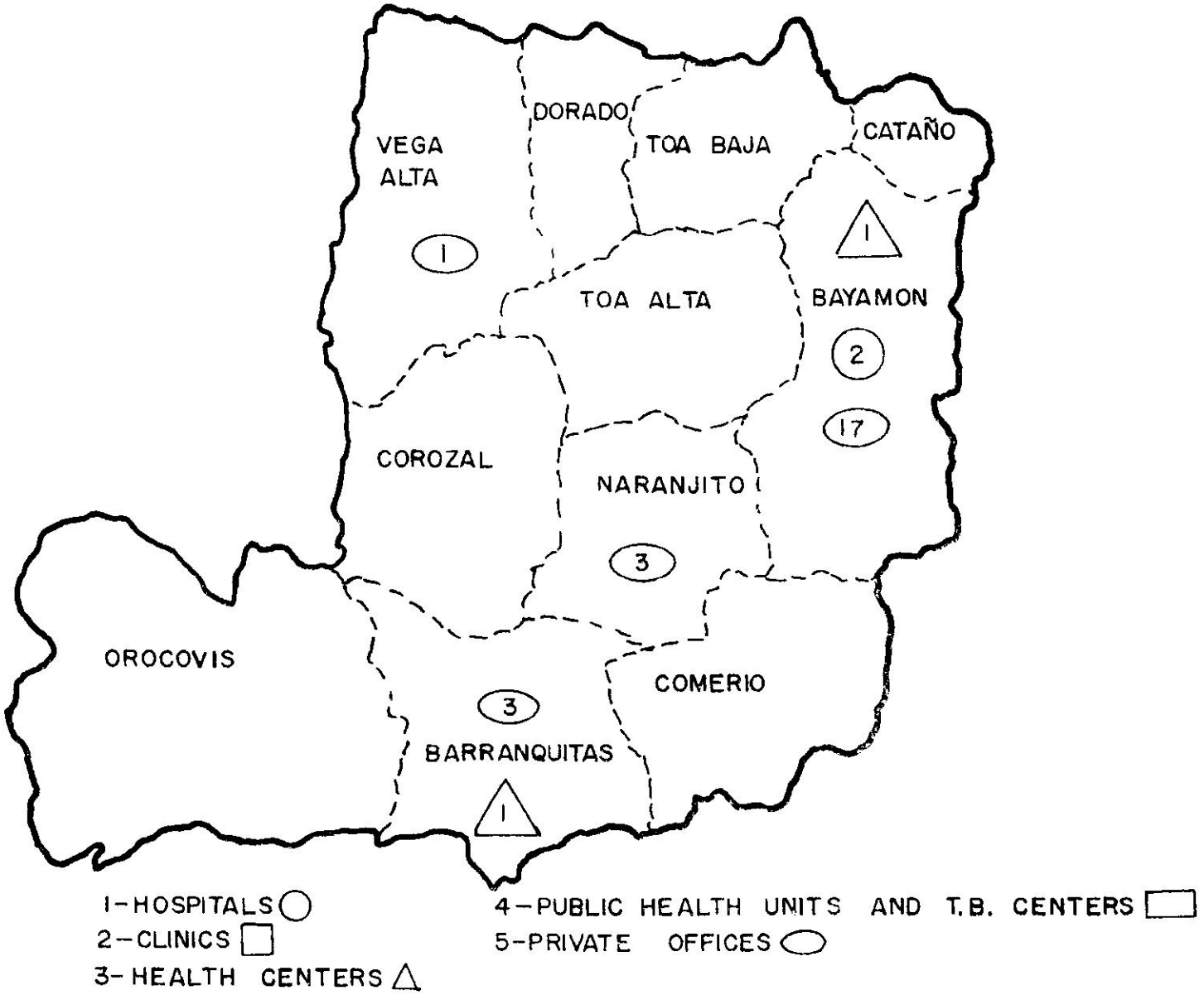


FIGURE – 2 B

DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS, BY GEOGRAPHIC LOCATION AND BY TYPE OF FACILITY.

BAYAMON AREA, PUERTO RICO – 1968.

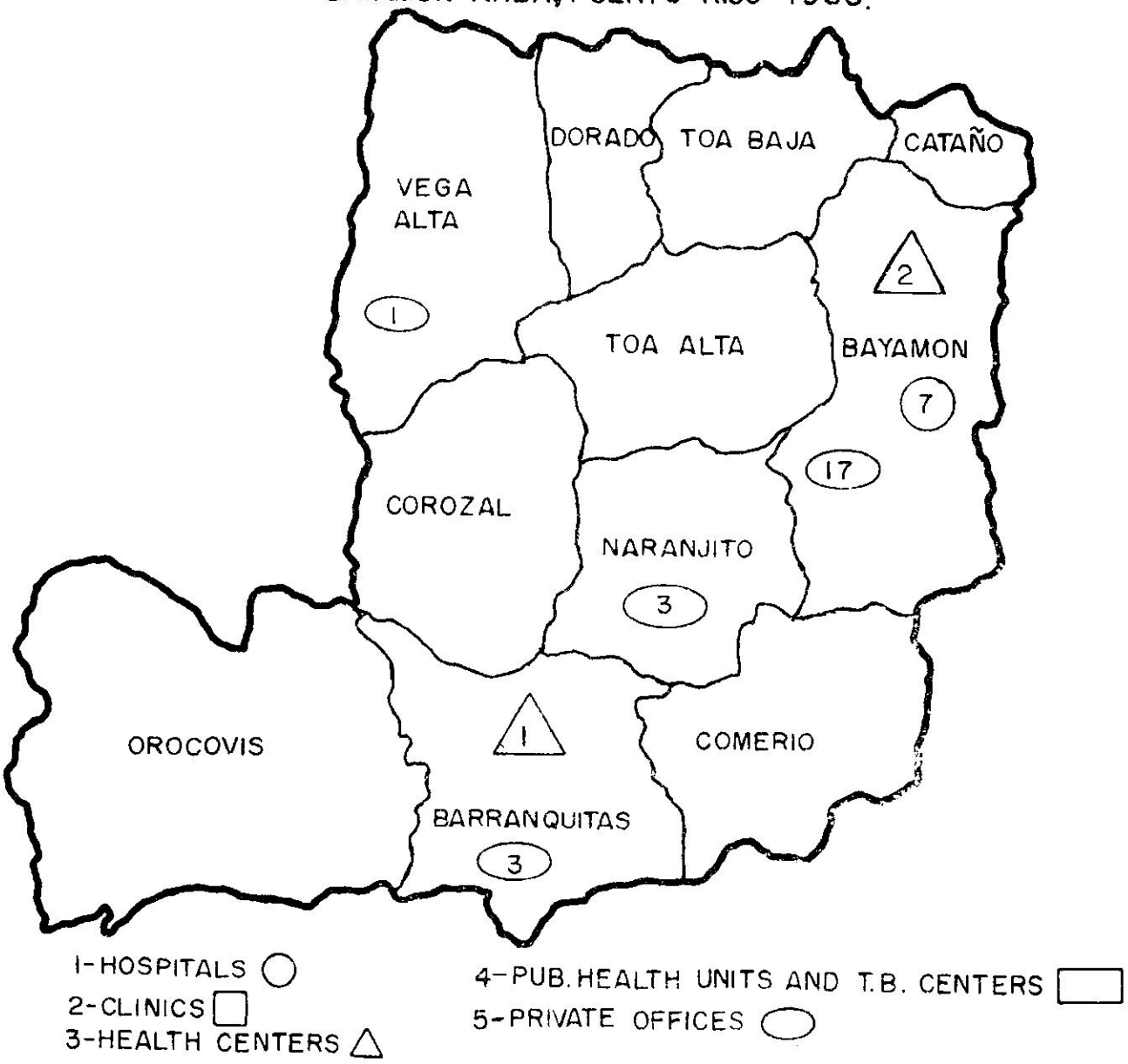
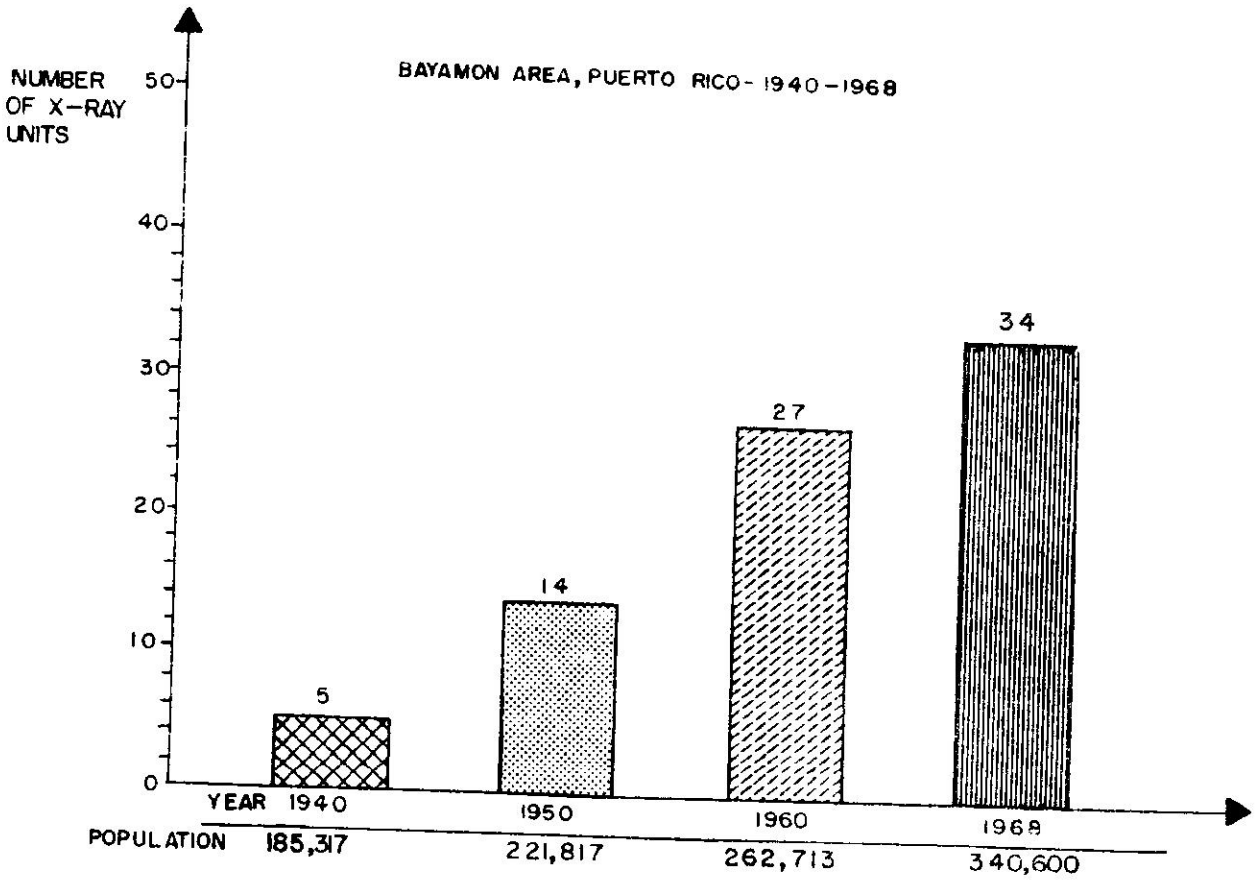


FIGURE – 3 B

VARIATION OF POPULATION AND NUMBER OF DIAGNOSTIC X-RAY UNITS IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS.



APPENDIX I

RADIOTHERAPY IN PUERTO RICO

LIST OF TABLES

TABLE - 1R

DISTRIBUTION OF THERAPEUTIC X-RAY UNITS USED FOR SUPERFICIAL TREATMENT BY LOCATION, MANUFACTURER AND NUMBER OF PATIENTS

PUERTO RICO-1970

LOCATION	MEDICAL FACILITY	MANUFACTURER AND MODEL	K.V.P.	NUMBER OF PATIENTS TREATED WEEKLY (APPROX)	DATE OF LAST TECHNICAL CHECK-OUT
SAN JUAN	PRESBYTERIAN HOSPITAL	GEN. ELECTRIC	100	2	FEB. '70 (MONTHLY)
	P.R. NUCLEAR CENTER	PICKER	120	15	
	GONZALEZ-MARTINEZ ONCOLOGIC HOSPITAL	GEN. ELECTRIC	100	50	
	PRIVATE OFFICES	PROFEX-RAY * (TWO HEADS)	100		
		UNIVERSAL (TWO HEADS)	95		
		UNIVERSAL (TWO HEADS)	95		
		UNIVERSAL	95		
		GEN. ELECTRIC	100		
		GEN ELECTRIC	100		
		PICKER ZEPHYR	120		
		PICKER ZEPHYR	120		
PONCE	ONCOLOGIC CLINIC	STANDARD	100	25	SEPT. '70
MAYAGUEZ	MEDICAL CENTER	G E MAXIMAR	100	NOT IN USE YET	—

* One head for Grenz Ray rated at 15MA, 20 kVp, second head for superficial radiation rated at 5MA, 95 kVp.

1) This average will change according to filter, size of field, F S D, and tumor dose to be delivered.

TABLE 2-R

DISTRIBUTION OF INTERMEDIATE (ORTHOVOLTAGE) THERAPEUTIC X-RAY UNITS BY LOCATION, MANUFACTURER AND NUMBER OF PATIENTS PUERTO RICO-1970

Location	Medical Facility	Manufacturer and Model	kVp	Number of Patients Treated Weekly (Approximately)	Date-Last Technical Check-out
Ponce	Oncological Clinic	Gen. Electric	250	25	Sept. '70
	Damas Hospital	Gen. Electric	250	3 per year	-
	Dr. Pila Clinic	Gen. Electric	250	Not in use.	-
Mayaguez	Medical Center	Gen. Electric	300	Not in use yet.	-
San Juan	Gonzalez Martinez Oncological Hospital	Gen. Electric	250	50	

TABLE 3-R

DISTRIBUTION OF RADIONUCLIDE APPLICATOR UNITS USED FOR DEEP THERAPY
BY LOCATION, TYPE OF SOURCE AND SOURCE ACTIVITY
PUERTO RICO-1970

Location	Medical Facility	Manufacturer	Type of Source	Approximate Source Activity, in Curies Determined at Date Given	Source Checked Annually	Number of Treatments Weekly (Approx.)
San Juan	Gonzalez-Martinez Oncologic Hospital	Picker	Cesium ^{137}	2500 at February, 1962	Not in use	-
		Picker	Co^{60}	1850 at November, 1969	yes	200
		A.E.C.L.	Co^{60}	2790 at November, 1962	yes	100
		A.E.C.L.	Co^{60}	6986 at August, 1968	yes	250
	Presbyterian Hospital	Picker	Co^{60}	1400 at February, 1970	yes	75
	Veterans Hospital	Picker	Co^{60}	4137 at December, 1969	yes	50
	Puerto Rico Nuclear Center	A.E.C.L.	Co^{60}	6090 Ci at Sept., 1970	yes	200
	Aurilio Mutuo Hospital	Picker	Co^{60}	3000 at 1964	yes	
Ponce	Oncologic Clinic	A.E.C.L.	Co^{60}	1500 at November, 1970	yes	100
		Picker	Co^{60}	4000 at November, 1970	yes	150
Mayaguez	Medical Center	A.E.C.L. Picker (Theratron 80)	Co^{60}	2500 at February, 1969	Not in use yet.	-

* This average time will be changed according to the age of the source.

APPENDIX II

NUCLEAR MEDICINE IN PUERTO RICO

STATISTICAL DATA ON NUCLEAR MEDICINE IN PUERTO RICO-1970

The beginning of nuclear medicine goes back to 1934, when Nobel Laureate George De Hevesy first used heavy water to determine the total body water content of a patient. In 1936, J. G. Hamilton and R. S. Stone of the University of California administered Na-24 to patients for diagnostic purposes.

The era of nuclear medicine began in earnest in August 1946, with the first shipment of artificially produced radionuclides from Oak Ridge National Laboratory, Oak Ridge, Tennessee to a St. Louis, Missouri Hospital.

In Puerto Rico one of the first thyroid uptake determinations was delivered by the Nuclear Chemical Instrument Corporation (now Nuclear Chicago) in 1956, to the Mimiya Hospital in Santurce. Very soon nuclear methods became an integral part of diagnostics, providing otherwise unavailable information on an organ and its function, as well as supplying corroborative evidence to support a suggested diagnosis. Moreover nuclear diagnosis is safe and accurate. Today more than fifty nuclear-medical units are operative on the Island.

The Atomic Energy Commission's List of Licensees -- authorized to own and use radioactive sources for nuclear medical purposes in Puerto Rico -- enumerates the following facilities:

AEC List of Licensees
Authorized to Own and Use Radioactive Sources
for Nuclear Medical Purposes

Puerto Rico 1970

MEDICAL FACILITY	GEOGRAPHIC LOCATION	NUMBER OF LICENSED PHYSICIANS	
Puerto Rico Nuclear Center - Clinical Applications Div.	San Juan	2	
Gonzales Martinez Oncological Hospital	San Juan	1	
Municipal Hospital	San Juan	2	
Veterans' Hospital	San Juan	1	
Presbyterian Hospital and Ashford Nuclear Center	San Juan	1	
Hospital Pavia and Dr. A. L. Rodriguez Rosado's Office	San Juan	1	
Hospital Mimiya and Dr. Buso's Office	San Juan	1	
Regional Hospital and Damas Hospital	Ponce	1	
Mayaguez Medical Center	Mayaguez	1	To Be Opened 1971
Total		11	

Having visited the above facilities it was learned that out of the 10 physicians using radioactive nuclides in 1970, eight were practicing diagnostic and therapeutic nuclear medicine while two were practicing only diagnostic nuclear medicine.

Radioactive tracers are used to determine the *in vivo* distribution of the labeled material. Relevant parameters entering in the choice of a certain radioactive tracer are among others, the energy and the half life of the emitted radiation.

The emitted photons have to have sufficient energy to be detectable outside the body.

Technetium 99m, which emits a 140 kev gamma ray, with no associated particulate radiation and which decays with a half life of six hours is one of the tracers having the most desirable physical characteristics for *in vivo* applications.

I-131 with a 0.637 mev gamma ray and a half life of 8.08 day was used in 9,311 thyroid uptake studies in 1970, amounting to 81% of the total 11,513 function studies. I-131 was used in more than 93% of all the function studies (thyroid and others).

Blood volume determination (442 cases) was generally conducted by means of I-131 labeled albumin.

Another rather widely used radionuclide in function studies was Co-57 primarily for Vitamin B-12 absorption tests. It was used three times as frequently as the longer half life Co-60.

Scanning procedures, based upon the differential concentration of a certain radionuclide in a given body organ were used in a total of 6,621 cases in Puerto Rico in 1970, as shown in the Table NM-3

LIST OF TABLES

TABLE 1 MM

DISTRIBUTION OF RADIOISOTOPE EQUIPMENT FOR NUCLEAR MEDICINE
BY MEDICAL FACILITY, MANUFACTURER AND YEAR OF INSTALLATION
PUERTO RICO 1970

Location	Medical Facility	Manufacturer and Model	Application	Year of Instal-lation	No. of Patients Treated Weekly (5 work days)	Comments
Ponce	District Hospital	Nuclear Chicago Renaltron	Kidney Function System	1966	2	
		Nuclear Chicago	Thyroid Uptake System	1964	10	
		Nuclear Chicago	Well Counter System 1-2"	1964	5	
		Picker	Color-Scan	1969	7	
	Damas Hospital	Nuclear Chicago	Thyroid Uptake System	1964	10 daily	I^{131}
		Nuclear Chicago	Well Counter System 1-2"	1964	1-2 week	
		Picker	Color-Scan	1969	6	
San Juan	Municipal Hospital	Nuclear Chicago	Radioisotope Scanner	1966	20	
		Nuclear Chicago	Kidney Function System 2 units (one not in use)	1962	3	
		Nuclear Chicago	Thyroid Uptake System	1963	25	
		Nuclear Chicago	Well Counter System 1-3"	1962	25	
	Gonzales-Martinez Oncological Hospital	Nuclear Chicago	Well Counter System 1-3"	1969	3	
		Nuclear Chicago	PHO/Gamma Camera	1967	30	
		Nuclear Chicago	Mediac Dose Calibrators	1969		
		Nuclear Chicago	Mediac T3 Counter	1969	1	
		Nuclear Chicago	Volmetron (Blood volume)		1 per month	
		Nuclear Chicago	Thyroid Uptake System	1967	25	
		Texas Nuclear	For high radiation log series with alarm			
	Nuclear Center Clinical Application	Picker	Color-Scan (Magnascanner)	1968	20	
		Picker	Uptake Counting System	1969	40	
		Picker	Kidney Function System	1969	6	
		Curtis Nuclear Corporation	Curtis Photo-Scanner	1963	3	
		Picker	Dynacamera for Functional Test and Scanning			
		1) Nucl. Chicago	Well Counter System	1967	20	
		2) Picker	" " "	1968		
		3) Baird Atomic Counter	" " "	1969	-	
		4) Nucl. Chicago	" " " - -	1957	-	#4 out of order

Cont. on following page

TABLE 1 NM (Cont.)

Location	Medical Facility	Manufacturer and Model	Application	Year of Instal-lation	No. of Patients Treated Weekly (5 work days)	Comments
San Juan (cont.)	Pavia Hospital and Dr. A. L. Rodriguez Rosado's Office	Picker	Magno-Scanner (5" Cristal)		40	
		Nuclear Chicago	Kidney Function System	1962	10	
		Nuclear Chicago	Thyroid Uptake System		50	
		Nuclear Chicago	Well Counter System 1-3"	1963	50	
		Nuclear Chicago	Radioisotope Scanner	1963	--	Out of Order
	Presbyterian Community Hospital and Ashford Nuclear Center	Nuclear Chicago	Pho-Gamma III Camera	1967	50	
		Nuclear Chicago	Mediac Dose Calibrators	1968	--	
		Nuclear Chicago	Well Counter System 1-3"	1968	10	
		Nuclear Chicago	Kidney Function System Renaltron IV	1966	3	
		Nuclear Chicago	Thyroid Uptake System	1966	25	
		Nuclear Chicago	Well Counter System 1-3"	1966	25	
		Nuclear Chicago	Radioisotope Scanner Pho-Dot	1966	5	
	Veterans Administration Hospital	Nuclear Chicago	Kidney Function System	1969	5	
		Nuclear Chicago	Thyroid Uptake System	1964	5	
		Nuclear Chicago	Well Counter System 1-2"	1963	4	
		Baird Atomic Counter[2]	Thyroid Uptake System	1965	25	
		Nuclear Chicago	PHO/Gamma Camera	1969	15	
		Nuclear Chicago	Mediac Dose Calibration	1969	-	
		Nuclear Chicago	Actigraphs-Chromatograph	1969	-	
	Mimiya Hospital & Foundation	Nuclear Chicago	Kidney Function System	1962	-	Not in use.
		Nuclear Chicago	Thyroid Uptake System	1956	19 weekly	
	Clinical Research Center	Nuclear Chicago	Thyroid Uptake System	1964	-	Not in use for patients
		Nuclear Chicago	Liquid Scintillation System	1963	-	Only samples
		Nuclear Chicago	Automatic Gamma Counters	1963	-	Only samples for research
		Baird Atomic Inc.	Well Counter System (All procedures in vitro only)			
	Dr. A. Buso	Nuclear Chicago	Thyroid Uptake System	1961	20	

TABLE-2N M

PRINCIPAL NUCLEAR MEDICAL FUNCTION PROCEDURES PERFORMED DURING 1970

PUERTO RICO

RADIONUCLIDE	COMPOUND	PROCEDURE	PHYSICIANS LICENSED FOR PROCEDURE	NUMBER OF PATIENTS	PERCENT
I-131	SODIUM IODIDE	THYROID UPTAKE		9,311	80.87
I-131	LABELED ALBUMIN	BLOOD VOLUME DETERMINATION		322	2.79
I-131	SODIUM IODOHIPPURATE	RENAL FUNCTION		905	7.89
Co-57	LABELED VITAMIN B_{12}	VITAMIN B_{12} ABSORPTION		344	2.98
Cr-51	SODIUM CHROMATE	BLOOD VOLUME DETERMINATION		120	1.07
Co-60	LABELED VITAMIN B_{12}	VITAMIN B_{12} ABSORPTION		73	0.63
I-131	LABELED FATS	FATS MALABSORPTION		48	0.41
Cr-51	SODIUM CHROMATE	RBC SURVIVAL		117	1.01
Fe-59	CHLORIDE OR CITRATE	IRON TURNOVER		130	1.12
I-131	LABELED ALBUMIN	CARDIAC OUTPUT		34	0.29
I-131	ROSE BENGAL	HEPATIC FUNCTION		109	0.94
TOTAL			10	11,513	100

TABLE 3 NM

PRINCIPAL NUCLEAR MEDICAL SCANNING PROCEDURES PERFORMED
Puerto Rico 1970

Procedure	Radionuclide	Compound	Physician Performing Procedures	Number of Patients	Per Cent
Thyroid Scanning	I-131	Sodium Iodide		2,536	38.30
Brain Scanning	Tc-99m	Pertechnetate		1,208	18.24
Liver Scanning	Au-198	Colloidal Gold		629	9.50
Brain Scanning	Hg-203	Labeled Mercurials		8	0.12
Lung Scanning	I-131	Labeled Albumin		480	7.24
Liver Scanning	I-131	Rose Bengal		147	2.22
Brain Scanning	Hg-197	Labeled Mercurial		63	0.95
Kidney Scanning	Hg-203	Labeled Mercurial		92	1.38
Kidney Scanning	Hg-197	Labeled Mercurial		223	3.36
Bone Scanning	Sr-85	Nitrate or Chloride		189	2.85
Liver Scanning	Tc-99m	Technetium Sulfur Colloid		347	5.24
Placenta Scanning	I-131	Labeled Albumin		16	0.24
Brain Scanning	I-131	Labeled Albumin		256	3.86
Kidney Scanning	I-131	Sodium iodohippurate		62	0.93
Spleen Scanning	Cr-51	Heat Treated R.B.C.		5	0.07
Thyroid Scanning	I-125	Sodium Iodide		14	0.29
Heart Scanning	I-131	Labeled Albumin		8	0.12
Bone Scanning	Sr-87m	Nitrate or Chloride		30	0.45
Spleen Scanning	Hg-197	Mercurihydroxypropane		278	4.17
Thyroid Scanning	Tc-99m	Pertechnetate		10	0.12
Lung Scanning	Tc-99m	Labeled Albumin		50	0.72
TOTAL			8	6,651	100.00

Table NM 4 shows the brain scanning procedures by radionuclides.

TABLE NM 4

Brain Scanning Procedures by Type of Radionuclides Used
Puerto Rico 1970

Type of Procedure	Number of Procedures Performed	Percentage of Procedures Performed	Radionuclides Used
Brain Scanning	1,208	78.7%	Tc-99m
Brain Scanning	256	16.7%	I-131
Brain Scanning	63	4.1%	Hg-197
Brain Scanning	8	.5%	Hg-203
TOTAL	1,535	100.0%	

Relative frequency of organ scanning is given in Table NM 5.

TABLE NM 5

Relative Frequency of Organ Scanning
Puerto Rico 1970

Organ	Per Cent
Thyroid	38.74
Brain	23.17
Liver	16.96
Kidney	5.67
Lung	7.99
Other	7.47
Total	100.00

Table NM 6 gives the breakdown of pharmaceutical therapy procedures performed in Puerto Rico in 1970.

TABLE NM 6

Principal Radiopharmaceutical Therapy Procedures Performed Puerto Rico 1970

Treatment	Radio Nuclide	Compound	Number of Patients	Per Cent
Hyperthyroidism	I-131	Sodium Iodide	180	91.83
Thyroid Cancer	I-131	Sodium Iodide	11	5.68
Leukemia	P-32	Soluble Phosphate	4	2.44
Malignant Effusions	Au-198	Colloidal Gold	1	0.05
TOTAL			196	100.00

Four various procedures in radiopharmaceutical therapy were used in Puerto Rico in 1970. The number of administrations of I-131 for therapeutic uses was 180, or 97% of all therapeutic treatment. 92% of all therapeutic procedures was for hyperthyroidism.

The Clinical Radioisotope Applications Division offers a basic course in clinical applications of radioisotopes twice annually for physicians and other medical personnel and a nuclear medicine orientation course for medical technologists.

TABLE 7-NM

NUMBER OF TRAINEES IN THE CLINICAL APPLICATIONS DIVISION - PRNC
BY TYPE OF TRAINEE, COUNTRY OF ORIGIN AND YEAR OF TRAINING
PUERTO RICO

Year	Type of Trainees	Yearly No. of Trainees	Country of Origin	Number of Trainees	Total No. of Trainees
1968	Physicians (M.D.)	5	Argentina	1	
			Bolivia	1	
			Dominican Rep.	3	
	Medical Technicians	2	Ecuador	1	
			Venezuela	1	
	Medical Technologists	43	Puerto Rico	43	50
1969	Physicians (M.D.)	7	Paraguay	1	
	Medical Technicians	4	Argentina	1	
			Uruguay	1	
			Spain	1	
			Puerto Rico	7	
	Medical Technologists	51	Dominican Rep.	1	
			Puerto Rico	50	62
1970	Physicians (M.D.)	8	Greece	1	
	Medical Technicians	4	Ecuador	4	
			Argentina	1	
			Bolivia	1	
			Venezuela	1	
			Dominican Rep.	1	
			Puerto Rico	3	12
1971	Physicians (M.D.)	5	Peru	1	
	Medical Technicians	2	Columbia	1	
			Bolivia	1	
			Costa Rica	1	
			Honduras	1	
			Puerto Rico	2	
	Medical Technologists	49	Puerto Rico	49	54
GRAND TOTAL					178