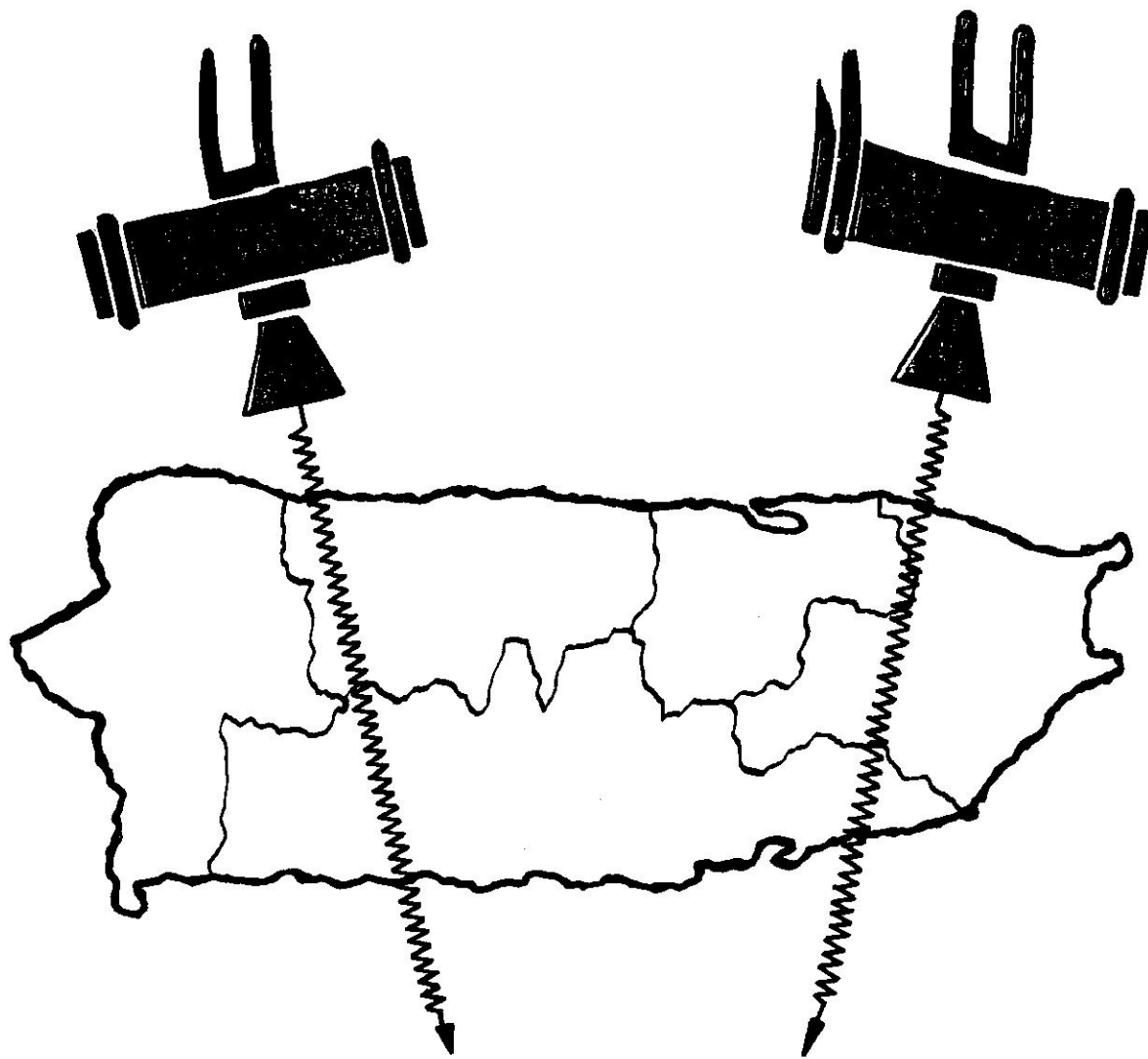


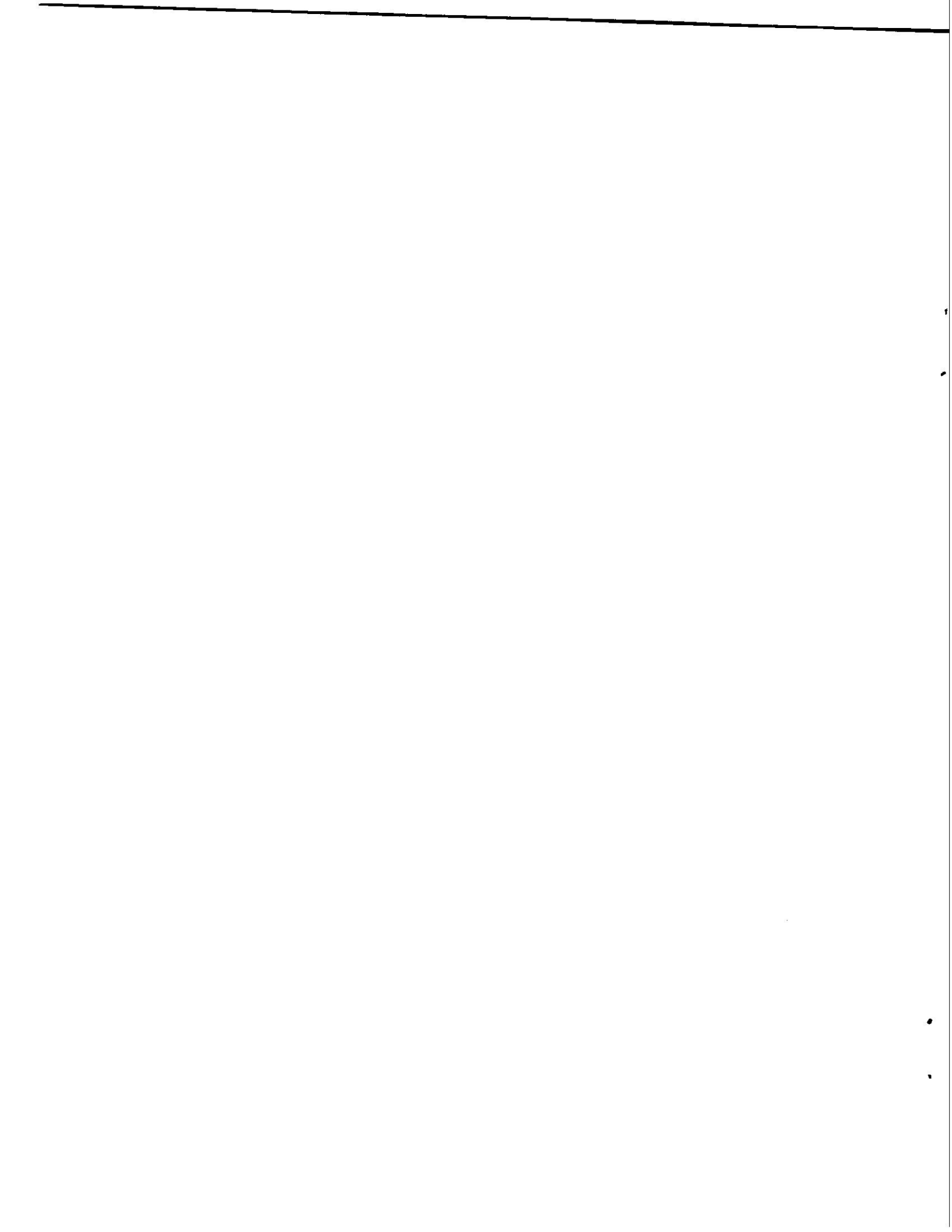
# JOINT RADIATION SURVEY



COMMONWEALTH OF PUERTO RICO

NUCLEAR CENTER  
DEPARTMENT OF HEALTH

SECOND REPORT



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

REPORT NUMBER 2 - SOUTHERN REGION  
*MICHAEL GILEADI, M.S. — RESEARCH ASSOCIATE*  
PUERTO RICO NUCLEAR CENTER  
JUNE 1970



**“It has been demonstrated that gonad doses can be reduced very decidedly with improved techniques by a factor of 50 to 100 percent”**

**—Report of the United Nations,  
General Assembly, New York, 1958.**



Dr. Ernesto Colón Yordán, Secretary of Health of Puerto Rico (second from right) receives the first report of the Joint Radiation Survey from its author, Michael Gileadi, a senior associate with PRNC. At far left is Deputy Secretary of Health, Dr. Carlos Náter and far right is Dr. Henry S. Gomberg, Director of the Pinellas Nuclear Center.

### ACKNOWLEDGEMENTS

The author wishes to express his appreciation for the assistance in the preparation of this second report to:

Dr. Angel A. Colón-Olivieri, Assistant Secretary for Environmental Health and Consumer Protection, for his warm attitude and encouragement in this project.

Mr. Modesto Reyes-Reyes, Environmental Health Supervisor, Southern Health District of Puerto Rico, for his devoted and valuable cooperation in collecting certain data.

Dr. Ramberto Pérez-Ribier, Radiologist; Mrs. Zoila Rosario Iglesias, Chief X-ray Technician; and the Administrative Staff of the Ponce District Hospital for their assistance in permitting the author to use their equipment for dose measurements.





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## INTRODUCTION

The present paper is the second partial report in the framework of an island-wide X-ray Survey Project. Its primary objective is to evaluate the health hazards caused by unintentional irradiation of the gonads of male and female patients of a specially selected group undergoing routine diagnostic X-ray examinations.

The first report surveyed the Western Region, while this second report deals with the same problem in the Southern Region of Puerto Rico-1968.

In the first report, the per capita annual gonadal dose (associated with the above mentioned selected group undergoing diagnostic X-ray procedures) was used as a quantitative measure to describe the magnitude of the health hazard involved. The present paper shows besides the per capita annual gonadal dose, the so called genetically significant dose as the relevant index. This index characterizes the magnitude of the health hazard to the next generation due to unintentional irradiation of the parent-generation, and is used in Puerto Rico for the first time.

The genetically significant dose associated with diagnostic procedure is the average of the mean gonadal dose per patient, weighted by the total expected number of children to all the irradiated patients, and then divided by the total expected number of children in the subsequent generation.

This index is important because the irradiation dose delivered to the gonads of the parent presents a potential hazard to all future offspring.

It should be kept in mind that irradiated genetic material may endanger the health of future generations long after the death of the irradiated parent.

Thus, the importance of keeping the unintentional gonadal doses as low as compatible with the diagnostic purpose, merits great emphasis. Exposure during diagnostic X-ray procedures are the most significant of all exposures from man-made radiation sources.

We learn from the present report that, using eighty three X-ray units, 217,732 examinations were performed in the Southern Region of Puerto Rico in 1968. The number of exposures for abdominal examinations was 161,628 and the number of thoracical exposures was 107,040. This means that from a population of 493,500, the number of abdominal and thoracical exposures reached 268,996. These figures illustrate the significance of the problem.

While radiation exposure of the patient in radiological practice depends upon several technical and physical factors, the major reasons contributing to population exposure are:

- 1) Using equipment that fails to meet up-to-date safety specifications.
- 2) Employment of inadequately trained personnel for operating X-ray units, which is particularly hazardous when more advanced techniques are used.

These shortcomings are more frequent in private offices than in public institutions, where we seldom find unlicensed X-ray operators.

In order to keep unintentional irradiation to an absolute minimum, it is imperative to upgrade the education of X-ray technicians. An academic degree would be most desirable. This upgrading should take place through all means at our disposal: continuing education, special courses in radiation protection, familiarization with the professional literature and, in general, all means conducive to the objective of optimum diagnostic safety per unit of radiation exposure of patient and personnel.

*One of the interesting results of the present report points to the fact that although the number of X-ray examinations per 100 patients is higher in the Southern Region than the corresponding figure for the Western Region 1967-68 (40.6 vs. 34.1) the per capita gonadal dose in the Southern Region in 1968 is lower than the corresponding figure in the Western Region in 1968 (43.6 vs 56.4). This points to technically sounder radiological practices in the Southern Region due, at least in part, to the generally higher industrial and technical level of that geographic region.*

*It is certainly hoped that in the future close collaboration between the Department of Health and the Puerto Rico Nuclear Center will be of great benefit to the future population of this island. Since the Department of Health recognizes the important role of radiation protection for the well-being of the population of the island, present and future generations included, a new related project was approved to survey Puerto Rico's dental units. This survey will be done in cooperation with the School of Dentistry and the University of Puerto Rico. It is hoped that its results will complete the survey of the island's diagnostic X-ray units.*



Ernesto Colón Yordán, M. D.  
Secretary of Health

## SUMMARY

Per capita annual gonadal doses, as well as genetically significant doses associated with a selected group of abdominal and thoracical X-ray diagnostics in the Southern Region of Puerto Rico during 1968, have been determined and are reported herewith. Similar indicators referring to the Western Region of Puerto Rico have been updated in order to make comparisons more meaningful. Some of the most important results of the survey are summarized below and compared with available 1967 data.

	REGION AND YEAR OF REFERENCE		
	S.R.-1968 Pop. 493,500	W.R.-1968 Pop. 420,200	W.R.-1967 Pop. 415,400
Mean gonadal dose per abdominal X-ray diagnostic examination	443.6 mrad	424.8 mrad	422.8 mrad
Mean gonadal dose per thoracical X-ray diagnostic examination	1.04 mrad	1.14 mrad	*
Per capita per annum gonadal dose due to abdominal X-ray diagnostic examination	43.6 mrad	56.4 mrad	48.3 mrad
Per capita per annum gonadal dose due to thoracical X-ray diagnostic examination	.25 mrad	.26 mrad	*
GSD due to diagnostic abdominal X-ray examination	36.2 mrad per offspring	48.4 mrad per offspring	*
GSD due to thoracical X-ray examination	.2 mrad per offspring	.2 mrad per offspring	*

\* Values that were not evaluated in the 1967 survey.

These results indicate that, generally speaking, the genetic hazard due to thoracical examinations is negligible as compared to the hazard caused by abdominal X-ray diagnostics. The results point to the imperative need for accurate collimation and shielding to reduce the gonadal dose to the minimum compatible with reliable diagnosis.

Further relevant data and results are enumerated below:

	REGION AND YEAR OF REFERENCE	
	S.R.-1968 Pop. 493,500	W.R.-1968 Pop. 420,200
Number of diagnostic X-ray units (excluding dental X-ray units)	83	78
Total number of abdominal X-ray diagnostic examinations termed "genetically hazardous"	48,586	55,364
Total number of thoracical X-ray diagnostic examinations	105,576	97,258
Number of X-ray diagnostic exam- inations in public institutions	164,370	151,153
Total number of X-ray diagnostic examinations	217,732	215,197
Population per X-ray unit	5,945	5,387
Number of X-ray examinations per 100 patients	37.4	34.1
Per capita annual gonadal dose (mrads)	43.6	56.4

While in the previous report the dose evaluation was based on phantom measurements only, dose determination in the Southern Region, 1968, included both measurements using a phantom, and measurements in vivo. This furnishes a more realistic evaluation than one based on phantom measurements only.

GSD evaluations are—to the author's knowledge—the first ones made in Puerto Rico. The expected number of future offspring per parent by age and sex groups has been evaluated specifically for this purpose, using data provided by the Division of Vital Statistics of the Department of Health, P.R.

The status of X-ray technicians (operators) in Puerto Rico and its relevance to the amount of radiation unintentionally received by the patients is discussed in the appendix.

## SCOPE

The scope of the present report has been extended beyond the topics treated in the first partial report.

The genetically significant dose is an important addition since this is a meaningful quantitative parameter indicative of irradiation hazards. The inclusion of "in vivo" dose measurement is a further significant improvement.

To obtain more meaningful values of the genetically significant dose (GSD), gonadal doses associated with thoracical examinations have been included.

To implement the scope of work described above it was necessary to:

- 1). Collect the relevant statistical data, including: the number and distribution of X-ray units and their characteristic parameters; the number of thoracical and abdominal X-ray examinations performed by each unit during a specified time interval by type of examination, age and sex of patient, geographic location, etc.
- 2). Measure the unintentional irradiation dose associated with each type of diagnostic X-ray examination considered, taking into account differences in the dose due to the use of different X-ray units, different collimation and/or filtration as well as differences in the technique of positioning.
- 3). Establish correlation of dose data measured in vivo on the one hand and on a Rando Phantom on the other. Several popular models of X-ray tubes were used in this procedure in order to assess the relevance of hazards evaluations based on phantom data.
- 4). Evaluate from the measure data
  - a. the average annual per capita gonadal dose,
  - b. the genetically significant dose using demographic data published by the Government of Puerto Rico.

In order to execute each of the above mentioned operations, appropriate procedures were developed and followed.

**COLLECTION AND ANALYSIS OF STATISTICAL DATA**  
**Southern Region, Puerto Rico—1968**

Statistical data was collected and analyzed in the Southern Region of Puerto Rico in a similar manner as in the Western Region, following the Planning Board System.

Table 1-S shows the municipalities of the Southern Region and their respective populations.

The names and addresses of all medical facilities were taken from the Medical Directory of Puerto Rico—1968.

The required data were collected by sending a detailed questionnaire and cover letter to each medical facility and private medical office in the Southern Region that operated one or more diagnostic X-ray units.

Copies of the new improved sample questionnaires are part of this report. The new questionnaires facilitate automatic data processing, as planned for future surveys.

The presence of the Health Department among the sponsoring agencies, and the active support of the project by the Deputy Secretary of Health, improved the response of the private medical offices significantly. Long-distance telephone calls and personal visits were nevertheless necessary to complete the required data.

Some of the difficulties encountered in data collection stemmed from the fact that the Southern Region of Puerto Rico is larger in area, and more mountainous than the Western Region. A copy of the sample questionnaire along with a copy of the cover letter signed by the Subsecretary of Health is included in this report.

Unlike the procedure followed in the previous report, diagnostic chest X-rays were included in the present survey in order to make the average gonadal dose, as well as the genetically significant dose values, more meaningful.

The cover letter of Undersecretary of Health Sr. Carlos Nater, and a sample questionnaire, are shown on the following pages.






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.

**X-RAY RADIATION SURVEY - 1968 — QUESTIONNAIRE - NO. 1**

1) NAME OF FACILITY		2) TELEPHONE																	
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**X- RAY RADIATION SURVEY - 1968 - QUESTIONNAIRE - 2**

1) NAME OF FACILITY	2) TELEPHONE
3) LOCATION (CITY, STREET & NUMBER, ZIP CODE)	4) DATE (MO., DAY, YR.)

5) AVERAGE NUMBER OF DIAGNOSTIC X-RAY EXAMINATIONS PER WEEK - 1968

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BREAK DOWN BY SEX AND AGE

AGE	SEX		TOTAL
	MALE	FEMALE	
0-14			
15-29			
30-44			
45-64			
TOTAL			

6) AVERAGE NUMBER OF THORACICAL DIAGNOSTIC X-RAY EXAMINATIONS PER WEEK - 1968.

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BREAK DOWN BY SEX AND AGE

KVP

--	--	--

MAS

--	--	--

TPD - CM

--	--	--

AGE	SEX		TOTAL
	MALE	FEMALE	
0-14			
15-29			
30-44			
45-64			
TOTAL			

7) AVERAGE NUMBER OF ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS PER WEEK - 1968

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BREAK DOWN BY TYPE OF EXAMINATION, AGE AND SEX

	KVP	MAS	TPD CM	TOTAL		0-14		15-29		30-44	
				M	F	M	F	M	F	M	F
				ABDOMEN							
CHOLECYST											
LUMBAR SP											
G. INT. SER											
BARIUM E.											
IVP											
PELVIS											
HIP JOINT											
PELVIM.											
TOTAL											

**X-RAY RADIATION SURVEY - 1968 QUESTIONNAIRE - 3**

**RADIOGRAPHIC**

1) NAME OF FACILITY	2) TELEPHONE										
3) LOCATION (CITY, STREET & NUMBER, ZIP CODE)	4) DATE (MO., DAY, YR) <table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
5) EQUIPMENT IDENTIFICATION											
g) SERIAL NUMBER OF RADIOGRAPHIC MACHINE	<table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
b) CONTROL PANEL MODEL AND MAKE	_____										
c) TUBE MODEL AND MAKE	_____										
d) COMBINATION	YES _____ NO _____										
e) TYPE	1. FIXED RADIOGRAPHIC (INDICATE SPECIAL TYPE) 2. PHOTOFLUOROGRAPHIC 3. MOBILE 4. OTHER (SPECIFY)										
f) NUMBER OF TUBES	<input type="checkbox"/> g) MAX. KVP <table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table> h) MA <table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
6) FILTRATION - MM AL	d) TOTAL <table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table> b) INHERENT <table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
7) a. AVERAGE NUMBER OF PATIENTS PER WEEK	<table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
b. AVERAGE NUMBER OF EXPOSURES PER WEEK	<table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
8) EXPOSURE SWITCH LOCATION ADEQUATE											
YES _____ NO _____											
9) TIMER ADEQUATE											
YES _____ NO _____											
10) USE OF GONADAL SHIELDING FOR PATIENTS											
YES _____ NO _____											
11) a. DARK ROOM IN PLACE	YES _____ NO _____										
b. AUTOMATIC PROCESS	YES _____ NO _____										
c. TEMPERATURE OF DEVELOPER	<table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										
d. DEVELOPING TIME (MINUTES)	<table border="1" style="float: right; border-collapse: collapse;"> <tr> <td style="width: 20px; height: 15px;"></td> <td style="width: 20px; height: 15px;"></td> </tr> </table>										

**X-RAY RADIATION SURVEY-1968 QUESTIONNAIRE- 4  
FLUOROSCOPIC**

1) NAME OF FACILITY _____		2) TELEPHONE _____															
3) LOCATION (CITY, STREET & NUMBER, ZIP CODE) _____		4) DATE (MO., DAY, YR.) <table border="1" style="float: right; text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>															
5) EQUIPMENT IDENTIFICATION _____																	
a) SERIAL NUMBER OF FLUOROSCOPIC MACHINE _____		<table border="1" style="float: right; text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>															
b) CONTROL PANEL MODEL AND MAKE _____																	
c) TUBE MODEL AND MAKE _____																	
d) COMBINATION 1. _____ YES 2. _____ NO																	
e) TYPE: 1. _____ VERTICAL 2. _____ HORIZONTAL																	
3. _____ TILTING TABLE																	
f) IMAGE INTENSIFYING DEVICE USED 1. _____ YES 2. _____ NO																	
6) ACCESSORY SHIELDING:																	
a) LEADED GLOVES 1. YES _____ 2. NO _____																	
b) LEADED APRON 1. _____ YES 2. _____ NO																	
c) LEADED DRAPES AROUND SCREEN 1. _____ YES 2. _____ NO																	
7) USUAL PROCEDURES:																	
EXAMINATION	KVP	MA	MINUTES TUBE ACTIVATED PER EXAMINATION	EXAMINATIONS PER WEEK													
GASTRO-INTEST. SERIES	<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>					<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>					<table border="1" style="text-align: center;"> <tr><td> </td><td> </td></tr> </table>			<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td></tr> </table>			
BARIUM ENEMA	<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>					<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table>					<table border="1" style="text-align: center;"> <tr><td> </td><td> </td></tr> </table>			<table border="1" style="text-align: center;"> <tr><td> </td><td> </td><td> </td></tr> </table>			
OTHER (SPECIFY)																	
8) TIMER																	
a) DEADMEN TYPE EXPOSURE SWITCH 1. _____ YES 2. _____ NO																	
b) CUMULATIVE TIMER TERMINATES EXPOSURE 1. _____ YES 2. _____ NO																	



# SOUTHERN REGION, PUERTO RICO—1968

The Southern Region includes the southern coast of the Island, with sixteen municipalities and a population of 493,500 (1968).

Ponce, the most important city of the Region, preceded only by San Juan, is a dynamic city with a promising economic, cultural and political future. Heavy industry is being developed in this area. There is a private university, three schools of nursing and the Southern Tabulating and Technology College which offers an X-ray Technicians' Course.

Ponce has a medical center with a district hospital, two private hospitals, two clinics and three anti-tuberculosis facilities (Hospital Anti-Tuberculosis, Public Health Unit and the T. B. Center). There are five municipal hospitals in the area, ten Health Centers and two private hospitals.

### LIST OF TABLES

- Table 1—S:** Municipalities of the Southern Region of Puerto Rico and their Population-1968.
- Table 2—S:** Distribution of Diagnostic X-Ray Units by Medical Facility, by Geographic Location and Population per X-Ray Unit. Southern Region, Puerto Rico-1968.
- Table 3—S:** Total Number of X-Ray Examinations in Public Institutions, Total Number of Patients and Number of X-Ray Examinations per 100 Patients. Southern Region, Puerto Rico-1968.
- Table 4—S:** Distribution of Diagnostic X-Ray Units by Medical Facility and by Manufacturer. Southern Region, Puerto Rico-1968.
- Table 5—S:** Census of Diagnostic X-Ray Units. Southern Region, Puerto Rico-1968.
- Table 6—S:** Number of Abdominal X-Ray Diagnostic Examinations by Medical Facility, by the Type of Examination and by Sex. Southern Region, Puerto Rico-1968.
- Table 7—S:** Number of Diagnostic Thoracical X-Ray Examinations by Geographic Location, Medical Facility and Sex. Southern Region, Puerto Rico-1968.
- Table 8—S:** Total Number of Diagnostic Thoracical and Abdominal X-Ray Examinations. Southern Region, Puerto Rico-1968.
- Table 9—S:** Number of Abdominal X-Ray Examinations by Type of Facility and by Type of Examination. Southern Region, Puerto Rico-1968.
- Table 10—S:** Number of Films Exposed (Exposures) in Abdominal Radiographic Examinations, by Type of Facility and by Type of Examination. Southern Region, Puerto Rico-1968.
- Table 11—S:** Number of Films Exposed (Exposures) in Radiographic Examinations of the Abdomen and Thorax, by Type of Facility. Southern Region, Puerto Rico-1968.
- Table 12—S:** Number of Exposed Films (Exposures) of Abdomen and Thorax X-Ray Examinations, by Type of Examination and by Sex. Southern Region, Puerto Rico-1968.
- Table 13—S:** Supervision by Radiologists. Southern Region, Puerto Rico-1968.



TABLE I-S  
MUNICIPALITIES OF THE SOUTHERN REGION OF PUERTO RICO AND THEIR POPULATION — 1968.<sup>1)</sup>

MUNICIPALITIES	POPULATION
ADJUNTAS	19,800
ARROYO	15,200
COAMO	29,200
GUANICA	17,400
GUAYAMA	41,100
GUAYANILLA	19,000
JAYUYA	16,200
JUANA DIAZ	34,700
MAUNABO	10,600
PATILLAS	20,400
PEÑUELAS	16,500
PONCE	162,300
SALINAS	26,800
SANTA ISABEL	15,400
VILLALBA	17,100
YAUCO	31,800
TOTAL POPULATION SOUTHERN REGION	493,500

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

TABLE 2-S  
 DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS BY MEDICAL FACILITY BY GEOGRAPHIC LOCATION  
 AND POPULATION PER X-RAY UNIT.  
 SOUTHERN REGION, PUERTO RICO - 1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X RAY UNIT
ADJUNTAS	HEALTH CENTER	-	19,800	19,800
	PRIVATE OFFICES	1		
ARROYO	HOSPITAL LAFAYETTE	3	15,200	5,666
	HOSPITAL MUNICIPAL	-		
COAMO	HEALTH CENTER	2		
	PRIVATE OFFICES	1		
COAMO TOTAL		3	29,200	9,766
GUANICA	MUNICIPAL HOSPITAL	1	17,900	17,900
	CENTRAL GUANICA HOSPITAL	-		
GUAYAMA	HEALTH CENTER	3		
	HOSPITAL SANTA ROSA	2		
	PRIVATE OFFICES	3		
GUAYAMA TOTAL		8	41,100	5,871
GUAYANILLA	HEALTH CENTER	1	19,000	19,000
	PRIVATE OFFICES	-		
JAYUYA	HEALTH CENTER	2	16,200	8,100
	PRIVATE OFFICES	-		
JUANA DIAZ	HEALTH CENTER	1 (TEMPORARILY NOT IN USE)		
	PRIVATE OFFICES	2		
JUANA DIAZ TOTAL		3	34,700	11,366

TABLE 2-S (CONT.)  
 DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS BY MEDICAL FACILITY BY GEOGRAPHIC LOCATION,  
 AND POPULATION PER X-RAY UNIT  
 SOUTHERN REGION, PUERTO RICO - 1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF X-RAY UNITS	POPULATION	POPULATION PER X-RAY UNIT
MAUNABO	MUNICIPAL HOSPITAL	-	10,600	-
PATILLAS	HEALTH CENTER	-	20,400	-
PEÑUELAS	HEALTH CENTER	1	16,500	16,500
PONCE	DISTRICT HOSPITAL	15		
	HOSPITAL DE DAMAS	4		
	CLINICA DR. PILA	6		
	CLINICA ONCOLOGICA	1		
	HOSPITAL MUNICIPAL	3		
	ST. LUCAS EPISCOPAL HOSPITAL	5		
	HOSPITAL ANTI-TUBERCULOSIS AND T.B. HEALTH CENTER	2		
PUBLIC HEALTH UNIT	1			
FONDO DEL SEGURO DE ESTADO	1			
PRIVATE OFFICES	17			
PONCE TOTAL		55	162,300	2,956
SALINAS	PUBLIC HEALTH UNIT	1		
	HOSPITAL MUNICIPAL	-	26,800	26,800
SANTA ISABEL	PUBLIC HEALTH UNIT	-		
	HOSPITAL MUNICIPAL	1	15,400	15,400
VILLALBA	HEALTH CENTER	-	17,100	-
	PUBLIC HEALTH UNIT	1		
YAUCO	HOSPITAL MUNICIPAL	2		
	PRIVATE OFFICES	-		
YAUCO TOTAL		3	31,800	10,600
SOUTHERN REGION TOTAL		83	493,500	5,824

TABLE 3-S  
 TOTAL NUMBER OF X-RAY EXAMINATIONS IN PUBLIC INSTITUTIONS, TOTAL NUMBER OF PATIENTS,  
 AND NUMBER OF X-RAY EXAMINATIONS PER 100 PATIENTS.

SOUTHERN REGION, PUERTO RICO—1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMS <sup>(1)</sup>	NUMBER OF X-RAY EXAMS PER 100 PATIENTS
ADJUNTAS	HEALTH CENTER	47,948	—	—
ARROYO	HOSP. LAFAYETTE		4,888	27.6
COAMO	HEALTH CENTER	33,406	5,720 <sup>(1)</sup>	17.1
GUANICA	CENTRAL GUANICA HOSPITAL	13,548	988	7.3
GUAYAMA	HEALTH CENTER	60,134	16,380 <sup>(2)</sup>	27.2
	CLINICA SANTA ROSA	6,428	1,721	26.7
GUAYAMA TOTAL		66,562	18,101	27.2
GUAYANILLA	HEALTH CENTER	37,166	—	—
JAYUYA	HEALTH CENTER	35,874	—	—
JUANA DIAZ	HEALTH CENTER	23,347	2,972	10.8
MAUNABO	HEALTH CENTER	2,172	—	—
PATILLAS	HEALTH CENTER	1,515	—	—
PEÑUELAS	HEALTH CENTER	11,696	—	—
PONCE	DISTRICT HOSPITAL	69,022	33,126	47.9
	HOSPITAL DE DAMAS	13,853	12,540	90.5
	CLINICA DR. PILA	14,999	9,216	61.4
	CLINICA ONCOLOGICA	6,200	3,701	59.6
	FONDO DEL SEGURO DEL ESTADO	25,908	18,000	69.4
	HOSPITAL MUNICIPAL	20,073	13,428	66.8
	ST. LUCAS EPISCOPAL HOSPITAL	10,294	3,324 <sup>(3)</sup>	31.3
	HOSPITAL ANTI-TUBERCULOSIS	1,590	1,598 <sup>(4)</sup>	100.5
	PUBLIC HEALTH UNIT	18,929	18,929 <sup>(4)</sup>	100.0
	TB. CENTER	676	676	100.0
PONCE TOTAL		181,544	84,628	40.6

CONTINUED ON FOLLOWING PAGE

TABLE 3 - S (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL NUMBER OF PATIENTS	TOTAL NUMBER OF X-RAY EXAMS.	AVERAGE NO. OF X-RAY EXAM PER 100 PATIENTS
SALINAS	MUNICIPAL HOSPITAL	30,259	2,474	8.1
SANTA ISABEL	MUNICIPAL HOSPITAL	35,258	2,145	6.0
VILLALBA	HEALTH CENTER	21,378	---	---
YAUCO	PUBLIC HEALTH UNIT	21,746	10,452	48.0
GRAND TOTAL		581,107	164,370	28.2

● TOTAL NUMBER INCLUDES ADMISSIONS AND OUTPATIENTS

- 1) INCLUDED 3,626 PHOTOFUOROGRAPHS
- 2) INCLUDED 6,872 PHOTOFUOROGRAPHS
- 3) INCLUDED 208 TOMOGRAPHIES
- 4) INCLUDED 18,063 PHOTOFUOROGRAPHS
- 5) INCLUDED 8,212 PHOTOFUOROGRAPHS

TABLE 4-S  
DISTRIBUTION OF DIAGNOSTIC X-RAY UNITS BY MEDICAL FACILITY AND BY MANUFACTURER.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER	GENERAL ELECTRIC	WESTINGHOUSE	UNIVERSAL	PROFEX-RAY	STANDARD	MATTERN	SIEMENS	ACOMA & TANKA	CONTINENTAL	TOTAL	
												MA	MA
ADJUNTAS	PRIVATE OFFICE		1 200										1
ARROYO	HOSPITAL LAFAYETTE		1 300 100 15 MOB.										3
			1 200 MINOGR. (ODELCA) 100										3
GUANICA	CENTRAL GUANICA HOSPITAL		1 200										1
GUAYAMA	HEALTH CENTER	1 80 300	1 MINOGR. (ODELCA)										8
	HOSP. SANTA ROSA	1 300 200 MOB,											
	PRIVATE OFFICE		1 15 FL. 100		1 75								
SUB-TOTAL		4	11	0	1	0	0	0	0	0	0	0	16

LEGEND  
MOB.=MOBILE UNIT  
MINOGR.=MINOGRAPHIC UNIT  
FL.=FLUOROSCOPIC UNIT

TABLE 4-S (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER		GENERAL ELECT.		WESTINGHOUSE		UNIVERSAL		PROFEX-RAY		STANDARD		MATTERN		SIEMENS		ACOMA & TANKA		CONTINENTAL		TOTAL
		MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA		
GUAYAQUIL	PRIVATE OFFICE		1	200																	1	
	NILLA																					3
JUANA DIAZ	HEALTH CENTER	1		300																		1
	PRIVATE OFFICES	1		75																		1
JAYUYA	PRIVATE OFFICE						1	60														1
	HEALTH CENTER														1	15						1
PONCE	DISTRICT HOSPITAL	6		300	2	200 (MOB)	1	200		1	300											15
	HOSPITAL	1		200						1	500											
		1		20 (MOB)	1	200																
		1		80 (MOB)																		
SUB-TOTAL	HOSPITAL DE DAMAS				1	300																4
					1	200																
					1	100																
					1	15 (MOB)																
SUB-TOTAL		12	8	2		2			2					1				1		0	26	

TABLE 4-S (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER		GENERAL ELECT.		WESTINGHOUSE		UNIVERSAL		PROFEX-RAY		STANDARD		MATTERN		SIEMENS		AGOMA & TANKA		CONTINENTAL		TOTAL	
		MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA			
PONCE CONT.	CLINICA DR. PILA		1	100	1	100																6	
			1	200		(MOB)																	
	FONDO DEL SEGURO		1	500																			1
			2	30		(MOB.)																	
	CLINICA ONCOLOGICA																						1
			1	30		(MOB.)																	
	HOSPITAL MUNICIPAL		1	15																			3
			1	300																			
	ST. LUCAS EPISCOPAL HOSPITAL			1	100	1	100																5
			1	300																			
HOSPITAL T.B.		1	1	30	1	30																2	
						(FL.)																	
PUBLIC HEALTH UNIT			1	MINOGR. (ODELCA)																		1	
		3	9																				
SUB-TOTAL		3	9	3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	19		



TABLE 4-S (CONT.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	PICKER		GENERAL ELECTRIC		WESTINGHOUSE		UNIVERSAL		PROFEX-RAY		STANDARD		MATTERN		SIEMENS		ACOMA & TANKA		CONTINENTAL		TOTAL		
		MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA	MA				
PONCE CONT.	PRIVATE OFFICES	1	300	1	200	1	300			1	300					1	500			1	100	17		
		2	200	2	300																			
		1	300	1	500																			
		1	100	1	30FL																			
				2	5FL																			
SALINAS <sup>1</sup>	HOSPITAL MUNICIPAL			1	100																	1		
SANTA ISABEL	PRIVATE OFFICE			1	100																	1		
YAUICO	PUBLIC HEALTH UNIT			1	MINOGR (ODELCA)																	3		
				2	100																			
TOTAL		5	13	1		6	7.22 %	3	3.63 %	4	4.83 %	1	1.2 %	1	1.2 %	0	0	0	0	1	1.2 %	22		
SOUTHERN REGION GRAND TOTAL		25	40																			83		
PERCENTAGE		30.12 %	48.2 %	7.22 %	3.63 %	4.83 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	1.2 %	100		

1) PRIVATE MEDICAL OFFICE WITH A DIAGNOSTIC X-RAY UNIT WAS OPENED IN SALINAS IN AUGUST, 1969.

TABLE 5-S

## CENSUS OF DIAGNOSTIC X-RAY UNITS

## SOUTHERN REGION OF PUERTO RICO-1968

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER MODEL-MAKE	MANUFACTURE OR PURCHASE YEAR	TUBES MODEL-MAKE	COLLIMATION	TOTAL FILTRATION mm Al.	COMMENTS
Adjuntas	Health Center	1 Fluoroscopy	-	-	-	-	Out of order since 1965.
	1 Private Office	G.E.-200 MA, 100 K.V.P.	1950	G.E.-L.W.R.T.	Variable Collimation	2.5	
	Public Health Unit	-	-	-	-	-	-
Arroyo	Private Office	G.E.-15MA	1940	G.E.-DX	No collimation	.5	Mobile
	Hospital Lafayette	G.E.-100MA R-2 G.E.-300 MA Aristocrat 125 K.V.P.	1949 1968	Coolidge	No collimation Variable Collimation	.5 2.5	
	Hospital Municipal	G.E. Fluoroscopy 10MA	-	-	-	-	Out of order.
Coamo	Health Center	G.E.-200 MA KX-12 100 K.V.P.	1950	G.E.-L.W.R.T.	Collimator Videx	2.5	
		Odelca-70 and G.E.-K.X.E.-25 200 K.V.	1966	G.E.-L.W.R.T.	Photo-Odelca	2.5	Mass Chest Examinations
	1 Private Office	G.E.-100MA 100 K.V.P.	1960	G.E.-L.D.X.C.	-	2	
Guanica	Central Hospital	G.E.-200MA 100 K.V.P.	1948	G.E.-L.W.R.T.	Collimator Mascot Videx	2.5	

TABLE 5-S Cont.

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER MODEL-MAKE	YEAR OF MANUFACTURE OR PURCHASE	TUBES MODEL-MAKE	COLLIMATION *	TOTAL FILTRATION mm. Al.	COMMENTS
Guayama	Health Center	Photofluorography G.E.-KXE-225-200MA 125 KVP	1966	G.E.-L.W.R.T.	Photo-Odelca	2.5	Mass Chest Examinations
		Picker-100MA 100 K.V.P. Picker-300MA 125 K.V.P.	1948 1958	PX-1B PX-10E	Var. Collimation Var. Collimation	2 2.5	
	Clinica Santa Rosa	Picker-300MA 125 K.V.P. Picker-200MA 100 K.V.P.	1958 1965	PX-10A PX-10A	Var. Collimation Var. Collimation	2.5 2.5	Mobile
		Universal 75 Ma G.E.-30MA Fluoroscopy G.E.-100MA 100 K.V.P.	1967 1950 1939	DX DX	- -	.5 1	
	Health Center	-	-	-	-	-	-
Juana Diaz	Private Office	G.E.-200MA 100 K.V.P.	1945	R-6	Collimation Videx	2.5	
	Health Center	Picker-300MA 125 K.V.P.	1958	PX-10 (2 tubes)	Variable Collimation	2.5	The unit is in good condition but not working due to lack of personnel.
	2 Private Offices	Picker-75MA Picker-100MA 100 K.V.P.	1958 1948	PX-1B	Variable Collimation Cones	2.5 1	Changed in 1969 to a new 200 with 120 K.V.P.
Jayuya	Health Center	Mattern-15MA Fluoroscopy	-	-	-	-	Out of order.
	2 Private Offices	Westinghouse 60MA Tanka 40MA 100 K.V.P.	Not available.	Not available.	Cone	.5 .5	Japanese.

\* Var. Collimation = Variable Collimation.

TABLE 5-S Cont.

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER MODEL-MAKE	YEAR OF MANUFACTURE OR PURCHASE	TUBES MODEL-MAKE	COLLIMATION	TOTAL FILTRATION mm. Al.	COMMENTS	
Maunabo	Municipal Hospital	-	-	-	-	-	-	
Patillas	Health Center	1 Standard Fluoroscopy	-	-	-	-	Out of order.	
Peñuelas	Health Center	1 Mattern Fluoroscopy	-	-	-	-	Out of order.	
Ponce	District Hospital	Picker-300MA 125 K.V.P.	1960	PX-10A 2 tubes	Var. Collimation	3	Gastro-intest.	
		Picker-300MA 125 K.V.P.	1958	PX-10A 2 tubes	" "	3	Barium enema	
		Picker-300MA 125 K.V.P.	1958	PX-18R 2 tubes	" "	3	Tomograph & Chest Routine	
		Picker-300MA 125 K.V.P.	1958	PX-10A 2 tubes	" "	3	Routine	
		Picker-300MA 120 K.V.P.	1960	PX-17 1 tube	Image Intensify.	Image Intensify.	3	Catheterization
		Picker-300MA 125 K.V.P.	1963	PX-17 2 tubes	Collimator	Collimator	2.5	Craniograph*
		Picker 20MA 90 K.V.P. Mob.	1958	PX-1B 2 tubes	Cones	Cones	.5	Operation Room.
		Picker 80MA 110 K.V.P. Mob.	1958	PX-1B	Collimator	Collimator	2.5	Mobile
		Picker 200MA 110 K.V.P. Mob.	1965	PX-10A	Collimator	Collimator	3.5	Chest
		G.E.-200MA 100 K.V.P. Mob.	1955	HRT	DX-25 Dunlee	Collimator	3	Mobile
		Profex-Ray-300MA 125 K.V.P.	-	-	L.W.R.T.	Var. Collimation	2.5	Routine
		G.E.-200MA 125 K.V.P.	1955	-	Dynamax 500	" "	2.5	I.V. Pyelogram
		Profex-Ray-500MA	1968	-	Aeromax 8	Image Intens.TV	2.5	Special exams.
		Westinghouse-200-MA 130KVP	-	-	L.W.R.T.	Var. Collimation	2	Urology
		G.E.-200MA 100 K.V.P.	1961	-	L.W.R.T.	" "	3	
Hospital de Damas		G.E.-300MA 125 K.V.P.	1954	HRT 2 tubes	Collimator Videx	3.5	Routine	
		G.E.-200MA	1945	CRT 2 tubes	Var. Collimation	2.5	I.V.P.	
		G.E.-200MA	1945	D.X.C.	Cones	2.5	Urology	
		G.E.-15MA Mobile	1940	E-1.7	-	-	.5	Mobile

Ponce continued next page.

\* Not in operation since 1966.

TABLE 5-S Cont.

GEOGRAPHIC LOCATION	NAME OF FACILITY	MANUFACTURER MODEL-MAKE	YEAR OF MANUFACTURE OR PURCHASE	TUBES MODEL-MAKE	COLLIMATION	TOTAL FILTRATION mm AL.	COMMENTS
Ponce cont.	Clinica Dr. Pila	G.E.-200MA	1961	H.R.T.	Var. Collimation	3	Routine
		G.E.-500MA 130 K.V.P.	1964	(DXC Fluor. & CRT Radiography)	"	3	I.V. Pylo.
		G.E.-100MA	1954	XX-21	Var. Collimation	.5	Urology
		2 G.E.'s-30MA Mob.	1940 (?)	E-1.7	No cone used.	.5	Two automatic working mobile units for operating room.
		Westinghouse-100MA	-	H.R.T.	Var. Collimation	2	Mobile.
		G.E.-90MA 100 K.V.P.	1961		"	2	Routine.
	Clinica Oncologica	Standard-100MA (2 Cobalt sources for therapy & Picker Maximar)	1948	SXRC 2 D.F.	Cones	2.5	In 1969, Picker 300 in new bldg.
	Fondo del Seguro	Picker-300MA 125 K.V.P.	1968 (Purchase)	PX-10E	Var. Collimation	3	Routine
	Municipal Hospital	Profex-Ray-300MA Picker-300MA 125 K.V.P. G.E.-30MA Mobile	1963 1940	DX-25 Dunlee PX-10E DX-25	Collimator Videx Var. Collimation	2 2.5	
	Hospital Episcopal St. Lucas	Westinghouse-100MA G.E.-300MA G.E.-15MA Mobile Universal-125MA Universal-200MA	1966 1961 1940 1969 1967	- H.R.T. E 1.7 UX-20H Op. Rm. Port. UX-20H	Collimator Videx Image Intensify Collimator Videx Collimator Videx	1.5 3 .5 2.5 2.5	Out of order.
	Hospital Anti-Tuberculosis	Picker-100 with Tomogr. 110 K.V.P. Westinghouse-30MA Fluor.	1953 -	PX-1B -	Variable Collimation -	3 .5	For tomography. Not in working condition.
	Public Health Unit	G.E.-200MA-Odelca KXE-225 125 K.V.P. Photofluor.	1966	H.R.T.	Photo-Odelca		Mass Chest Examinations

Ponce continued next page.

TABLE 5-S Cont.

GEOGRAPHICAL LOCATION	NAME OF FACILITY	MANUFACTURER MODEL-MAKE	YEAR OF MANUFACTURE OR PURCHASE	TUBES MODEL-MAKE	COLLIMATION	TOTAL FILTRATION mm.-Al.	COMMENTS
Ponce cont.	T.B. Center	They use the same unit as Hospital Anti-Tubercul	-	-	-	-	-
	4 Private Radiologists	G.E.-300MA KXD325	1960 Mfg.	H.R.T.	Variable Colli. Image Intens. Image Intens. Variable Colli. Variable Colli.	3.5	
		G.E.-300MA	1960 Mfg.	H.R.T.		3.5	
		G.E.-500MA 150 K.V.P.	1967	HDN		3.5	
		Siemens-500MA		Dynamax 40		3	
		G.E.-200MA 100K.V.P.	1953	Dynamax 25		3	
		Westinghouse-300MA	1965	2 tubes	2.5		
	9 Private Offices	Picker 300 MA	1968	PX-10E	Var. Collimator Var. Collimator No collimator No collimator No collimator No collimator Variable Colli. Variable Colli. Cones Cones	2.5	
		Picker 200 MA	1965	PX-10E		2.5	
		G.E.-15MA Fluoroscopy	1940	E 1.7		.5	
G.E.-90MA		1950	E 1.7	.5			
G.E.-30MA Fluoroscopy		1950	DXC	.5			
Standard-15MA Fluoroscopy		1934 Mfg.	Coolidge glass	.5			
Picker-200MA		1965	PX-10E	2.5			
G.E.-200MA		1958	L.W.R.T.	2.5			
Picker-200MA 125 K.V.P.		1968	PX-10E	3		Automatic	
Picker-100MA 100 K.V.P.		1956	PX-8E	2			
	Continental-100MA	1949	Eureka Type II	4			
Salinas	Municipal Hospital	G.E.-100MA 85 K.V.P.	1940 (Installed)	DX	Collimator Videx	2.5	
	Private Office	G.E.-100MA 100 K.V.P.	"	LDXC	No collimator	.5	
Santa Isabel	P. Health Unit	-	-	-	-	-	
	Municipal Hospital	-	-	-	-	-	
Villalba	Private Off.	G.E.-100MA 100 K.V.P.	1959	L.D.X.	-	2.5	
	Health Ctr.	Fluoroscope	-	-	-	-	Out of order.
Yauco	Public Health Unit	G.E.-200-Odelca 125 KVP Photofl.	1966	H.R.T.	-	3	Mass chest Examinations.
	2 Private Offices	G.E.-100MA Auto. KVP G.E.-200MA 100 K.V.P.	1940 1958	DX L.W.R.T.	1 cone 7.5x10" cone	2 2.5	

TABLE 6-S

NUMBER OF ABDOMINAL X-RAY DIAGNOSTIC EXAMINATIONS BY MEDICAL FACILITY, BY TYPE OF EXAMINATION AND BY SEX. SOUTHERN REGION, PUERTO RICO—1968

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL X-RAY EXAMINATIONS	SEX	TYPE OF ABDOMINAL EXAMINATION										TOTAL				
				ABDOMEN	CHOLECYSTOGRAPHY	LUMBAR SPINE	GASTRO-INTESTINAL SERIES	BARIUM ENEMA	I. V. P.	PELVIS	HIP JOINT	PELVIMETRY						
ADJUNTAS	I PRIVATE OFFICE	2,184	MALE	208	—	—	—	—	—	—	—	—	—	—	—	—	208	
			FEMALE	156	—	—	—	—	—	—	—	—	—	—	—	—	—	156
			TOTAL	364	—	—	—	—	—	—	—	—	—	—	—	—	—	364
ARROYO	HOSPITAL LAFAYETTE	4,888	MALE	66	—	25	—	—	—	66	—	—	—	—	—	—	157	
			FEMALE	142	—	20	—	—	50	—	—	—	—	—	—	—	—	212
			TOTAL	208	—	45	—	—	116	—	—	—	—	—	—	—	—	369
COAMO	HEALTH CENTER	5,720	MALE	8	14	30	40	—	—	16	—	—	—	—	—	—	108	
			FEMALE	40	40	22	30	—	32	—	—	—	—	—	—	—	—	164
			TOTAL	48	54	52	70	—	48	—	—	—	—	—	—	—	—	272
COAMO TOTAL	I PRIVATE OFFICE	4,225	MALE	208	—	156	208	—	—	—	—	—	—	—	—	—	780	
			FEMALE	312	520	312	416	—	—	260	—	—	—	—	—	—	—	2,132
			TOTAL	520	520	468	624	—	—	260	—	—	—	—	—	—	—	2,912
COAMO TOTAL	CENTRAL GUANICA HOSPITAL	9,945	MALE	216	14	186	248	—	—	16	—	—	—	—	—	—	888	
			FEMALE	352	560	334	446	—	—	32	260	—	—	—	—	—	—	2,296
			TOTAL	568	574	520	694	—	—	48	260	—	—	—	—	—	—	3,184
GUANICA	HEALTH CENTER	16,380	MALE	102	21	—	42	—	—	14	—	—	—	—	—	—	179	
			FEMALE	82	10	—	28	—	6	—	—	—	—	—	—	—	—	126
			TOTAL	184	31	—	70	—	20	—	—	—	—	—	—	—	—	305
GUAYAMA	HEALTH CENTER	16,380	MALE	195	65	364	167	13	121	332	—	—	—	—	—	—	1,413	
			FEMALE	377	208	338	184	91	117	352	234	—	—	—	—	—	—	5,914
			TOTAL	572	273	702	351	104	238	684	390	—	—	—	—	—	—	3,327

TABLE-6-S CONT.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL X-RAY EXAMINATIONS	SEX	TYPE OF ABDOMINAL EXAMINATION										TOTAL			
				ABDOMEN	CHOLE — CYSTO — GRAPHY	LUMBAR SPINE	GASTRO — INTESTINAL SERIES	BARIUM ENEMA	I.V.P.	PELVIS	HIP JOINT	PELVI — METRY					
GUAYAMA (CONT.)	CLINICA SANTA ROSA	1,721	MALE	156	52	—	91	—	—	52	—	—	—	—	—	351	
			FEMALE	156	104	52	104	13	104	13	—	—	—	—	—	—	546
			TOTAL	312	156	52	195	13	156	13	—	—	—	—	—	—	897
2 PRIVATE OFFICES		1,217	MALE	156	—	178	—	—	—	—	—	—	—	—	—	334	
			FEMALE	108	—	52	—	—	—	—	—	—	—	—	—	—	160
			TOTAL	264	—	230	—	—	—	—	—	—	—	—	—	—	494
GUAYAMA TOTAL		19,318	MALE	507	117	542	258	13	173	332	156	—	—	—	—	2,098	
			FEMALE	641	312	442	288	104	221	365	234	13	—	—	—	—	2,620
			TOTAL	1,148	429	984	546	117	394	697	390	13	—	—	—	—	4,718
GUAYANILLA	1 PRIVATE OFFICE	4,030	MALE	290	112	270	90	—	66	232	—	—	—	—	—	1,060	
			FEMALE	230	200	250	66	—	124	150	—	—	—	—	—	—	1,020
			TOTAL	520	312	520	156	—	190	382	—	—	—	—	—	—	2,080
JAYUYA	1 PRIVATE OFFICE	390	MALE	7	—	—	—	—	—	—	—	—	—	—	—	7	
			FEMALE	16	—	—	—	—	—	—	—	—	—	—	—	—	16
			TOTAL	23	—	—	—	—	—	—	—	—	—	—	—	—	23
JUANA DIAZ	HEALTH CENTER	2,972	MALE	35	5	45	85	—	—	—	—	—	—	—	—	170	
			FEMALE	80	15	30	60	5	—	—	—	—	—	—	—	—	210
			TOTAL	115	20	75	145	5	—	—	—	—	—	—	—	—	380
2 PRIVATE OFFICES		4,225	MALE	260	—	364	—	—	—	—	—	—	—	—	—	624	
			FEMALE	936	—	—	52	—	104	—	—	—	—	—	—	—	1,092
			TOTAL	1,196	—	364	52	—	104	—	—	—	—	—	—	—	1,716



TABLE 6--S CONT.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL X-RAY EXAMINATIONS	SEX	TYPE OF ABDOMINAL EXAMINATION								TOTAL		
				ABDOMEN	CHOLE -- CYSTO -- GRAPHY	LUMBAR SPINE	GASTRO -- INTESTINAL SERIES	BARIUM ENEMA	I. V. P.	PELVIS	HIP JOINT		PELVI -- METRY	
JUANA DIAZ (CONT.) TOTAL		7,197	MALE	295	5	409	85	--	--	--	--	--	794	
			FEMALE	1,016	15	30	112	5	104	--	--	20	1,302	
			TOTAL	1,311	20	439	197	5	104	--	--	20	2,096	
MAUNABO		--		--	--	--	--	--	--	--	--	--		
PATILLAS		--		--	--	--	--	--	--	--	--	--		
PENUELAS		--		--	--	--	--	--	--	--	--	--		
PONCE	DISTRICT HOSPITAL	3,326	MALE	1,203	639	1,258	1,330	153	376	80	137	--	5,176	
			FEMALE	1,298	926	618	1,771	307	414	94	110	79	--	5,617
			TOTAL	2,501	1,565	1,876	3,101	460	790	174	247	79	--	10,793
HOSPITAL DE DAMAS		1,2540	MALE	208	--	52	104	--	156	--	--	--	520	
			FEMALE	312	156	260	312	104	104	--	--	60	--	1,308
			TOTAL	520	156	312	416	104	260	--	--	60	--	1,828
CLINICA DR. PILA		9,216	MALE	13	52	365	208	180	230	195	156	--	1,399	
			FEMALE	286	246	296	439	156	224	117	39	22	--	1,825
			TOTAL	299	298	661	647	336	454	312	195	22	--	3,224
CLINICA ONCOLOGICA		3,701	MALE	52	52	156	104	--	--	--	104	--	468	
			FEMALE	104	--	--	104	--	52	156	104	--	--	520
			TOTAL	156	52	156	208	--	52	156	208	--	--	988

TABLE 6-S CONT.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	TOTAL X-RAY EXAMINATIONS	SEX	TYPE OF ABDOMINAL EXAMINATION										TOTAL			
				ABDOMEN	CHOLE—CYSTO—GRAPHY	LUMBAR SPINE	GASTRO—INTESTINAL SERIES	BARIUM ENEMA	I.V.P.	PELVIS	HIP JOINT	PELM—METRY	TOTAL				
PONCE CONT.	FONDO DEL SEGURO	18,000	MALE	—	—	1040	—	—	—	—	—	—	—	—	—	1040	
			FEMALE	—	—	52	—	—	—	—	—	—	—	—	—	—	52
			TOTAL	—	—	1092	—	—	—	—	—	—	—	—	—	—	1092
	MUNICIPAL HOSPITAL	13,428	MALE	91	78	130	234	78	104	—	—	26	—	—	—	741	
			FEMALE	325	273	104	260	65	65	39	—	—	26	52	—	—	1,209
			TOTAL	416	351	234	494	143	169	39	—	—	52	52	—	—	1,950
	ST LUCAS EPISCOPAL HOSPITAL	3,224	MALE	78	13	56	102	13	117	—	—	29	—	—	—	423	
			FEMALE	182	39	37	145	26	208	13	—	—	21	63	—	—	734
			TOTAL	260	52	93	247	39	325	28	—	—	50	63	—	—	1,157
	HOSPITAL ANTI-TUBERCULOSIS	1,598	MALE	—	—	—	—	—	—	—	—	—	—	—	—	—	
			FEMALE	—	—	—	—	—	—	—	—	—	—	—	—	—	—
			TOTAL	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	T.B. CENTER	676	MALE	—	—	—	—	—	—	—	—	—	—	—	—	—	
			FEMALE	—	—	—	—	—	—	—	—	—	—	—	—	—	—
			TOTAL	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	PUBLIC HEALTH UNIT	18,929	MALE	—	—	—	—	—	—	—	—	—	—	—	—	—	
			FEMALE	—	—	—	—	—	—	—	—	—	—	—	—	—	—
			TOTAL	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	4 PRIVATE RADIO-LOGISTS	11,093	MALE	224	145	588	352	152	448	74	—	22	—	—	—	2,005	
			FEMALE	470	208	439	424	183	380	144	—	—	22	186	—	—	2,456
			TOTAL	694	353	1,027	776	335	828	218	—	—	44	186	—	—	4,461

TABLE 7-S Cont.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF THORACICAL DIAGNOSTIC X-RAY EXAMINATIONS BY TYPE										GRAND TOTAL		
		CHEST RADIOGRAPHY					CHEST TOMOGRAPHY						TOTAL	
		Male	Fem.	Total	Male	Fem.	Total	M.	F.	Tot.	Male		Fem.	
Juana Diaz	Health Center	650	625	1,275	-	-	-	-	-	-	-	650	625	1,275
	2 Private Offices	832	832	1,664	-	-	-	-	-	-	-	832	832	1,664
	<b>Total</b>	<b>1,482</b>	<b>1,457</b>	<b>2,939</b>	-	-	-	-	-	-	-	<b>1,482</b>	<b>1,457</b>	<b>2,939</b>
Maunabo	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Patillas	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Peñuelas	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Ponce	District Hospital	4,244	4,370	8,614	-	-	-	16	20	36	***	4,260	4,390	8,650
	Hospital de Damas	2,192	1,200	3,392	-	-	-	-	-	-	-	2,192	1,200	3,392
	Clinica Dr. Pila	1,750	2,088	3,838	-	-	-	-	-	-	-	1,750	2,088	3,838
Oncologica Municipal Hospital	Clinica	456	572	1,028	-	-	-	-	-	-	-	456	572	1,028
	Hospital	1,859	2,153	4,012	-	-	-	-	-	-	-	1,859	2,153	4,012
	Episcopal St. Lucas	1,404	1,820	3,224	-	-	-	-	-	-	-	1,404	1,820	3,224
Hosp. Anti-Tuberculosis T.B. Center	Hosp. Anti-Tuberculosis	572	718	1,290	-	-	-	156	52	208	-	728	770	1,498
	T.B. Center	209	467	676	-	-	-	-	-	-	-	209	467	676
	<b>Total</b>	<b>7,800</b>	<b>5,600</b>	<b>13,400</b>	-	-	-	-	-	-	-	<b>7,800</b>	<b>5,600</b>	<b>13,400</b>

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TABLE 7-S Cont.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	NUMBER OF THORACICAL DIAGNOSTIC X-RAY EXAMINATIONS BY TYPE											GRAND TOTAL
		CHEST RADIOGRAPHY			PHOTOFLUOROGRAPHY			TOMOGRAPHY			TOTAL		
		Male	Fem.	Total	Male	Fem.	Total	M.	F.	Tot	Male	Fem.	
Ponce cont.	Public Health Unit	436	430	866	9,389	8,674	18,063	-	-	-	9,825	9,104	18,929
	Private Radiologists	1,729	1,997	3,726	-	-	-	-	-	-	1,729	1,997	3,726
	Private Off.	3,816	3,416	7,232	-	-	-	-	-	-	3,816	3,416	7,232
Ponce Total		26,467	24,831	51,298	9,839	8,674	18,063	172	72	244	36,028	33,577	69,605
Salinas	Municipal Hospital	626	414	1,040	-	-	-	-	-	-	626	414	1,040
Santa Isabel	Private Office	364	156	520	-	-	-	-	-	-	364	156	520
Villalba	Health Center	-	-	-	-	-	-	-	-	-	-	-	-
Yauco	Public Health Unit	1,020	1,220	2,240	2,010	6,202	8,212	-	-	-	3,030	7,922	10,452
	Private Office	414	466	880	-	-	-	-	-	-	414	466	880
Yauco Total		1,434	1,686	3,120	-	-	-	-	-	-	3,444	7,888	11,332
SOUTHERN REGION TOTAL		35,463	33,094	68,557	15,987	20,788	36,775	172	72	244	51,622	53,954	105,576

\* 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.

\*\*\* The Tomography unit was inoperable during most of the year.

TABLE 8-S

TOTAL NUMBER OF DIAGNOSTIC THORACICAL AND ABDOMINAL X-RAY EXAMINATIONS  
Southern Region, Puerto Rico-1968

Geographic Location	Name of Facility	Total Number of X-ray Exams.	Total Number of Thoracical Exams.	Total Number of Abdominal Exams.
Adjuntas	Health Center	-	-	-
	Public Health Unit 1 Private Office	2,184	884	364
Arroyo	Municipal Hospital	-	-	-
	Hospital Lafayette	4,888	2,288	369
Coamo	Health Center	5,720	4,504 <sup>1</sup>	272
	1 Private Office	4,225	468	2,912
Coamo Total		9,945	4,972	3,184
Guanica	Central Guanica Hospital	998	450	305
	Public Health Unit Municipal Hospital	-	-	-
Guayama	Health Center	16,380	8,959 <sup>2</sup>	3,327
	Clinica Santa Rosa	1,721	576	897
	2 Private Offices	1,217	480	494
Guayama Total		19,318	10,115	4,718
Guayanilla	Health Center	-	-	-
	1 Private Office	4,030	1,144	2,080
Jayuya	Health Center	-	-	-
	1 Private Office	390	287	23

TABLE 8-S Cont.

Geographic Location	Name of Facility	Total Number of X-ray Exams.	Total Number of Thoracical Exams.	Total Number of Abdominal Exams.
Juana Diaz	Health Center	2,972	1,275	380
	2 Private Offices	4,225	1,664	1,716
Juana Diaz Total		7,197	2,939	2,096
Manabo	Health Center			
Pajillas	Health Center			
Peñuelas	Health Center			
Ponce	District Hospital	33,126	8,650 <sup>4</sup>	19,793
	Hospital de Pamas	17,340	3,392	1,828
	Clinica Dr. Pila	9,216	3,838	3,224
	Clinica Gecologica	3,701	1,028	938
	Fondo del Seguro	18,600	17,600	1,002
	hospital Municipal	13,428	4,012	1,950
	Hosp. Episcopal St. Lucas	3,224	3,224	-
	Hosp. Anti-Tuberculosis	1,398	1,398	-
	Public Health Unit	18,929	18,929	1,157
	T.B. Center	676	676	-
	4 Private Radiologists	11,953	3,726	4,661
9 Private Offices	25,850	7,332	6,332	
Ponce Total	151,381	62,605	31,528	
Salinas	Municipal Hospital	2,474	1,040	1,206
	Public Health Unit	-	-	-
Santa Isabel	Municipal Hospital	-	-	-
	1 Private Office	2,145	520	1,734

TABLE 8-S Cont.

Geographic Location	Name of Facility	Total Number of X-ray Exams.	Total Number of Thoracical Exams.	Total Number of Abdominal Exams.
Villalba	Health Center	-	-	-
Yauco	Public Health Unit 2 Private Offices	10,452 2,340	10,452 <sup>7</sup> 880	- 992
Yauco Total		12,792	11,332	992
SOUTHERN REGION TOTAL		217,732	105,576	48,586

These figures were estimated on the basis of the available number of thoracical and abdominal X-ray examinations using the proportions given in the report "Population Exposure to X-ray, U.S.-1964".

Thoracical X-ray examinations were 48.5% of the total number of X-ray examinations performed in the Southern Region-1968.

Abdominal X-ray examinations were 22% of the total X-ray examinations performed in the Southern Region-1968.

1. Included 3,626 photofluorographies.
2. Included 6,872 photofluorographies.
3. Data of only one private office was available.
4. Included 208 tomographies.
5. Included 20,800 photofluorographies.
6. Included 8,212 photofluorographies.
7. Included 36 tomographies.

TABLE 9-S  
 NUMBER OF ABDOMINAL X-RAY EXAMINATIONS, BY TYPE OF FACILITY AND BY TYPE OF EXAMINATION.  
 SOUTHERN REGION, PUERTO RICO-1968

TYPE OF EXAMINATION	TYPE OF FACILITY						TOTAL
	HOSPITALS	CLINICS	PUBLIC HEALTH UNITS <sup>(X)</sup> HEALTH CENTERS	RADIOLOGISTS	PRIVATE OFFICES	TOTAL	
ABDOMEN	4,609	742	735	719	6,279	13,084	
CHOLECYSTOGRAPHY	2,519	506	347	353	988	4,713	
LUMBAR SPINE	2,560	869	1,921	1,027	3,506	9,883	
GASTRO INTEST SERIES	4,328	1,050	566	776	884	7,604	
BARIUM ENEMA	746	349	109	335	—	1,539	
I.V.P	1,680	662	286	828	2,582	6,038	
PELVIS	397	481	684	218	1,266	3,046	
HIP JOINT	515	403	390	44	832	2,184	
PELVIMETRY	254	22	33	186	—	495	
TOTAL	17,608	5,084	5,071	4,486	16,337	48,586	

(X) INCLUDING FONDO DEL SEGURO, PONCE.



TABLE 10-S  
 NUMBER OF FILMS EXPOSED (EXPOSURES) IN ABDOMINAL RADIOGRAPHIC EXAMINATIONS, BY TYPE OF FACILITY AND BY TYPE OF EXAMINATION  
 SOUTHERN REGION, PUERTO RICO-1968.

TYPE OF EXAMINATION	NUMBER & SIZE OF FILMS MOST COMMONLY USED PER EXAMINATION		TYPE OF FACILITY					TOTAL
	NO	SIZE	HOSPITALS	CLINICS	PUBLIC HEALTH CENTERS	RADIOLOGISTS	PRIVATE OFFICES	
ABDOMEN	1	14x17"	4,609	742	735	719	6,279	13,084
CHOLECYSTOGRAPHY	4	8x10"	10,076	2,024	1,388	1,412	3,744	18,644
LUMBAR SPINE	3	2-11x14" 1-8x10"	7,680	2,607	5,763	3,081	10,518	29,649
GASTRO INTEST. SERIES	8	6-10x12" 2-8x10"	34,624	8,400	4,528	6,208	7,072	60,832
BARIUM ENEMA	5	1-11x14" 4-14x17"	3,730	1,745	545	1,675	—	7,695
I.V.P.	4	14x17"	6,720	2,648	1,144	3,312	10,320	24,144
PELVIS	1	14x17"	397	481	684	218	1,214	2,994
HIP JOINT	2	11x14"	1,030	806	780	88	1,664	4,368
PELVIMETRY	2	14x17"	508	44	66	372	—	909
TOTAL			69,374	19,497	15,633	17,085	40,311	162,400

(X) INCLUDES FONDO DEL SEGURO, PONCE

TABLE 11-S  
 NUMBER OF FILMS EXPOSED (EXPOSURES) IN RADIOGRAPHIC EXAMINATIONS  
 OF THE ABDOMEN AND THORAX, BY TYPE OF FACILITY,  
 SOUTHERN REGION, PUERTO RICO - 1968.

TYPE OF FACILITY	NUMBER OF X-RAY EXAMINATIONS BY THE AREA OF THE BODY		
	ABDOMINAL	THORACICAL	TOTAL
HOSPITALS	17,608	24,554	42,162
CLINICS	5,084	5,542	10,626
HEALTH CENTERS PUB. HLTH UNITS & FONDO DEL SEGURO	5,071	58,195	63,266
RADIOLOGISTS OFFICES	4,486	3,726	8,212
PRIVATE OFFICES	16,337	13,559	28,896
TOTAL	48,586	105,576	154,162

TYPE OF FACILITY	NUMBER OF EXPOSED FILMS BY THE AREA OF THE BODY		
	ABDOMINAL	THORACICAL	TOTAL
HOSPITALS	69,374	26,018	95,392
CLINICS	19,437	5,542	25,039
HEALTH CENTERS PUB. HLTH UNITS & FONDO DEL SEGURO	15,633	58,195	73,828
RADIOLOGISTS OFFICES	17,085	3,726	20,811
PRIVATE OFFICES	40,811	13,559	54,370
TOTAL	162,400	107,040	269,440

TABLE 12-S  
 NUMBER OF EXPOSED FILMS (EXPOSURES) OF ABDOMINAL AND THORACICAL X-RAY  
 EXAMINATIONS, BY TYPE OF EXAMINATIONS AND BY SEX .  
 SOUTHERN REGION , PUERTO RICO -1968 .

TOTAL NUMBER OF ABDOMEN AND THORAX X-RAY EXAMINATIONS IN SOUTHERN REGION	ABDOMEN	CHOLE- CYSTO- GRAPHY	LUMBAR SPINE	GASTRO- INTEST. SERIES	BARIUM ENEMA	I.V.P	PELVIS	HIP JOINT	PELVI- METRY	TOTAL ABDOMINAL	TOTAL THORAX	GRAND TOTAL
MALE	5,390	1,404	6,217	3,209	589	2,858	1,240	1,098		22,005	51,622	73,627
FEMALE	7,694	3,309	3,666	4,395	950	3,180	1,806	1,086	495	26,581	53,954	80,535
TOTAL	13,084	4,713	9,883	7,604	1,539	6,038	3,046	2,184	495	48,586	105,576	154,162
TOTAL NUMBER OF FILMS EXPOSED (EXPOSURE) ON MALES	5,390	5,512	18,651	25,672	2,945	11,424	1,188	2,196		72,978	52,654	125,632
TOTAL NUMBER OF FILMS EXPOSED (EXPOSURE) ON FEMALES	7,694	13,132	10,998	35,160	4,750	12,720	1,806	2,172	990	89,422	54,386	143,808
TOTAL NUMBER OF EXPOSED FILMS (EXPOSURE) ON MALES AND FEMALES	13,084	18,664	29,649	60,832	7,695	24,144	2,994	4,368	990	162,400	107,040	269,440

THIS NUMBER INCLUDED 172 TOMOGRAPHIES, WITH USUALLY SIX EXPOSURES FOR EACH EXAMINATION .

TABLE 13-S

## SUPERVISION\* BY RADIOLOGISTS

SOUTHERN REGION, PUERTO RICO-1968

Type of Facility	Number of Medical Diagnostic X-ray Examinations	Percent of Diagnostic X-ray Examinations	Number of Diagnostic X-ray Examinations Supervised by Radiologists	Percent of X-ray Examinations Supervised by Radiologists
All Types	217,732	100%	125,531	57.6%
Hospitals	72,266	33.19%	63,916	88.44%
Clinics	14,638	6.72%	12,917	88.24%
Health Centers, Public Health Units & Fondo del Seguro	73,129	33.58%	37,605	51.42%
Private Radiologists	11,093	5.0%	11,093	100%
Private Offices	46,606	21.40%	-	-

\* The word "supervision" is used here in the sense that a radiologist is employed by the institution, at least on a part-time basis, so that he can personally supervise and control all the technical factors involved in the radiological procedures including the ones needed to obtain safe exposure level rates.

As in this report we were able to estimate the total number of X-ray examinations performed in private offices, the total percentage of X-ray examinations supervised by radiologists is lower than in the first report, i.e. 57.6%. The number of X-ray examinations performed in hospitals is the highest for public institutions.

By utilizing information presented in Table 12-S, it can be estimated that 57.6% of the diagnostic X-ray examinations reported in this study were performed under the supervision of a radiologist.

Some of the hospitals and Health Centers in the small communities send their films for "interpretation" to hospitals or private radiologists in Ponce.

## LIST OF FIGURES

- Figure 1—S:** Geographical Distribution of Medical Facilities Equipped with X-Ray Units. Southern Region, Puerto Rico-1968.
- Figure 2—S:** Distribution of X-Ray Diagnostic Units in Southern Region of Puerto Rico, -1968.
- Figure 3—S:** Distribution of X-Ray Units by Manufacturer. Southern Region, Puerto Rico-1968.
- Figure 4—S:** Variation of Population and Number of X-Ray Diagnostic Units in Public and Private Medical Institutions. Southern Region, Puerto Rico-1968.
- Figure 5—S:** Variation of Population and Number of Tubes in X-Ray Diagnostic Units in Public and Private Medical Institutions. Southern Region, Puerto Rico-1968.
- Figure 6—S:** Percent Distribution of Radiographic Examinations by Body Area in Public and Private Medical Institutions. Southern Region, Puerto Rico-1968.
- Figure 7—S:** Percent Distribution of Diagnostic X-Ray Examinations in Medical Institutions by Type of Facility. Southern Region, Puerto Rico-1968.
- Figure 8—S:** Percent Distribution of X-Ray Units by Total Filtration and Type of Facility. Southern Region, Puerto Rico-1968.
- Figure 9—S:** Geographic Distribution of the Annual Rate of Diagnostic X-Ray Examinations, with Respect to the Number of Population. Southern Region, Puerto Rico-1968.

FIGURE I-S  
 GEOGRAPHICAL DISTRIBUTION OF MEDICAL FACILITIES EQUIPPED WITH X-RAY UNITS  
 SOUTHERN REGION OF PUERTO RICO - 1968

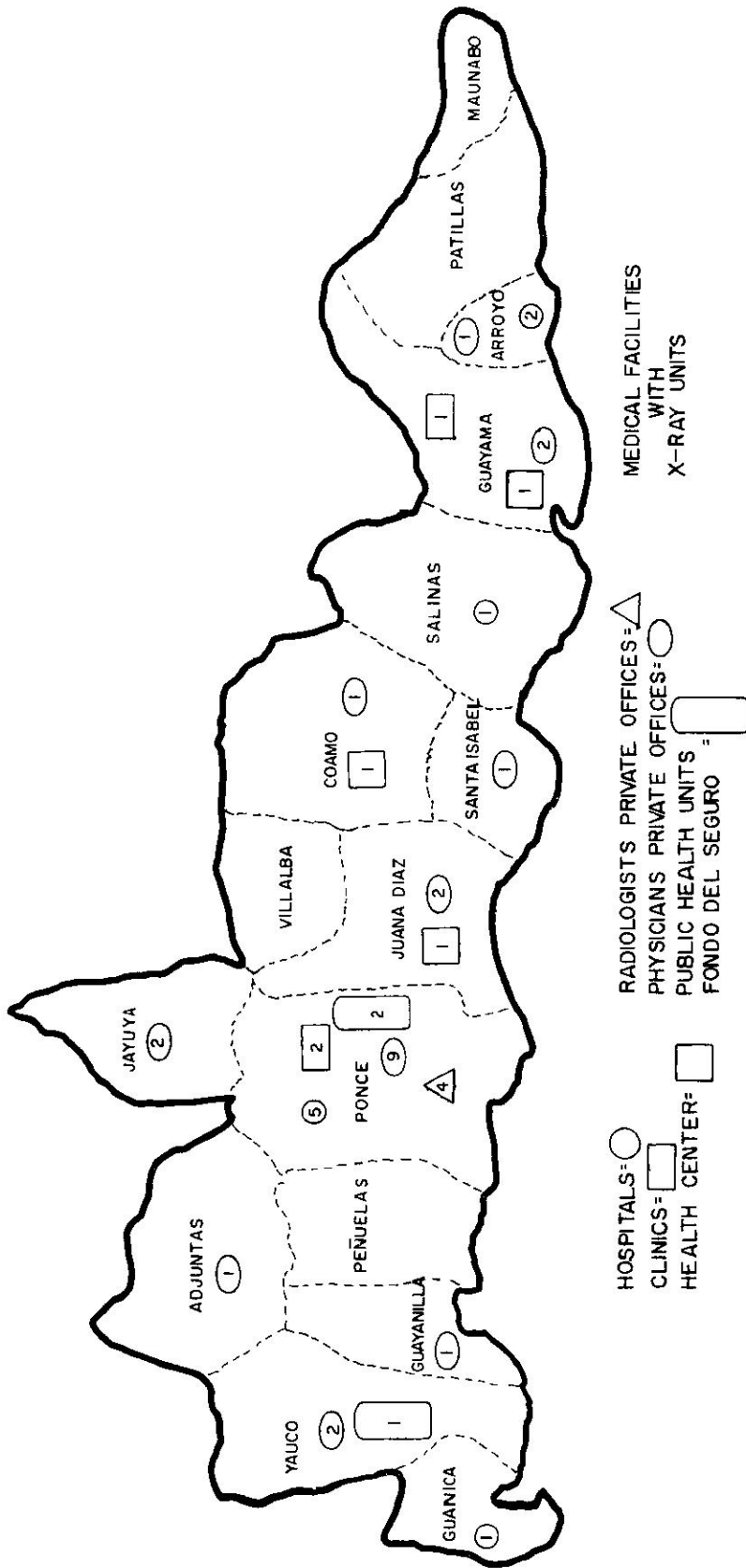
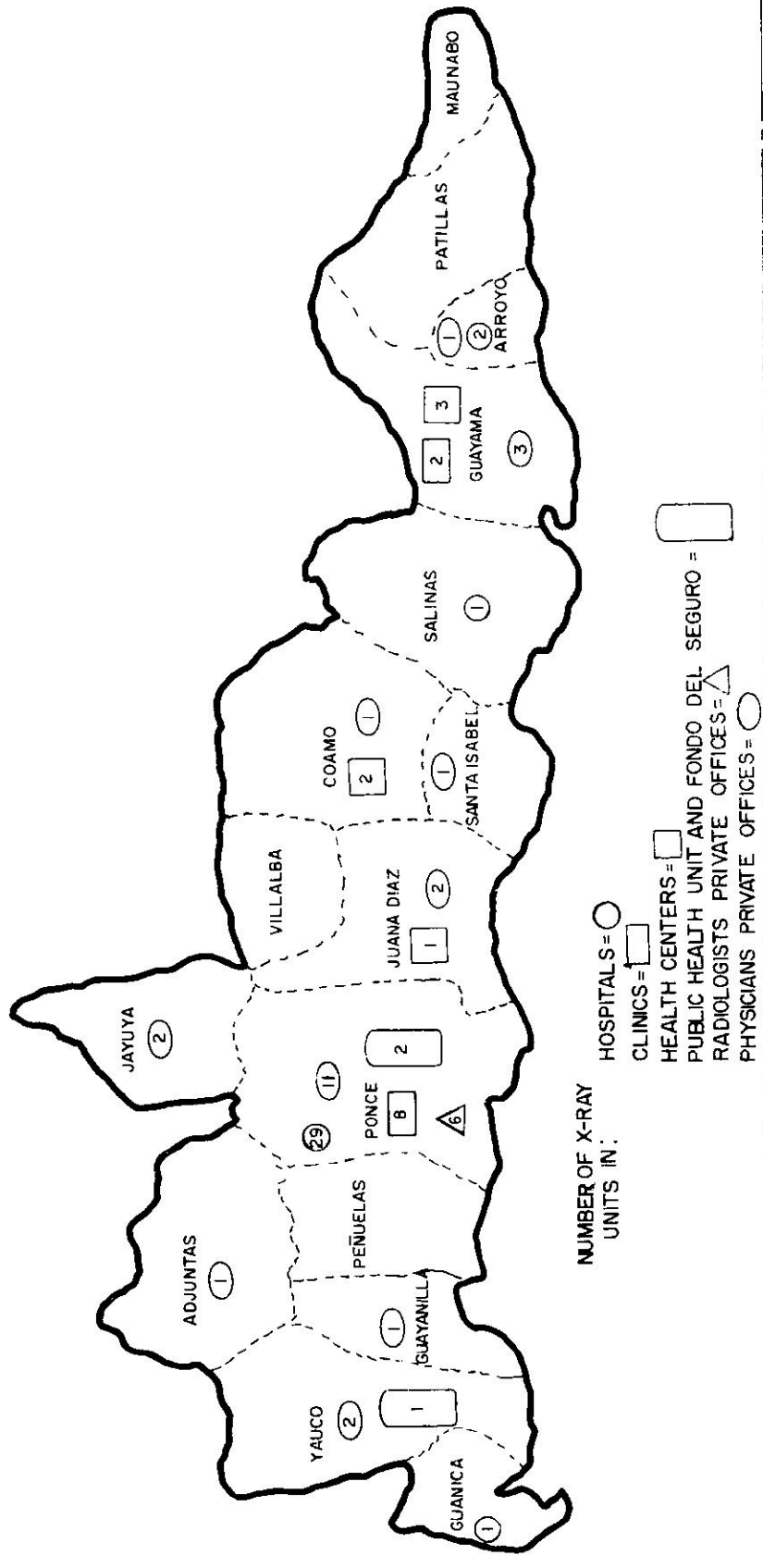
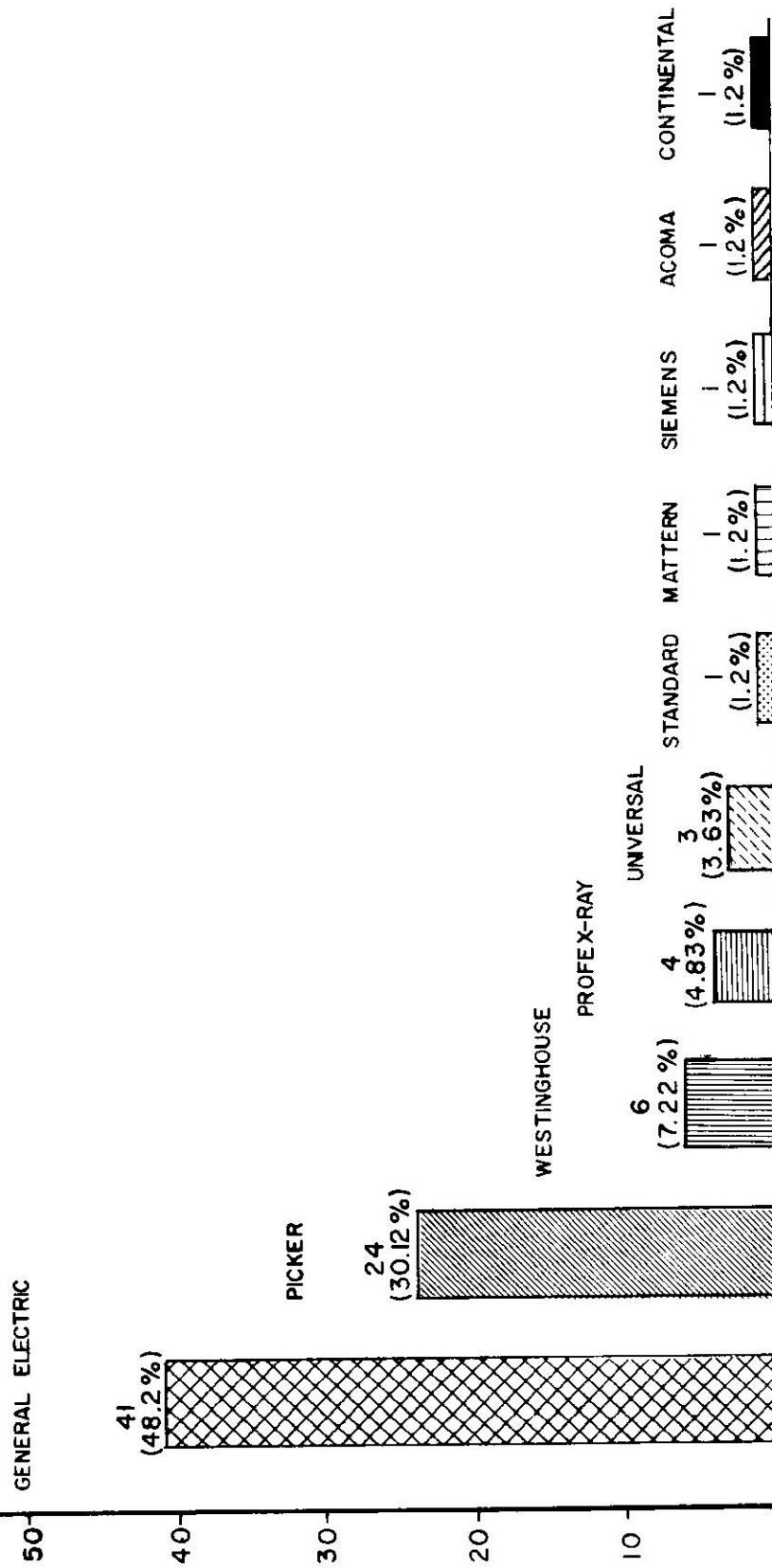


FIGURE 2 S  
 DISTRIBUTION OF X-RAY DIAGNOSTIC UNITS IN SOUTHERN REGION OF PUERTO RICO-1968



IN THE TOWN OF PONCE THE T.B. CENTER USED THE SAME X-RAY UNIT AS THE T.B. HOSPITAL.

FIGURE 3-S  
 DISTRIBUTION OF X-RAY UNITS BY MANUFACTURER,  
 SOUTHERN REGION PUERTO RICO-1968.



THIS FIGURE DOES NOT INCLUDE X-RAY UNITS IN DENTAL OFFICES.



FIGURE 4-S

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

SOUTHERN REGION PUERTO RICO - 1940-1968.

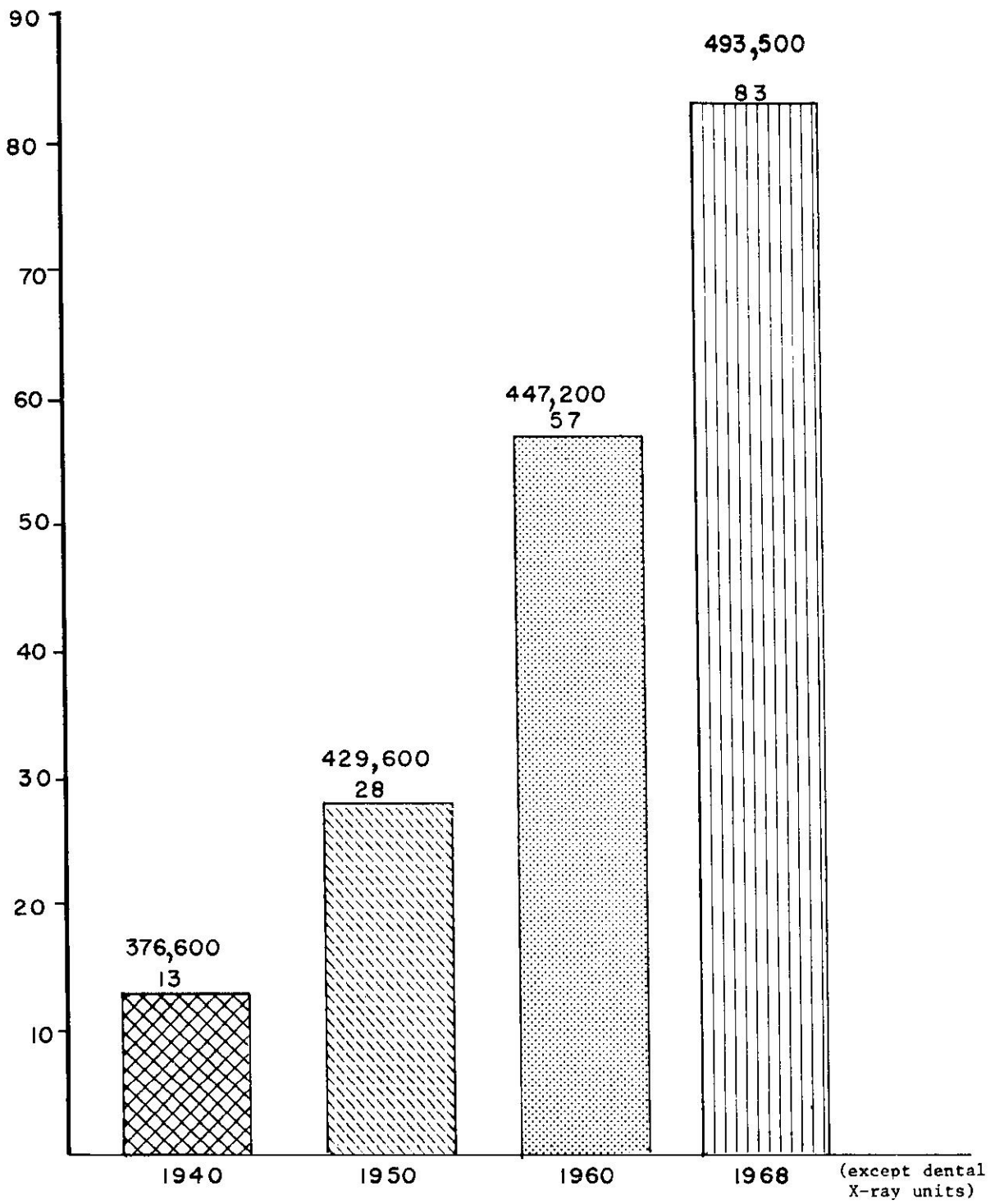
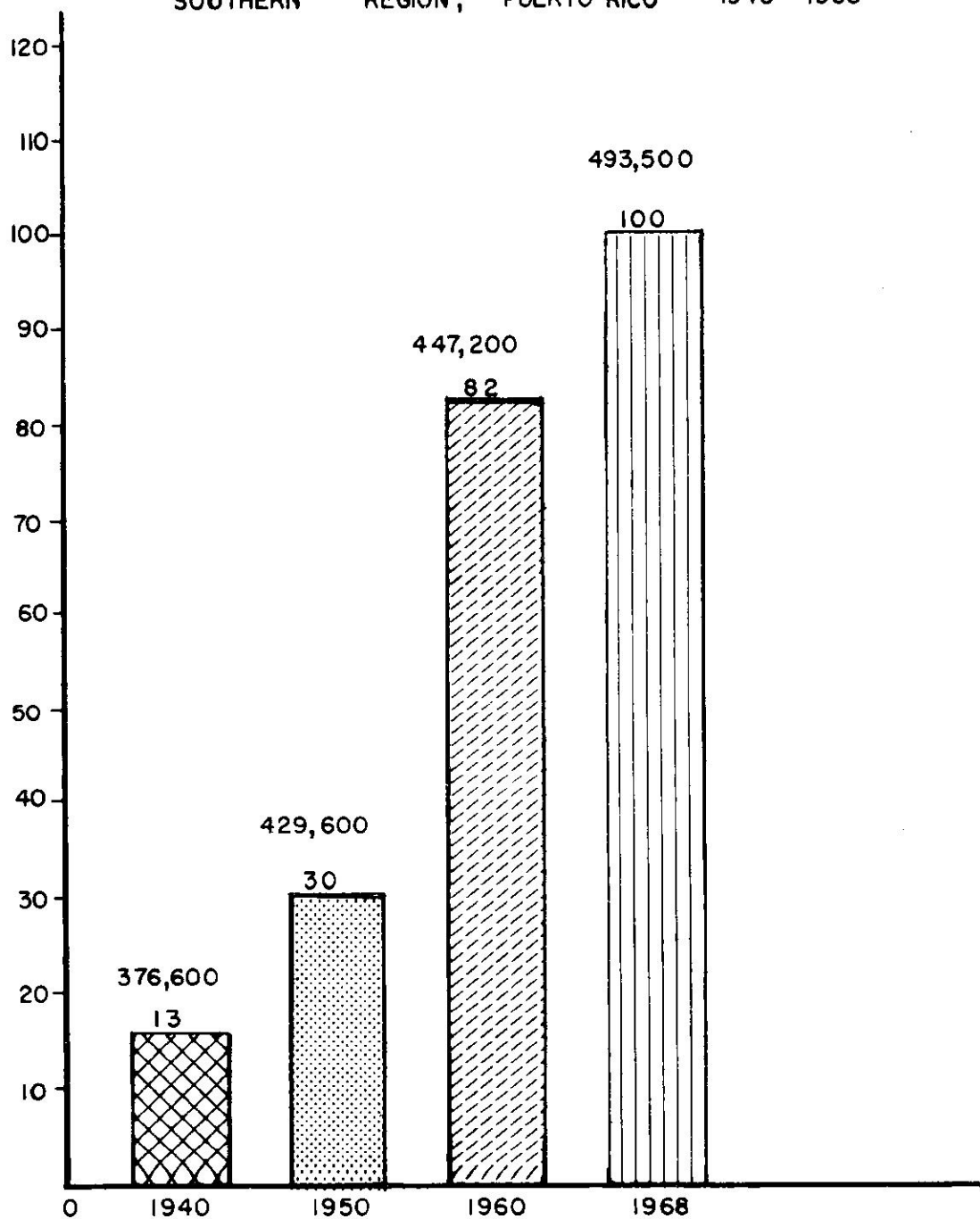


FIGURE 5-S

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

SOUTHERN REGION, PUERTO RICO — 1940—1968

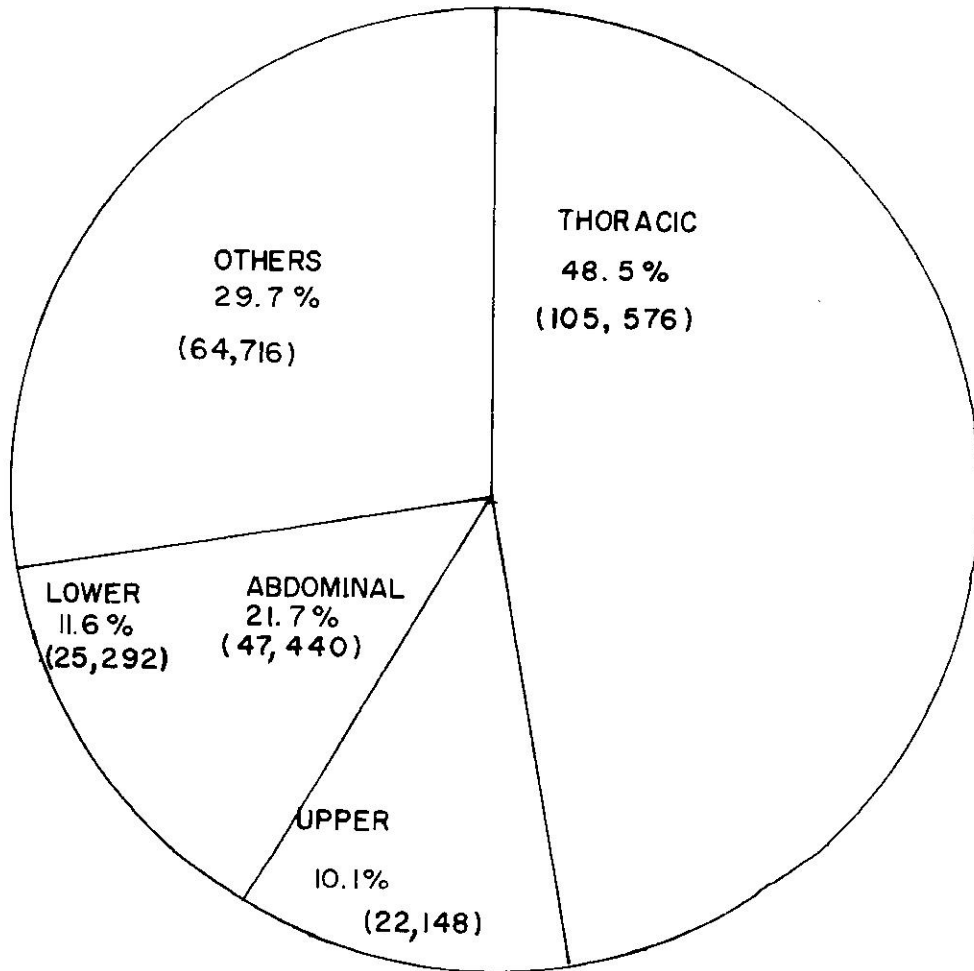


THIS FIGURE DOES NOT INCLUDE X-RAY UNITS IN DENTAL OFFICES.

FIGURE 6-S

PERCENT DISTRIBUTION OF RADIOGRAPHIC EXAMINATIONS  
BY BODY AREA IN PUBLIC AND PRIVATE MEDICAL INSTITUTIONS

SOUTHERN REGION PUERTO RICO - 1968.



The percent distribution of the 217,732 radiographic examinations by body area in the Southern Region is shown in Figure 6-S.

About half of all X-ray examinations performed in this region were related to the thorax. Abdominal X-ray examinations represented about 22% of the total X-ray examinations (47,440). There was a slightly higher percentage of lower abdominal examinations (25,292) than upper abdominal examinations (22,148).

FIGURE 7-S

PERCENT DISTRIBUTION OF DIAGNOSTIC X-RAY EXAMINATIONS  
IN MEDICAL INSTITUTIONS BY TYPE OF FACILITY.

SOUTHERN REGION OF PUERTO RICO-1968.

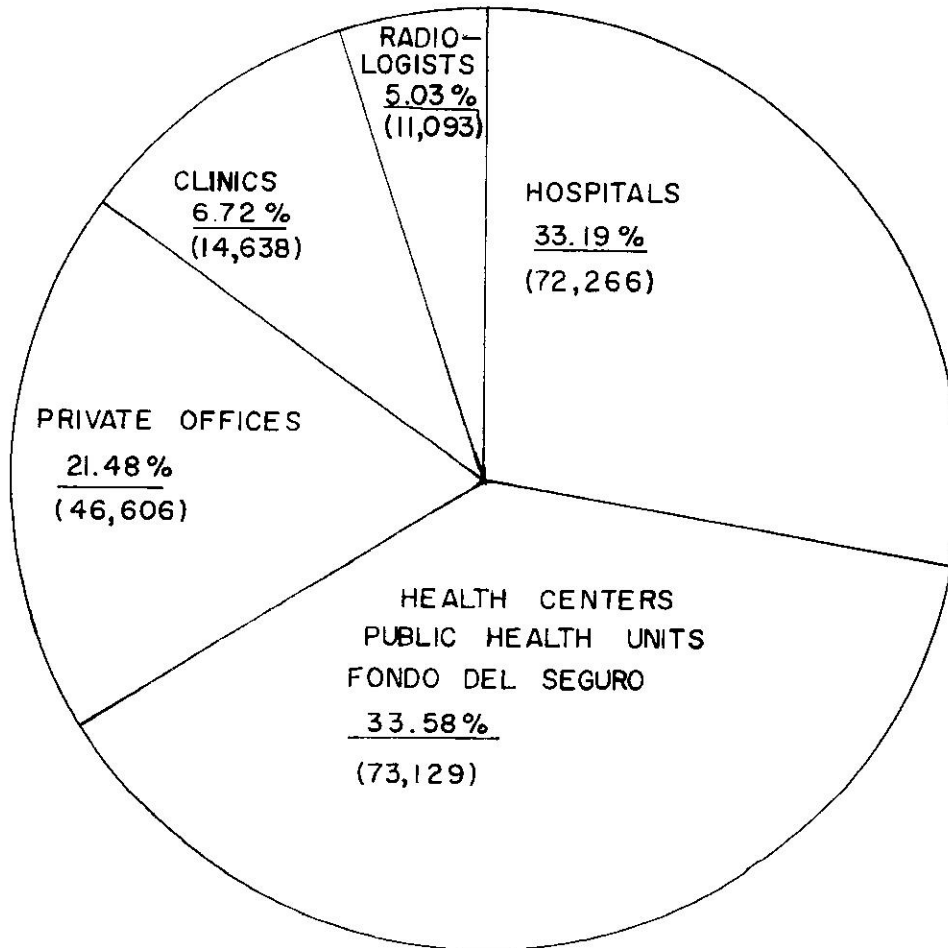


Figure 7-S shows that the rate of X-ray examinations per 100 population is the highest in Ponce, which has the most sophisticated X-ray machinery (and the highest economic and social standards) of the area.

The data showed that as in the Western Region, those who live in the cities have more medical X-ray examinations per 100 population per year than those who live outside the cities.

These differences are related to economic and educational factors, which influence medical care. Persons in families of higher educational and income brackets make a larger percentage of X-ray visits than those of the lower educational and income level.

FIGURE 9-S  
 PERCENT DISTRIBUTION OF X-RAY UNITS BY TOTAL FILTRATION AND  
 TYPE OF FACILITY.  
 SOUTHERN REGION, PUERTO RICO — 1968.

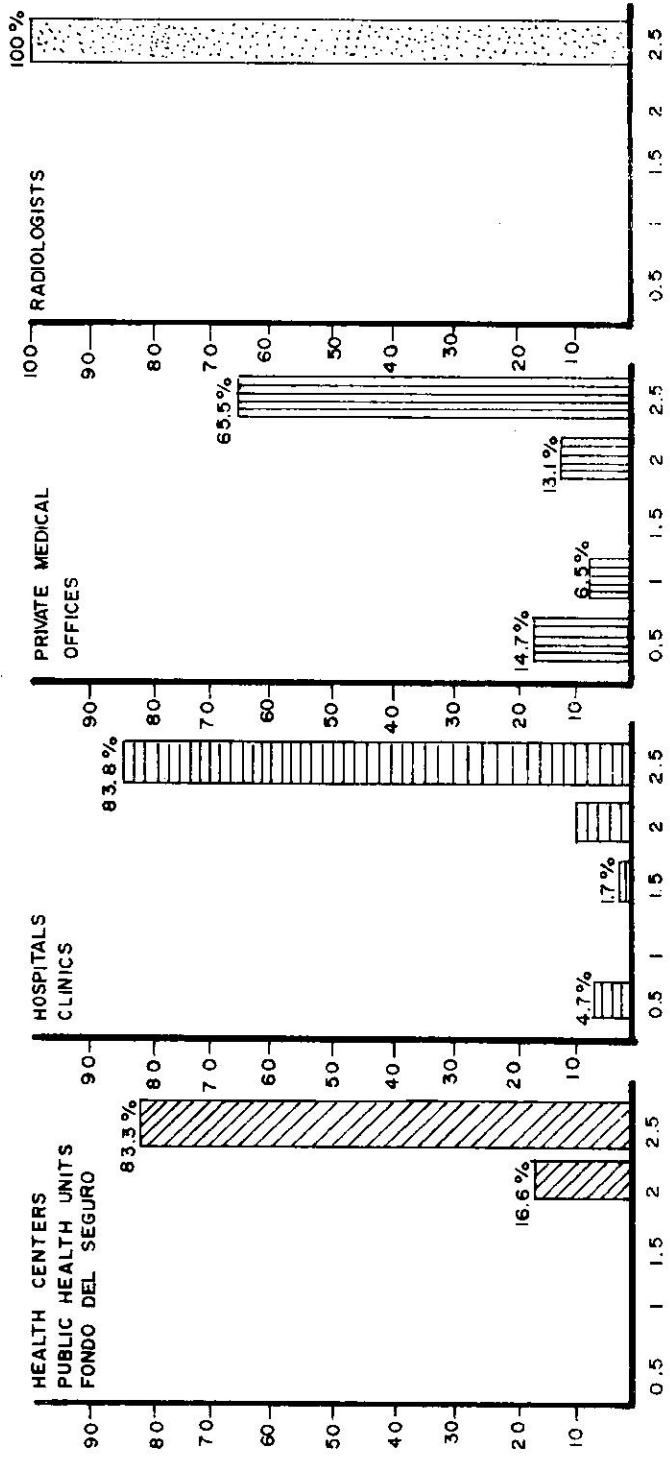
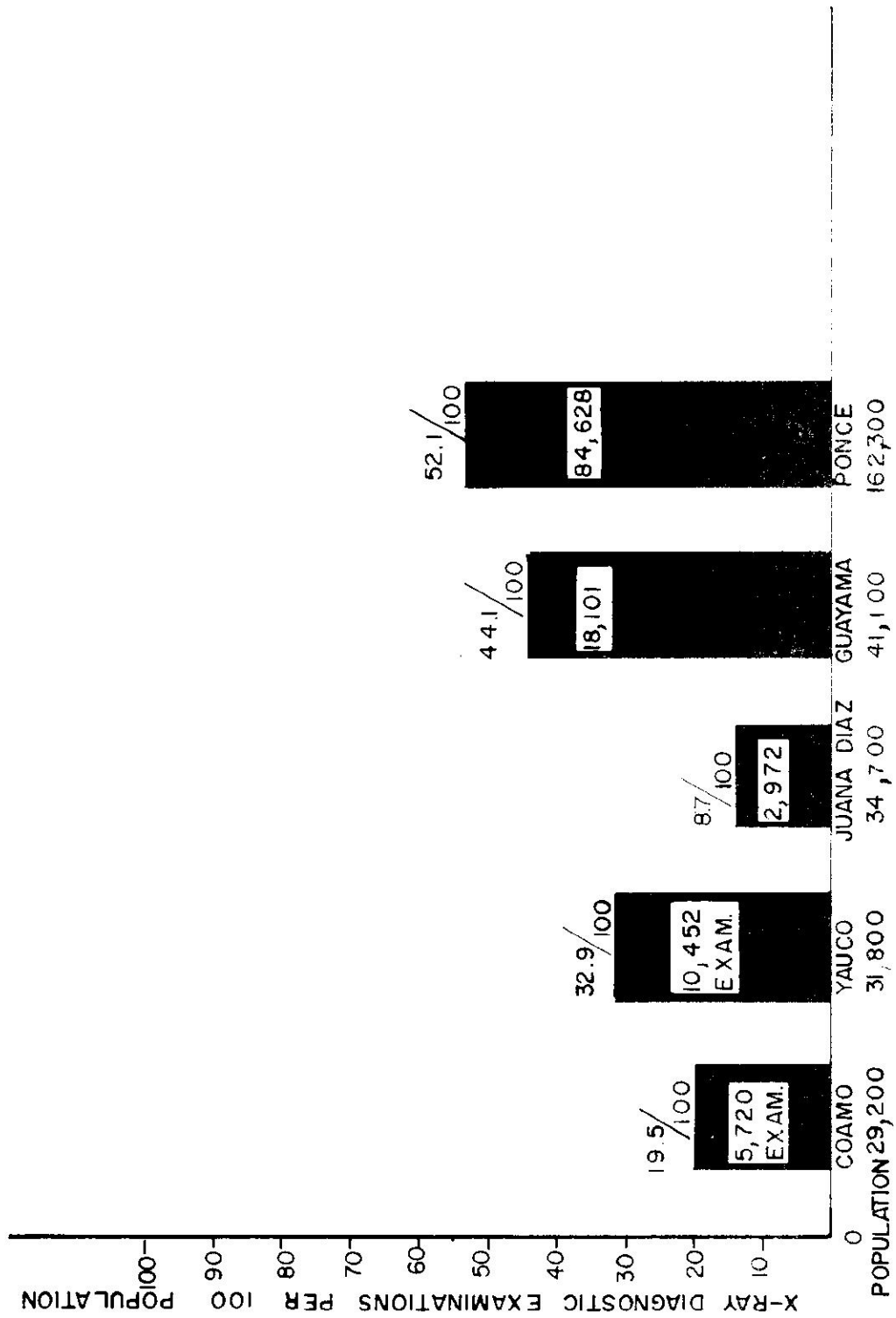


FIGURE 8-S  
 GEOGRAPHIC DISTRIBUTION OF THE ANNUAL RATE OF DIAGNOSTIC X-RAY  
 EXAMINATIONS, WITH RESPECT TO THE NUMBER OF POPULATION.  
 SOUTHERN REGION PUERTO RICO-1968.



# DOSE MEASUREMENTS

*"Medical radiation equipment is the most important electronic product with regard to population exposure"*

—John C. Villforth, Director, Bureau of Radiological Research, Second Annual National Conference on Radiation Control, May-1970, Palm Beach, Florida.

Radiation imparted to the gonads—for any reason—constitute a potential health hazard not only to the individual, but also to his (or her) future offspring via the irradiated genetic material, that may garble the genetic code transmitted from parent to offspring and may cause changes—mutations—that are seldom beneficial.

In order to express the health hazard associated with each individual diagnostic procedure in a quantitative fashion, three types of characteristic indicators are generally used:

- (a) The mean gonadal dose per examination of a certain type,
- (b) The per capita per annum gonadal dose as referred to a suitably defined population,
- (c) The genetically significant dose.

Reliable and accurate dosimetric measurements are indispensable for the evaluation of these indicators. For this reason no effort was spared to make the dose measurements as accurate and reproducible as possible. The majority of the dosimetric measurements were carried out in the District Hospital of Ponce, using a Picker 300 MA X-ray unit, with a PX-10A tube as irradiation source. This unit has a total filtration equivalent to 3mm. of aluminum and a half value layer of 4mm. aluminum, corresponding to an effective energy of 37 KEV at 76 KVP, a tube voltage typically used in abdominal X-ray diagnostics. The unit is equipped with a variable collimator. Figures 1 D-S and 2 D-S contain the data and demonstrate the method used to determine the half value layer of two different sources.

The instrumentation used for dose measurements included the following:

- (a) Victoreen Model 227, bakelite-walled ionization chamber, 1000 mR range,
- (b) Victoreen Model 228, bakelite-walled ionization chamber, 5000 mR range.

All Victoreen ion chambers were calibrated by the Victoreen Company using intercomparison with instruments whose calibrations are traceable to the U.S. National Bureau of Standards and their accuracy is within  $\pm 3\%$ . A copy of the calibration certificate containing the approximate correction factors is enclosed with this report (see pp. 63-64 and curves correction factor vs. KVP are plotted in Figure 3 D-S.)

(c) Thermoluminescent dosimeters (TLD) manufactured by Con-rad, model No. P2-7-R, containing 43 mg. of powdered LiF, encapsulated in polyethylene capsules, having a diameter of 5 mm. and a length of 17 mm. These dosimeters were precalibrated by the company and equipped with low energy filters. Intercalibration curves relating LiF-TLD

readings with Victoreen readings are part of this report (see Tables 1 D-S, 2 D-S and Figures 4 D-S and 5 D-S).

(d) Con-rad Thermoluminescence Dosimetry System Model 5100 B Readout Instrument for reading the irradiated LiF-TLD dosimeters.

(e) Radiation sensitive film packages, Model Du Pont Sx-249-126 (high sensitivity).

(f) Sensitometer, Model Mackbeth Ansco (property of the Health Physics Division, Brookhaven National Laboratory). Intercalibration curves of film and Victoreen readings are part of this report (see Table 3 D-S, Figures 6 D-S and 7 D-S, pp. 67-68 and data sheets pp. 111-114).

(g) Rando-Phantom, Model Ran-100, manufactured by Macklett Laboratory, Inc. was used in lieu of the patient, with a radio absorptivity equivalent to human tissues, simulating cross sectional sizes and contents typical of the human body.

The soft tissues of the phantom were molded of a thermosetting isocyanate rubber, adjusted both physically and chemically to the desired values of Z and specific gravity.

In order to be able to measure the ovarian doses, the anatomic location of the ovaries was determined by a radiologist and a slot accommodating the thickness of a Victoreen 228 ion chamber was cut into the appropriate section (section No. 30 of the phantom). Table 4 D-S contains data concerning exposures at the location of the ovaries, at a depth of 12.5 cm. with the Rando-Phantom.

The intercalibration procedure was carried out by positioning the Rando-Phantom in such a manner that it should closely simulate the positioning of the patient in an actual diagnostic situation. With this positioning the gonadal exposure was measured first using a Victoreen chamber and next under identical conditions a LiF-TLD capsule.

Results of these measurements are reported in Table 5 D-S and Figure 8 D-S. Figure 8 D-S indicates that the relationship between Victoreen and corresponding TLD-LiF reading is linear within the range of slight experimental errors.

In vivo measurements were performed on male patients in the Ponce District Hospital, using TLD-LiF dosimeters to determine testicular in vivo exposures associated with each of the considered abdominal X-ray diagnostic examinations. The results of these in vivo measurements are reported in Table 6 D-S and are also compared to exposures on the Rando-Phantom obtained under identical radiological conditions (KVP, MAS, TFD etc.), measured first with a TLD-LiF dosimeter, then with a Victoreen chamber. Table 6 D-S shows very satisfactory agreement of in vivo and in phantom readings, thus reestablishing the reliability of the Rando-Phantom as a research tool and also establishing confidence in the validity of those in phantom irradiation data (e.g., ovaries' exposure) that are rather complicated to measure in vivo. Figure 9 D-S demonstrates this correlation between in vivo and in phantom readings.

Units recommended by the International Commission on Radiological Units and Measurements (published in N.B.S. Handbook No. 85, 1964), are used throughout this report.

Rad — for absorbed dose.

Roentgen — for exposure dose.

Absorbed dose is dependent upon the mass absorption coefficient of the absorbing medium, which in turn is energy dependent.

Using the customary spectral composition of the diagnostic X-ray beam in the 50-100 KEV region, one Roentgen exposure dose in air corresponds to .877 rads of absorbed dose in air.



One Roentgen exposure dose in soft tissue, under the same stipulations, corresponds to .92 rads of absorbed dose in soft tissue.

Table 7 contains the mean gonadal doses by type of examination. Each value was measured several times in order to minimize experimental error. A Rando-Phantom was used in lieu of the patient. Victoreen chamber was used to determine the exposures and the results were converted into millirads by multiplying the corrected readings by the suitable absorption factor (.92). Table 8 D-S serves as a worksheet to compute the per capita per annum doses by sex as referred to the total population of the Southern Region, 1968 reported in Table 9 D-S.

The method of calculation is given herewith:

In order to determine the corresponding gonadal doses (absorbed), one must multiply the exposure doses (mR) by the factor .92 (the proper conversion factor for soft tissues, as explained previously).

The first column of Table 8 D-S presents the Mean Gonadal Exposure Doses by Sex and by Type of Examination.

The second column of these Tables containing the Mean Absorption Doses, are obtained by multiplying the first column (Exposure Doses) by the conversion factor .92, as given in N.B.S. No. 85, 1964.

The third column of the Tables contain the Total Number of Examinations by Type of Examination and by Sex.

Each entry in the fourth column is computed by multiplying the corresponding entry of columns two and three, resulting in the Global Gonadal Absorption Dose by Sex and by Type of Examination.

The Total and Grand Total column contain the corresponding totals of Examinations and Global Gonadal Absorption Doses. The second figure in this column gives the Mean Gonadal Absorption Dose by Sex and the Average; computed by dividing the corresponding entries of column four by those of column three, i.e. the Average Gonadal Dose weighted by the corresponding number of cases.

The first figure of the Total column is obtained by dividing the corresponding second column entries by .92.

Using the Global Irradiation Dose in Table 8 D-S with the proper population figures, the per capita annual average irradiation dose due to all the genetically hazardous abdominal and thoracal diagnostic X-ray examinations in the Southern Region, Puerto Rico-1968 is computed thus: 22.7 mrad per person per year for males; 56.4 mrad per person per year for females and 43.6 mrad per person per year for both sexes.

Table 10 D-S contains the calculation of the mean gonadal doses by sex and by type of thoracal examination and the mean gonadal doses due to all thoracal examinations computed with the method described above.

It is interesting to observe that although the number of x-ray examinations per 100 patients is higher in the Southern Region than the corresponding figure in the Western Region-1967/8 (40.6 vs 34.1), the per capita gonadal dose in the S.R. in 1968 is lower than the corresponding figure in the W.R. in 1968 (43.6 vs 56.4). This may very well be due to technically sounder practices in the S.R., associated presumably with the generally higher industrial and technical level of that geographic region. As an illustration of what is meant by "technically sounder practices" it is worthwhile to point out that fifty (60.2%) of the eighty three diagnostic X-ray units in use in the Southern Region-1968 had variable collimators, while only seventeen (21.7%) of the seventy eight diagnostic X-ray units in the

Western Region-1968 had variable collimators. The importance of good collimation in relation to the unintentional gonadal dose is demonstrated in Figure 10 D-S which compares the anatomical regions of the body exposed to direct irradiation during thoracical X-ray diagnostics performed with:

- (a) a variable collimator,
- (b) a cone,
- (c) no collimation.

The thoracical examinations formed a large part (40-50%) of all diagnostic radiology in the Southern Region in 1968, though the gonad dose was only 1-2 millirads in the average chest diagnostic X-ray examination.

Certain radiological practices designed to save time for the radiologist may have adverse effect on the gonadal dose. It was observed that certain institutions practice the following routine in the "gastro-intestinal series": After the patient swallows the barium, 5-6 exposures of the 14" by 17" size are made in prescribed intervals by the X-ray technicians. The films are then interpreted by a radiologist. In this procedure the testes are almost always in the primary beam, resulting in a testicular dose of approximately 1500 mrad per examination, whereas the testicular dose associated with the "gastro-intestinal series" routine performed by spot film technique is only about 176.6 mrad (see Table 7 S-D).

This example should be indicative of how significant sound radiological practices are in keeping the unintentional gonadal doses as low as possible.

It may be concluded then, that since the unintentional gonadal dose is dependent upon a series of radiological parameters such as beam quality, collimation, direct testicular shielding, filtration, positioning etc.— those parameters require careful evaluation in each case by a radiologist in order to keep the unintentional gonadal dose as small as possible without interfering with the quality of the diagnostic information required.

Optimizing all parameters with this performance index in mind is the declared purpose of every professional involved in the complex field of radiation protection.

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- Figure 1 DS: Determination of Half Value Layer in the most common X-ray units. Southern Region, Puerto Rico-1968.
- Figure 2 DS: Determination of Half Value Layer, by graphical method. Transmitted radiation vs. absorber thickness.
- Figure 3 DS: Correction factor of Victoreen 227 and 228 chambers.
- Figure 4 DS: LiF-TLD powder and Victoreen 228 ionchamber intercalibration curves (Ref. Table 1 DS).
- Figure 5 DS: LiF-TLD powder and Victoreen 227 intercalibration curve. (Ref. Table 2 DS).
- Figure 6 DS: Indirect beam exposures as measured by Victoreen 227 chamber and by relative optical density of Du Pont SX249-135A films vs. voltage applied 20cm. caudal from central beam incidence.
- Figure 7 DS: Indirect beam exposures as measured by Victoreen 227 chamber and by relative optical density of Du Pont SX249-135A films vs. voltage applied 20cm. caudal from central beam incidence.
- Figure 8 DS: LiF-TLD reading vs Victoreen readings, irradiation simultaneous and under identical conditions.
- Figure 9 DS: (A) Correlation of in vivo and in phantom testicular exposures.  
(B) Mrad per in vivo count vs. LiF phantom count.
- Figure 10 DS: Influence of collimation techniques on the body area exposed to direct radiation, and as a consequence on the gonadal dose received by the patient during thoracical X-ray diagnostics.

FIGURE 1DS

DETERMINATION OF H.V.L. IN THE MOST COMMON X-RAY UNITS.

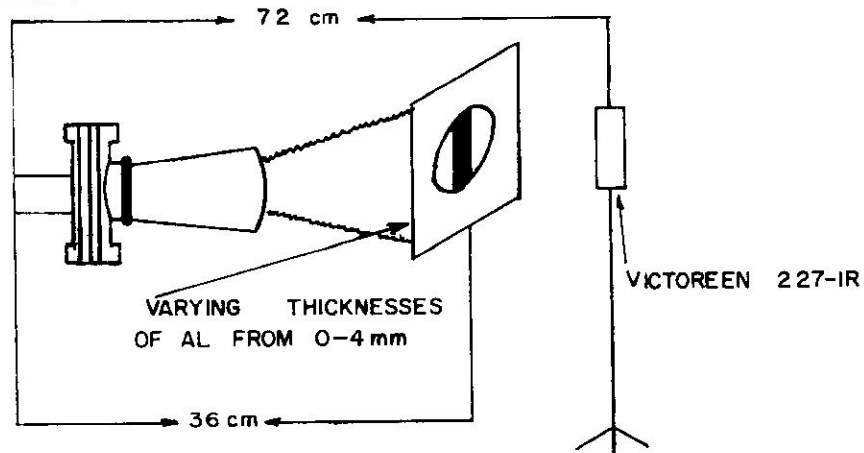
SOUTHERN REGION P. R. — 1968

PICKER-300 TEMP. 71°F

0	— 442
0.5	— 400
1	— 362
1.5	— 328
2	— 305
2.5	— 290
3	— 260
3.5	— 240
4	— 220
4.5	— 200

G.E.-200 TEMP. 71°F

0	— 375
0.5	— 340
1	— 310
1.5	— 280
2	— 260
2.5	— 230
3	— 200
3.5	— 180
4	— 155
4.5	— 140



PICKER-300

$$M = \frac{.693}{0.40 \text{ cm}} = 1.73$$

2.7  $\frac{\text{gr}}{\text{cc}}$  DENSITY OF AL.

TOTAL MASS AL. COEFFICIENT

$$M/P = \frac{1.73 \text{ cm}}{2.7 \frac{\text{gr}}{\text{cc}}} = 0.640 \frac{\text{gr}}{\text{cm}^2}$$

KEV. EFF. = 37 KEV.

G.E.-200

$$M = \frac{.693}{0.35 \text{ cm}} = 1.98$$

2.7  $\frac{\text{gr}}{\text{cc}}$  DENSITY OF AL.

TOTAL MASS AL. COEFFICIENT

$$M/P = \frac{1.98 \text{ cm}}{2.7 \frac{\text{gr}}{\text{cc}}} = 0.733 \frac{\text{gr}}{\text{cm}^2}$$

KEV. EFF. = 34.9 KEV.

- 1) DISTANCE T.V.D. — 72cm (TARGET-VICTOREEN — DISTANCE)
- 2) DISTANCE T.F.D — 36cm (TARGET-FILTER — DISTANCE)
- 3) MEASUREMENTS WERE MADE AT 71°F (22°C) —, THEREFORE NO TEMPERATURE CORRECTION WAS MADE.
- 4) VICTOREEN CHAMBER — 227 1,000mR WAS USED TO MEASURE EXPOSURE.

FIGURE 20S  
 DETERMINATION OF HALF VALUE LAYER BY GRAPHICAL  
 METHOD TRANSMITTED RADIATION V.S. ABSORBER THICKNESS

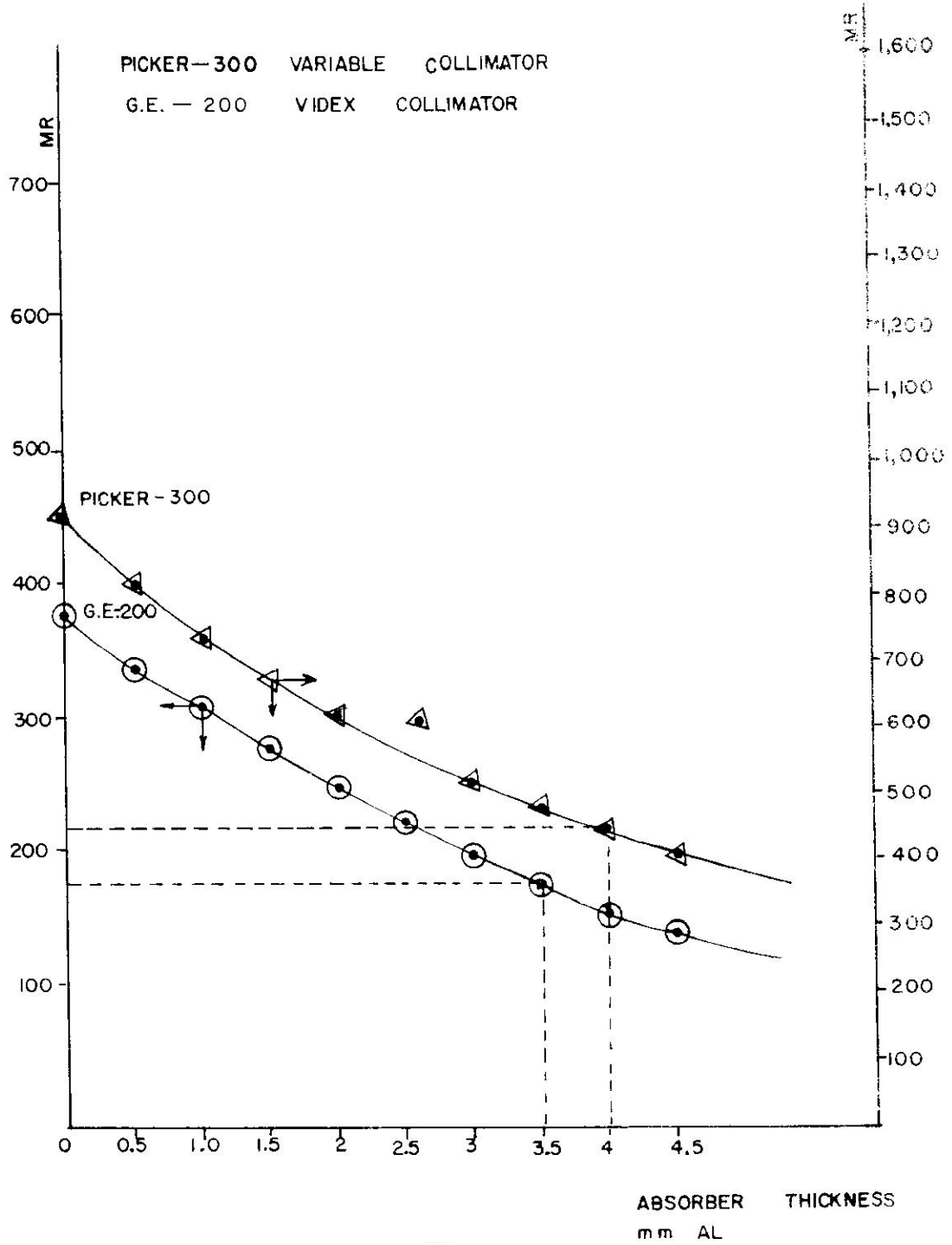
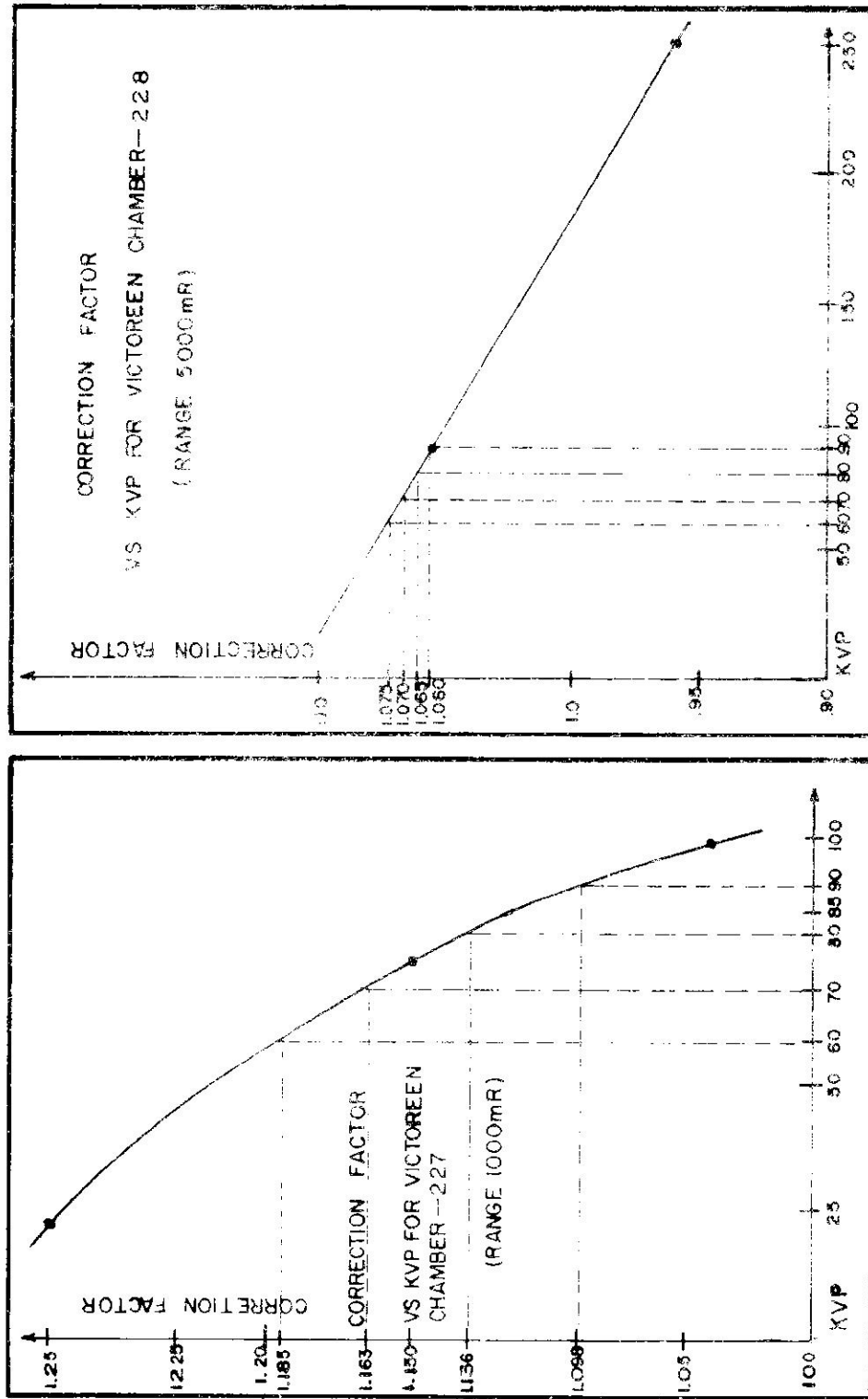
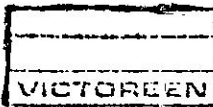


FIGURE 3 DS  
CORRECTION FACTOR OF VICTOREEN ---227 AND 228 CHAMBERS,





VICTOREEN INSTRUMENT DIVISION 10101 WOODLAND AVE., CLEVELAND, OHIO 44104  
 PHONE 223-1234 • FAX 223-1234 • TELETYPE 223-1234 • TELEFAX 223-1234

CALIBRATION REPORT

To: Electronics of Puerto Rico Date MAY 7 1968  
 Register # 11530C 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
M <sup>1</sup>	250	5	3.2	140	3.2	18
Cs <sup>137</sup> *	—	—	—	660	—	—
Co <sup>60</sup> *	—	—	—	1250	—	—

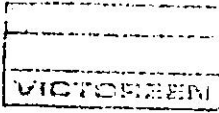
Correction factors for these techniques are obtained by intercomparison with instruments whose calibrations are traceable to the U.S. National Bureau of Standards and are accurate to within ±3%.

Model and Serial No.	Correction Factor (Multiplier) for Technique				
	(J)	(M)	(H)	(I)	(K)
<u>Re Chambers</u>					
<u>227 1. # 158</u>		<u>1.04✓</u>			<u>1.50</u>
<u>228 5. # 151</u>		<u>1.05</u>	<u>.97</u>		
<u>633 2.5A # 167</u>		<u>1.01</u>		<u>1.07</u>	<u>1.085 1.04</u>

\*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.T.  
 (X-Ray Lab.)

Form: 9664A-1-68



VICTOREEN INSTRUMENT DIVISION • 10101 WOODLAND AVE., CLEVELAND, OHIO  
 PHONE (216) 795-5200 • TWX (610) 421-8287 • TELETYPE 098-5388

Calibration Report

To: Electricista J. Puerto Rico Date MAY 7 1968  
 Register # 11530 Mode 227 #158; 633 #167

X-ray Technique

Lightly Filtered X-ray

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

Correction Factors  
(multiply by)

kv	3.2	23.0	40.6	50.0
Item				
227 #158	-	1.250 ✓	1.225 ✓	-
633 #167	-	-	1.175	-

Other -

Calibrated by [Signature] The Victoreen Instrument Co.  
 Radiation Lab. Cleveland, Ohio



FIGURE 4 DS

LiF-TLD POWDER AND VICTOREEN 228 ION CHAMBER INTER-  
-CALIBRATION CURVES (REF. TABLE 1 DS)

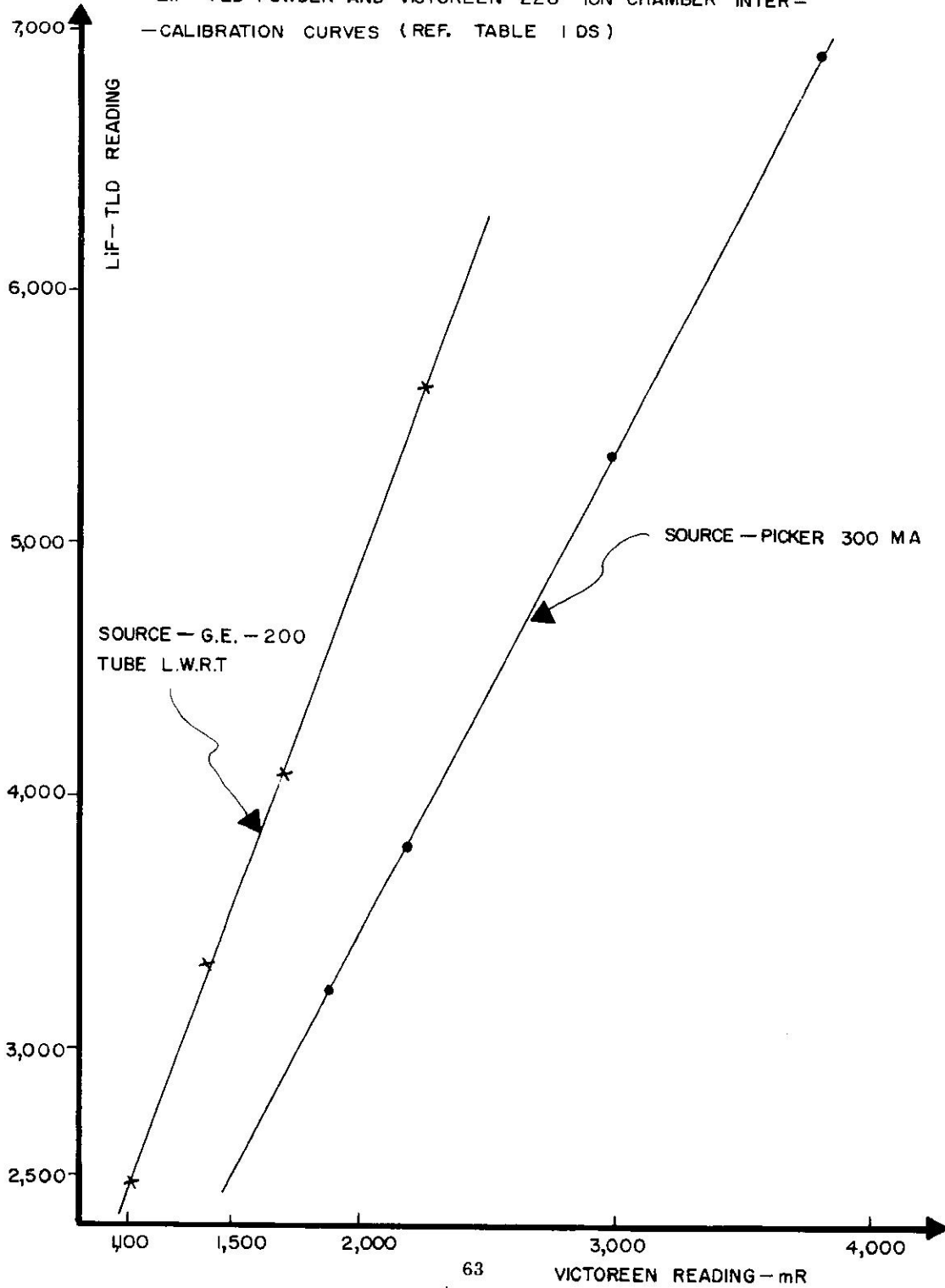
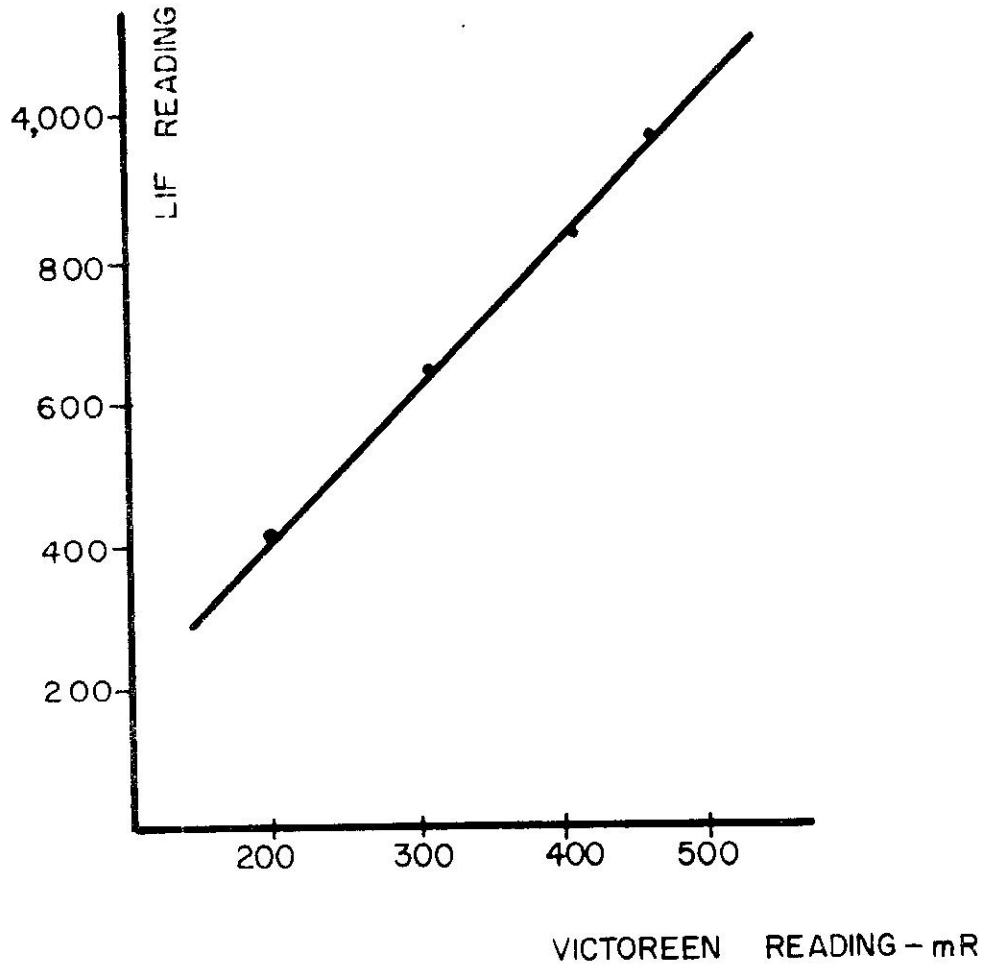


FIGURE 5D-S  
LIF-TLD POWDER AND VICTOREEN-227  
INTERCALIBRATION CURVE (REF. TABLE 2DS)



EXPERIMENTAL WORK SHEET

EXPERIMENTAL FILM FOR M. GILEADI

District Hospital  
BATCH NO. 5219, Ponce, P. R.

TYPE FILM DU PONT SX249-135A

DATE 3/5/70

FILM NO.	OPEN WINDOW		FILTERS			NTA FILM Tracks per 25 fields	CONDITIONS OF EXPOSURE
			Cd		Al		
	DENS.	EXPOSURE	DENS.	EXPOSURE	DENS.		
	Absolute Densities					Indirect Beam	
						Picker 300 MA	
						Dist. 36"	
		ow		ow			
		555		1290			
1.	.13						Control 1
2.	.13						Control 2
63.	5.07		0.22	.220		60 KV 1	.220
64.	5.04		0.22			60 KV 2	
65.	>6.00		0.26	.260		70 KV 1	.260
66.	>6.00		0.26			70 KV 2	
67.	>6.00		0.31	.315		80 KV 1	.315
68.	>6.00		0.32			80 KV 2	
69.	>6.00		0.38	.385		90 KV 1	.385
70.	>6.00		0.39			90 KV 2	

REMARKS: Background fog was subtracted at the time of reading. All densities are absolute densities. 555-Sensitive film. 1290-Insensitive film. Brookhaven National Laboratory, Health Physics Division.

EXPERIMENTAL WORK SHEET

District Hospital

EXPERIMENTAL FILM FOR M. GILEADI

BATCH NO. 5219, Ponce, P.R.

TYPE FILM DU PONT Sx249-135A

DATE 3/5/70

FILM NO.	OPEN WINDOW		FILTERS			NTA FILM Tracks per 25 fields	CONDITIONS OF EXPOSURE
			Cd		Al		
	DENS.	EXPOSURE	DENS.	EXPOSURE	DENS.		
	Absolute		Densities			Indirect Beam	
						G.E. 200MA	
						Dist. 36"	
		ow		ow			
		555		1290			
1.	.13						Control 1
2.	.13						Control 2
3.		5.26		0.22	.215	}	60 KV 1
4.		4.91		0.21			60 KV 2
5.		5.73		0.23	.230	}	70 KV 1
6.		5.82		0.23			70 KV 2
7.		>6.00		0.26	.255	}	80 KV 1
8.		>6.00		0.2			80 KV 2
9.		>6.00		0.26	.285	}	90 KV 1
10.		>6.00		0.31			90 KV 2

REMARKS: Background fog was subtracted at the time of reading. All densities recorded are absolute densities. 555-Sensitive film. 1290-Insensitive film. Brookhaven National Laboratory, Health Physics Division.

FIGURE 8 DS  
LIF-TLD READING VS. VICTOREEN READINGS, IRRADIATION  
SIMULTANEOUS AND UNDER IDENTICAL CONDITIONS.

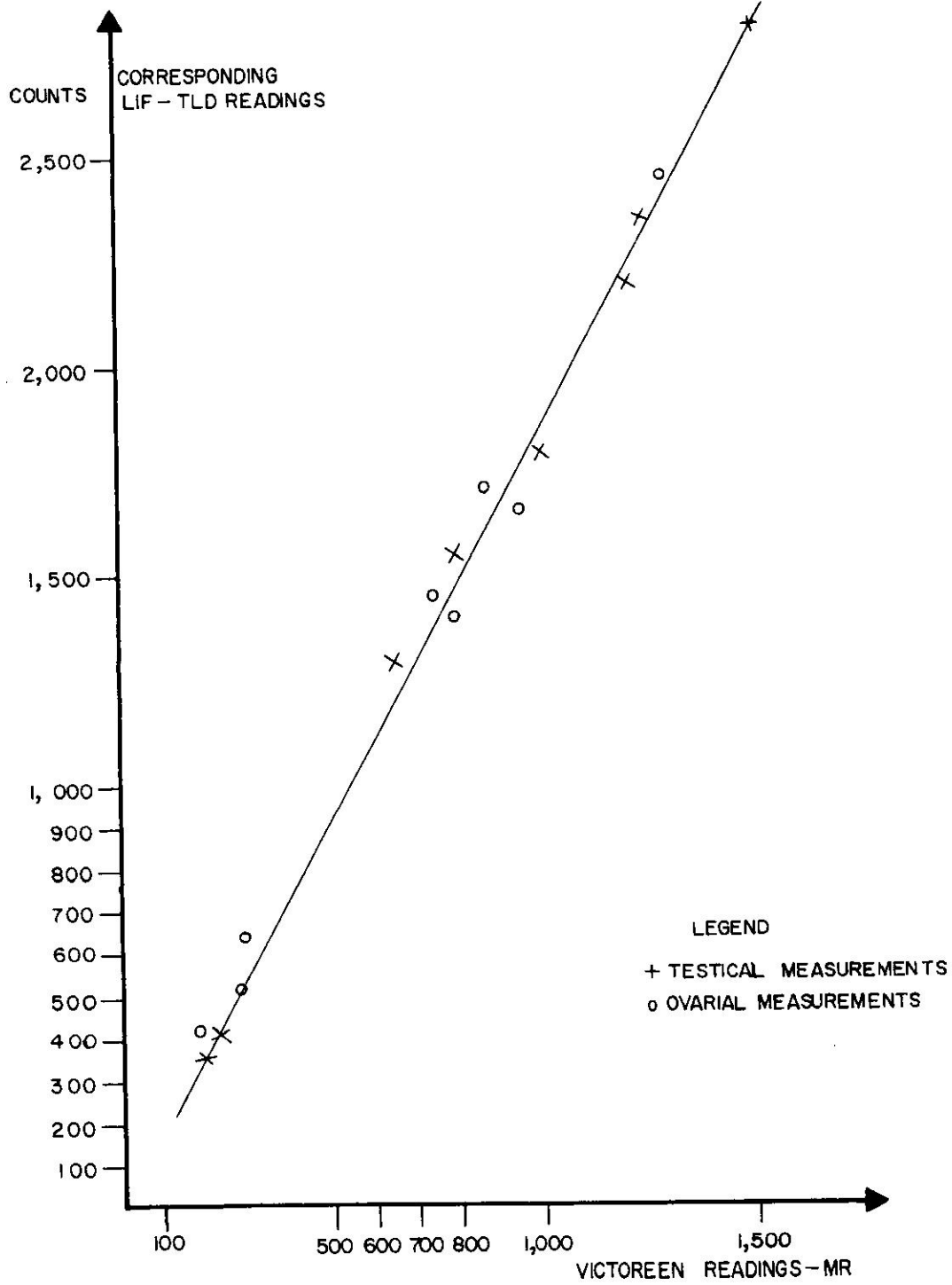


FIGURE 9DS

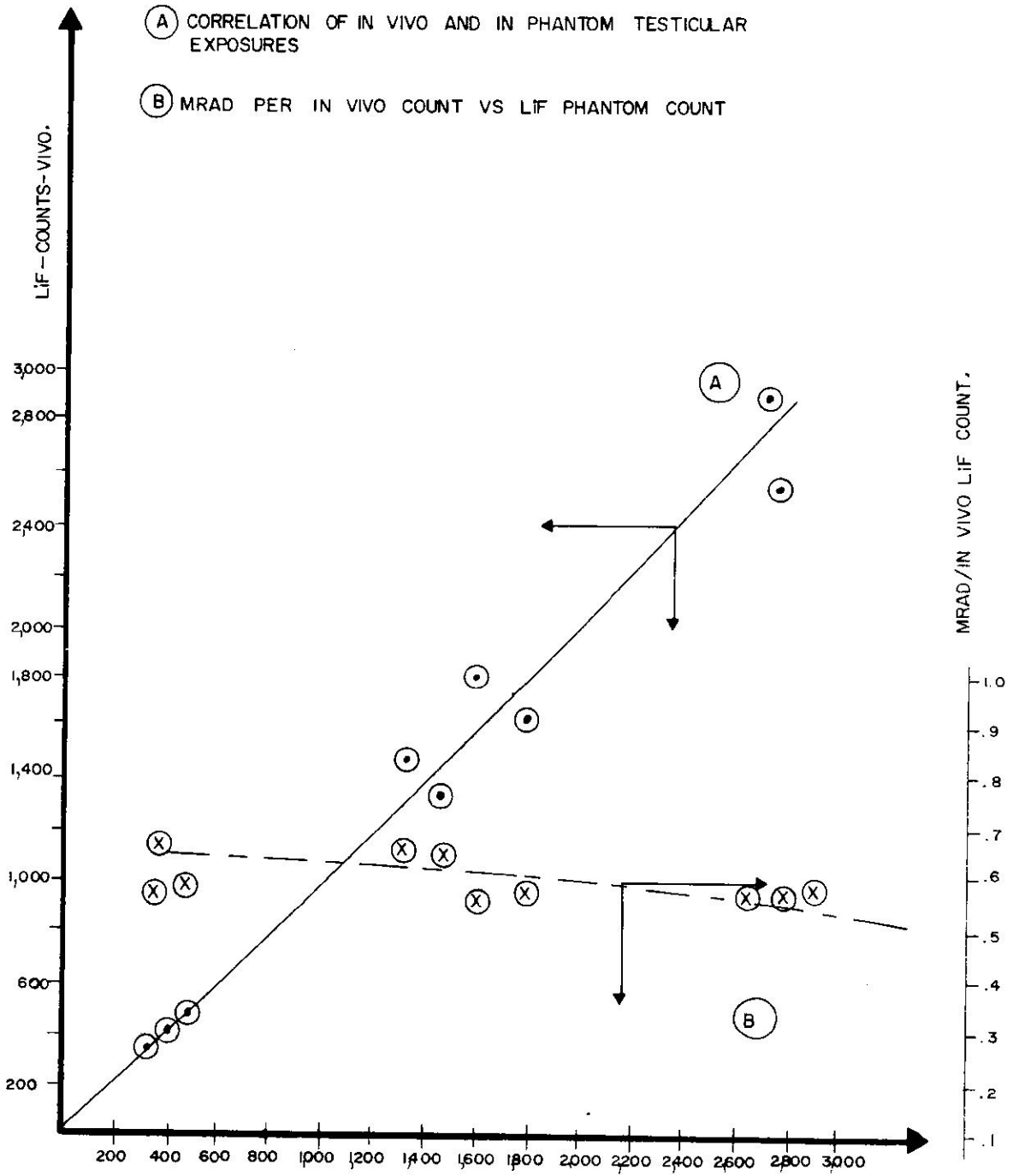
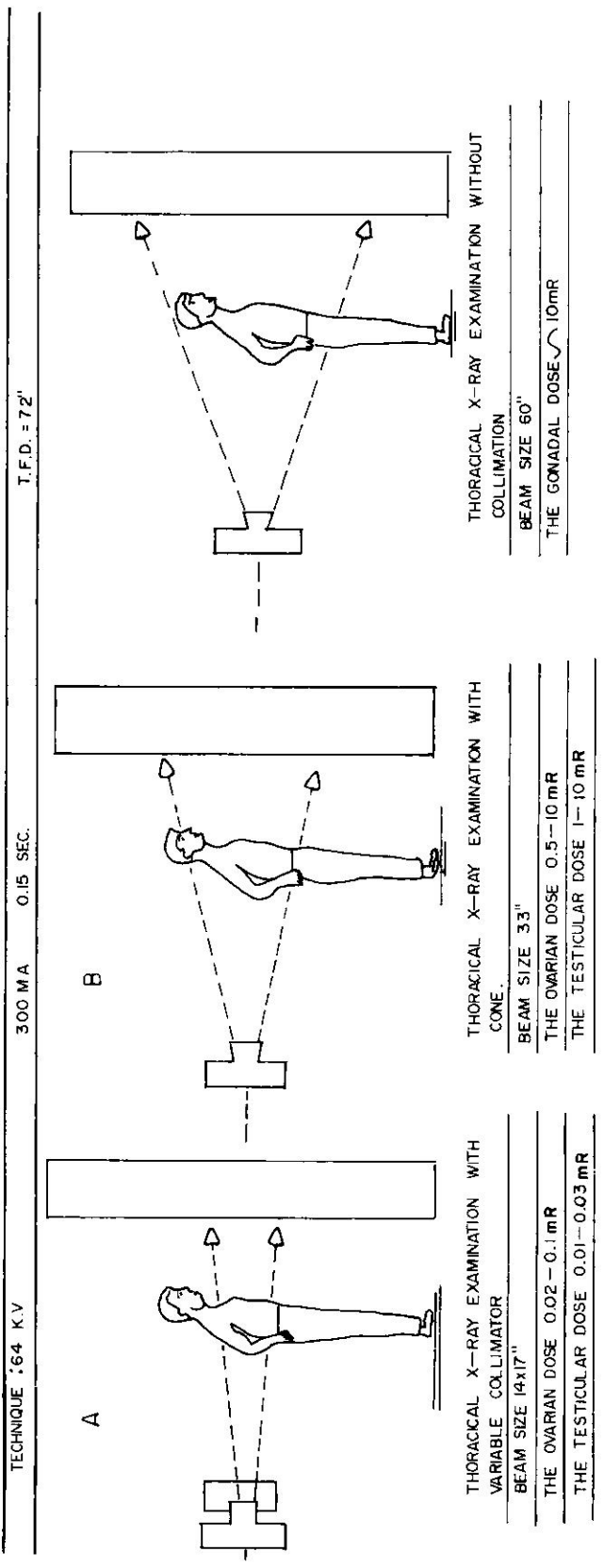


FIGURE 10-DS

EFFECT OF COLLIMATION TECHNIQUES ON THE BODY-AREA EXPOSED TO DIRECT RADIATION,  
AND AS A CONSEQUENCE ON THE GONADAL DOSE RECEIVED BY THE PATIENT DURING THORACICAL  
X-RAY DIAGNOSTICS. ①



① BASED ON THE ARTICLE TITLED:

"MEASUREMENT OF BONE MARROW AND GONADAL DOSE FROM THE CHEST X-RAY EXAMINATIONS AS A FUNCTION OF FIELD SIZE". BASED ON THE PAPER BY E.R. EPF, H. WEISS AND J. LANGHIN, BRITISH J. OF RADIOLOGY--1961

## LIST OF TABLES

- Table 1 D-S: LiF-TLD powder and Victoreen 228 ionchamber intercalibration data Southern Region, Puerto Rico.
- Table 2 D-S: LiF-TLD powder and Victoreen 227 ionchamber intercalibration data. Southern Region, Puerto Rico.
- Table 3 D-S: Du Pont SX249-135A film dosimeters and Victoreen 227 ionchamber intercalibration data. Southern Region, Puerto Rico.
- Table 4 D-S: Exposure at depth of 12.5 cm on the phantom, at location of the ovaries.
- Table 5 D-S: Comparison of testical and ovarial exposures per examination as measured by Victoreen 228 (5R) and by TLD-LiF dosimeters using Picker-300 X-ray unit and Rando Phantom. Southern Region, Puerto Rico-1968.
- Table 6 D-S: Comparison of in vivo and in phantom testicular exposures by type of examination. Southern Region, Puerto Rico-1968.
- Table 7 D-S: Mean gonadal dose per X-ray examination by type of examination and by sex. Southern Region, Puerto Rico-1968.
- Table 8 D-S: Mean gonadal dose per patient due to each thoracical X-ray examination. Southern Region, Puerto Rico-1968.
- Table 9 D-S: Computation of the mean per capita gonadal dose due to a selected group of genetically hazardous abdominal diagnostic X-ray examinations. Southern Region, Puerto Rico-1968.
- Table 10 D-S: Per capita, per annum mean gonadal dose due to all genetically hazardous abdominal and thoracical X-ray examinations. Southern Region, Puerto Rico-1968.



TABLE 1 D-S

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

Exposures measured on the surface of the skin, 15 cm. laterally from the incidence of the direct beam; using 100 MAS at a TFD=90 cm.

Southern Region, Puerto Rico

A. Irradiation source used to obtain data: <u>Picker-300 MA, Tube PX-10A, Filtration 3mm. Al. H.V.L. 4</u> (District Hospital, Ponce, P.R.)					
<u>Tube Voltage</u> <u>--KV--</u>	<u>Victoreen 228</u> <u>Reading</u> <u>MR.</u>	<u>Correction</u> <u>Factor</u>	<u>True</u> <u>Exposure</u> <u>MR.</u>	<u>LiF.-TLD</u> <u>Powder</u> <u>Readings*</u>	<u>Ratio of LiF.-TLD</u> <u>to Victoreen Reading</u>
60	1900	1.075	2,042	3,240	.63
70	2200	1.070	2,354	3,790	.62
80	3000	1.065	3,195	5,320	.60
90	3820	1.060	4,050	6,910	.58
B. Irradiation source used to obtain data: <u>G.E. -200, Tube L.W.R.T., Filtration 3mm. Al. H.V.L. 3.5</u>					
60	1100	1.075	1,182	2,475	.47
70	1400	1.070	1,498	3,325	.45
80	1700	1.065	1,810	4,104	.44
90	2267	1.060	2,403	5,595	.42

\* Background correction subtracted.

TABLE 2 D-S

LiF-TLD POWDER AND VICTOREEN-227 IONCHAMBER INTERCALIBRATION DATA

Exposures measured at location of the testes, 20 cm. caudal from central beam incidence using 100 MAS at a TFD=90 cm.

Southern Region, Puerto Rico

A. Irradiation source used to obtain data: <u>Picker 300 MA, Tube PX-10A, Filtration 3mm. Al. H.V.L. 4</u> (District Hospital, Ponce, P.R.)					
Tube Voltage KV	Victoreen 227 Reading mR	Correction Factor	True Exposure mR	LiF-TLD Powder readings*	Ratio of LiF-TLD to Victoreen Reading
60	200	1.185	237	403	.58
70	310	1.163	360	645	.55
80	410	1.136	465	836	.55
90	470	1.098	516	962	.53

\* Background correction subtracted.

TABLE 3 D-S

## DU PONT SX249-135A FILM DOSIMETERS AND VICTOREEN 227 IONCHAMBER INTERCALIBRATION DATA

Exposures made in indirect beam, 20cm. caudal from central beam at location of testes, using 100 MAS and TFD = 90cm. Southern Region, Puerto Rico

Irradiation made at District Hospital, Ponce.					
Tube Voltage	Victoreen 227 Reading	Correction Factor	True Exposure	Relative optical densities Non sensitive film	Ratio of film dosimeter reading to true exposure
KV	mR		mR		
60	220	1.185	260.7	0.220	0.084
70	330	1.163	383.7	0.260	0.067
80	490	1.136	556.6	0.315	0.056
90	665	1.098	730.1	0.385	0.052
A. Irradiation source used to obtain data: <u>Picker 300 MA, Tube PX-10A, Filtration 3mm. Al. H.V.L. 4</u>					
Irradiation source used to obtain data: <u>G.E. 200 MA, Tube L.W.R.T., Filtration 3mm. Al, H.V.L. 3.5</u>					
60	125	1.185	148.1	0.215	0.165
70	190	1.163	220.9	0.230	0.104
80	270	1.136	306.7	0.255	0.083
90	360	1.098	395.2	0.285	0.072

TABLE 4 D-S

EXPOSURE AT DEPTH OF 12.5 cm. ON THE PHANTOM, AT LOCATION OF THE OVARIES\*

Read with Victoreen-228 (5R). Irradiated with Picker-300 MA. Total Filtration 3mm. H.V.L. 4. Central Beam directed on 3rd lumbar. Variable collimator, maximum opening, TFD = 90cm., 100 MAS.

KV	Reading Victoreen 228 (5R)		Mean	Correction Factor	True Exposure (mR)
	Left Ovary	Right Ovary			
60	290	300	295	1.075	317.1
70	390	410	400	1.070	428.0
80	520	560	540	1.065	575.1
90	640	680	660	1.060	699.6

II

EXPOSURE AT DEPTH OF 12.5 cm. ON THE PHANTOM, AT LOCATION OF THE OVARIES

Irradiated with G.F.-200 MA. Total Filtration 3 mm. H.V.L 3.5, TFD = 90 cm., 100 MAS

KV	Reading Victoreen 228 (5R)		Mean	Correction Factor	True Exposure (mR)
	Left Ovary	Right Ovary			
60	278	260	269	1.075	289.1
70	310	350	330	1.070	353.1
80	490	510	500	1.065	532.5
90	600	660	630	1.050	661.5

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

TABLE 5 D-S

COMPARISON OF TESTICAL AND OVARIAL EXPOSURES PER EXAMINATION AS MEASURED BY VICTOREEN 228 (5R)  
AND BY TLD-LiF DOSIMETERS USING PICKER-300 X-RAY UNIT AND RANDO-PHANTOM  
SOUTHERN REGION, PUERTO RICO-1968

Total Filtration: 3 mm. Al. HVL 4 mm. Al. Variable Collimator District Hospital, Ponce, P.R. Sept. 30, '69											
Parameters and Exposures	Abdomen	Chole-cysto-graphy	Lumbar Spine	Gastro-intest. Series	Barium Enema	I. V. P.	Pelvis	Hip Joint	Pelvimetry		
Size of Field	14x17"	8x10"	11x14"	Total	Total	17x17"	14x17"	11x14"	14x17"		
KVP	80	30	70	80	85	70	65	30	35		
MAS	40 MAS (200x.2)	100 MAS (200x.5)	60 MAS (200x.3)			100 MAS (200x.5)	40 MAS (200x.2)		100 MAS (200x.5)		
Dist. Cm.	90	90	95	36	36	100	100	50	100		
Victoreen 228 & 5R Ovaries mR.	280	200	1,320	750	950	800	870	300	1,400		
Victoreen 228 & 5R Testes mR	230	0	200	220	1,500	1,250	800	1,000	-		
LiF Counts Ovaries	533	440	2,456	1,482	1,670	1,410	1,700	650	2,570		
LiF Counts Testes	414	10	380	450	2,800	2,350	1,550	1,800	-		
No. of Exposures per Examination	1	4	2	8	5	4	1	2	2		

Total included fluoroscopy.

TABLE 6 D-S

COMPARISON OF IN VIVO AND IN PHANTOM TESTICULAR EXPOSURES BY TYPE OF EXAMINATION  
SOUTHERN REGION, PUERTO RICO-1968

	In Vivo LiF. Reading Counts	In Phantom LiF. Reading Counts	Ratio of In Vivo to In Phantom Reading	Victoreen Reading mR	Corresponding Dose mrad	mrad per LiF. Count In Vivo
Abdomen	409	414	0.988	250	230	.562
Cholecystography	15	10	1.500	0	0	N.A.
Lumbar Spine	395	380	1.039	200	184	.465
Gastrointest. Series	435	427	1.018	220	202	.464
Barium Enema	2900	2750	1.054	1500	1380	.475
I.V.P.	2790	2520	1.107	1400	1288	.461
Pelvis	1340	1480	0.905	800	736	.549
Hip Joint	1800	1610	1.180	900	828	.460

TABLE 7 D-S

MEAN CONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX  
SOUTHERN REGION, PUERTO RICO-1968

TYPE OF EXAMINATION	MILLIRADS PER EXAMINATION	
	Male	Female
Chest	1.88	.94
Photofluorographic	.23	.14
Tomographic	37.2	6.0
Abdomen	355.2	533.2
Cholecystography	9	191.0
Lumbar Spine	160	1,187.7
Gastrointestinal Series	176.6	685.4
Barium Enema	1,239.2	879.5
I.V.P.	1,150.0	759.9
Pelvis	756.2	63.6
Hip Joint	782.2	281.5
Pelvimetry	-	1,029.4

TABLE 8 D-S

MEAN GONADAL DOSE PER PATIENT DUE TO EACH THORACICAL X-RAY EXAMINATION  
SOUTHERN REGION, PUERTO RICO-1968

	Chest		Photofluoro-		Tomography*		Total		GRAND TOTAL
	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.	
Mean Exposure Per Examination Milliroentgens	2	1	0.25	0.15	37.2	5.4	1.60	.69	1.13
Mean Absorbed Dose Per Examination Millirads	1.88	.94	.23	.14	35.0	5.0	1.48	.63	1.04
Total Number of Examinations	35,463	33,094	15,997	20,788	172	72	51,622	53,954	105,576
Global Irradiation Dose to All Examined Patients Millirads	66,670	31,108	3,677	2,910	6,020	360	76,367	34,378	110,745

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



TABLE 9 D-S

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP  
OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS  
SOUTHERN REGION, 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.	364.3	335	22,009	890,010
	F.	579.6	533	26,577	1,991,710
Cholecystography	M.	10	9	1,404	12,636
	F.	208	191	3,309	632,019
Lumbar Spine	M.	174	160	6,217	99,472
	F.	1291	1188	3,666	4,355,208
Gastrointest. Series	M.	192	177	3,209	567,933
	F.	745	685	4,395	3,010,575
Barium Enema	M.	1347	1239	589	729,771
	F.	956	879	950	835,050
I.V.P.	M.	1250	1150	2,858	3,280,950
	F.	826	760	3,180	2,416,800
Pelvis	M.	822	756	1,240	937,440
	F.	69	64	1,806	115,584
Hip Joint	M.	851	783	1,098	859,734
	F.	306	282	1,086	306,252
Pelvimetry	F.	1119	1029	495	509,355
Total	M.	364.3	335.2	22,009	7,378,006
	F.	579.6	533.2	26,577	14,172,553
GRAND TOTAL		481.2	443.6	48,586	21,550,559

TABLE 10 DS

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

SOUTHERN REGION, PUERTO RICO - 1968

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION SOUTHERN REGION PUERTO RICO - 1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	7,378,006	241,815	22.7
FEMALE	14,172,553	251,685	56.4
TOTAL	21,550,559	493,500	43.6

# GENETICALLY SIGNIFICANT DOSE

The unintentional irradiation of the gonads affects not only the patient. It may damage the patient's offspring, and future generations via the genetic material transmitted from irradiated parent to child.

In order to express the magnitude of this effect in a quantitative fashion, a representative parameter called The Genetically Significant Dose (GSD) was designed.

In their basic paper on the subject (see ref. 8) Penfil and Brown explain how the GSD is computed and how it is used as an index to measure genetically transmittable radiation hazards. Their general formula:

$$GSD = \frac{\sum D_i N_i P_i}{\sum N_i P_i}$$

is used in the publications of the U.S. Public Health Service (see ref. 8).

In this formula:

$D_i$  = the average gonadal dose to persons age (i) who receive X-ray examinations,

$N_i$  = the number of persons of a specific sex receiving the examination in the age class considered

$P_i$  = the expected future number of children of a person age (i), and

$N_i$  = the number of persons in the population of age (i).

The GSD as computed by the Penfil-Brown formula gives the average gonadal dose per offspring (referred to a given population) due to unintentional gonadal irradiation of the parent generation.

The formula used is:

$$GSD = \frac{\sum_i \sum_j \left[ \left( \frac{\text{Male}}{N_{ij} P_i D_{ij}} \right) + \left( \frac{\text{Female}}{N_{ij} P_i D_{ij}} \right) \right]}{\sum_i \left[ \left( \frac{\text{Male}}{N_i P_i} \right) + \left( \frac{\text{Female}}{N_i P_i} \right) \right]}$$

In order to perform the calculation, Table 2-GSD was first compiled by computing the number of examinations performed in the Southern Region of Puerto Rico during 1968, by age groups, sex and by type of examination.

Next a work sheet was set up for each type of examination, a sample of which is attached to this report. This contains the  $N_i$  values and mean gonadal dose values which correspond to the type of examination and sex. The product of the first, third, and fifth column entries was entered into the seventh column ( $N_{im}$ ,  $Dim$ ,  $P_{im}$ ) and the product of the second, fourth and sixth column ( $N_{if}$ ,  $D_{if}$ ,  $P_{if}$ ) was entered into the eighth column. The sum of the seventh and eighth column gives

$$\sum_{i=1}^4 (N_{im} Dim P_{im} + N_{if} D_{if} P_{if}).$$

This was divided by  $N_i P_i$ , which is the overall sum of products formed from population figures in the corresponding age sex group by the suitable number of expected future children. The GSD is the quotient of those two numbers. Table 5-GSD contains all GSD values by sex and type of examination as well as the total GSD values by sex for all types of examinations considered in this report.

Among all types of diagnostic X-ray examinations considered, the highest values are associated with Lumbar Spine, I.V.P. and Gastrointestinal Series. Except for examinations involving the pelvic region (which may have the testes in the direct beam) female GSD's are higher than male GSD's.

The genetically significant dose in 1968 in Puerto Rico's Southern Region is lower than the values reported for the U.S. (1964), Sweden (1955) and Japan (1960). The number of diagnostic X-ray examinations of all kinds per 100 population is 44.1, second only to the U.S. (1964) which had 53.

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- Table 1 GSD: Number of thoracical diagnostic X-ray examinations in the reproductive age (15-44) by geographic location, by medical facility and by sex. Southern Region, Puerto Rico-1968.
- Table 2 GSD: Number of abdominal diagnostic X-ray examinations by type of examination, age and sex. Southern Region, Puerto Rico-1968.
- Table 3 GSD: Number of thoracical diagnostic X-ray examinations by type of examination, age and sex. Southern Region, Puerto Rico-1968.
- Table 4 GSD: Genetically significant doses in millirads by type of examination, age and sex. Southern Region, Puerto Rico-1968.
- Table 5 GSD: Comparison of report annual genetically significant dose from diagnostic radiology (selected countries).

TABLE 1 (G.S.D.)  
 NUMBER OF THORACICAL DIAGNOSTIC X-RAY EXAMINATIONS IN THE REPRODUCTIVE AGE (15-44)  
 BY GEOGRAPHIC LOCATION, BY MEDICAL FACILITY, AND BY SEX.

GEOGRAPHIC LOCATION	MEDICAL FACILITY	AGE								TOTAL		
		15-29				30-44				Male	Female	Total
		Male	Female	Total	Male	Female	Total					
Adjuntas	Health Center Private Office	208	156	364	156	52	208	364	208	572		
Arroyo	Hosp. Lafayette	600	200	800	500	400	900	1,100	600	1,700		
Coamo	Private Office Health Center Photofluorogr.	52	104	156	104	208	312	156	312	468		
		88	110	198	140	172	312	228	282	510		
		700	1,300	2,000	500	400	900	1,200	1,700	2,900		
Coamo Total	Total	840	1,514	2,354	744	780	1,524	1,584	2,294	3,878		
Guanica	Central Guanica Hospital	100	180	280	70	109	170	170	280	450		
Guavama	Clinica Santa Rosa Private Office Health Center Photofluorogr.	39	130	169	70	60	130	109	190	299		
		140	110	250	100	80	180	240	190	430		
		143	208	351	416	403	819	559	611	1,170		
		1,820	2,080	4,900	1,100	1,142	2,242	2,920	3,222	6,412		
	Total	2,142	2,528	5,670	1,686	1,685	3,371	3,828	4,213	8,041		
Guayanilla	Private Office	200	300	500	240	300	540	440	600	1,040		
Jayuya	2 Private Off.	77	80	157	54	32	86	131	112	243		
Juana Diaz	Health Center 2 Private Off.	275	250	525	300	275	575	575	525	1,100		
		676	520	1,196	156	104	260	832	624	1,456		
	Total	951	770	1,721	456	379	835	1,407	1,149	2,556		

TABLE 1 (G.S.D.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	AGE												
		15-29			30-44			TOTAL						
		Male	Female	Total	Male	Female	Total	Male	Female	Total				
Maunabo	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Patillas	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Peñuelas	Health Center	-	-	-	-	-	-	-	-	-	-	-	-	-
Ponce	District Hosp.	1,605	1,815	3,420	1,654	1,573	3,227	3,259	3,388	6,642				
	Tomography	-	-	-	16	20	36	16	20	36				
	Total	1,605	1,815	3,420	1,670	1,593	3,263	3,275	3,408	6,683				
	Hospital de Damas	520	208	728	780	260	1,040	1,300	468	1,768				
	Clinica Dr. Pila	572	585	1,157	502	715	1,217	1,074	1,300	2,374				
	Clinica Oncologica	-	104	104	252	156	408	252	260	512				
	Fondo del Seguro	4,000	700	4,700	7,000	700	7,700	11,000	1,400	12,400				
	Municipal Hospital	299	455	754	247	830	1,077	546	1,285	1,831				
	St. Lucas Episcopal Hosp.	260	686	946	247	250	497	507	936	1,443				
	Hosp. Anti-Tuberculosis Tomography	260	52	312	104	208	312	364	260	624				
Total	52	52	104	52	-	52	304	52	156					
Total	312	104	416	156	208	364	468	312	780					
Public Health Unit	150	100	250	200	250	450	350	350	700					
Photofluorogr.	5,200	5,504	10,704	2,629	2,650	5,279	7,829	8,154	15,983					
Total	5,350	5,604	10,954	2,829	2,900	5,729	8,179	8,504	16,683					
Ponce Total	12,918	10,261	23,179	13,683	7,612	21,295	26,601	17,873	44,474					

TABLE 1 (G.S.D.)

GEOGRAPHIC LOCATION	MEDICAL FACILITY	AGE								TOTAL	
		15-29		30-44		TOTAL		Male	Female	Total	
		Male	Female	Male	Female	Male	Female				
Salinas	Municipal Hosp.	208	156	364	364	208	208	364	572	364	936
Santa Isabel	Municipal Hosp. 1 Private Off.	-	-	156	156	208	156	364	-	156	520
Villalba	Health Center	-	-	-	-	-	-	-	-	-	-
Yauco	2 Private Off. Public Health Unit Photofluorogr. Total	108	97	205	236	400	323	559	344	420	764
		520	510	1,030	1,010	400	460	860	920	970	1,890
		1,000	3,002	4,002	1,010	3,200	4,210	4,210	2,010	6,202	8,212
		1,628	3,609	5,237	1,646	3,983	5,629	5,629	3,274	7,592	10,866
SOUTHERN REGION GRAND TOTAL		20,028	19,754	39,782	19,807	15,687	35,494	35,494	39,835	35,441	75,276



TABLE 2 (G.S.D.)

NUMBER OF ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS  
 BY TYPE OF EXAMINATION, AGE AND SEX  
 SOUTHERN REGION, PUERTO RICO-1968

TYPE OF EXAMINATION	SEX	0-14	15-29	30-44	45 +	TOTAL	GRAND TOTAL
Abdomen	M.	152	2,198	3,000	44	5,394	13,084
	F.	257	1,916	5,445	72	7,690	
Cholecystography	M.	26	694	618	66	1,404	4,713
	F.	129	702	2,074	404	3,309	
Lumbar Spine	M.	67	3,287	2,765	98	6,217	9,833
	F.	70	1,454	2,070	72	3,666	
Gastrointestinal Series	M.	62	1,407	1,670	70	3,209	7,604
	F.	67	2,063	2,245	20	4,395	
Barium Enema	M.	63	246	248	32	598	1,539
	F.	14	439	487	10	950	
I.V.P.	M.	127	789	1,870	72	2,858	6,038
	F.	65	1,420	1,675	20	3,180	
Pelvis	M.	52	257	901	30	1,240	3,046
	F.	52	522	1,205	27	1,806	
Hip Joint	M.	51	392	593	62	1,098	2,184
	F.	18	233	815	20	1,086	
Pelvimetry	F.	-	321	174	-	495	495
Total	M.	600	9,270	11,665	474	22,005	48,586
	F.	672	9,070	16,190	645	26,581	
GRAND TOTAL		1,272	18,340	27,855	1,119	48,586	

TABLE 3 (G.S.D.)  
 NUMBER OF THORACICAL DIAGNOSTIC X-RAY EXAMINATIONS BY TYPE OF EXAMINATION, AGE AND SEX.  
 SOUTHERN REGION, PUERTO RICO-1968

AGE	CHEST		PHOTOFLUOROGRAPHIES		TOMOGRAPHIES		TOTAL
	Male	Female	Male	Female	Male	Female	
0-14	3,200	5,124	410	244	-	-	8,978
15-29	11,100	7,816	8,876	11,886	52	52	39,782
30-44	13,928	7,611	5,811	8,056	68	20	35,494
45 +	7,235	12,543	890	602	52	-	21,322
GRAND TOTAL	35,463	33,094	15,987	20,788	172	72	105,576

TABLE 4 G.S.D.

GENETICALLY SIGNIFICANT DOSES IN MILLIRADS BY TYPE OF EXAMINATION  
SOUTHERN REGION, PUERTO RICO-1968

Type of Examination	Genetically Significant Dose in mrad per future offspring		
	Male	Female	Total
Abdomen	3.3	6.0	4.7
Cholecystography	.023	1.7	0.9
Lumbar Spine	4.0	15.1	7.5
Gastrointestinal Series	2.1	11.3	6.8
Barium Enema	2.8	3.1	2.9
I.V.P.	4.3	8.9	6.6
Pelvis	2.8	0.4	1.6
Hip Joint	3.0	0.8	1.9
Pelvimetry	-	2.2	2.2
Subtotal All Abdominal Examinations	22.3	49.5	36.0
Subtotal All Thoracical Examinations	.215	.093	.2
Total Thoracical and Abdominal Examinations	22.515	49.593	36.2

TABLE 5 (G.S.D.)

COMPARISON OF REPORT ANNUAL GENETICALLY SIGNIFICANT DOSE  
FROM DIAGNOSTIC RADIOLOGY (SELECTED COUNTRIES)

Study	Genetically Significant Dose in Millirads	Examinations Per 100 Population
United States (1964)*	55	53
Sweden (1955)*	38	29
Japan (1960)*	39	41
Southern Region of Puerto Rico (1968)	36.2	44.1

\* Based on Population Dose From X-rays, U.S. 1964. U.S. Dept. of Health, Ed. and Welfare.

## APPENDIX I

# WESTERN REGION 1968

- A) DOSE MEASUREMENT -1968
- B) THE GENETICALLY SIGNIFICANT DOSE 1968

The following appendix contains statistical and dosimetric material referring to the Western Region of Puerto Rico-1968, tabulated and up-dated with respect to those published in the report PRNC-132, in a fashion that will facilitate the making of comparisons between data referring to the different geographic regions of the Island. Certain tables containing recent data on thoracical examinations, computations of GSD values, etc.—were added.

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- Table 1 W: Number of abdominal X-ray examinations by type of examination, age and sex. Western Region, Puerto Rico-1968.
- Table 2 W: Number of thoracical X-ray examinations by type of examination, age and sex. Western Region, Puerto Rico-1968.
- Table 3 W: Mean gonadal per examination dose due to each thoracical X-ray examination. Western Region, Puerto Rico-1968.
- Table 4 W: Mean gonadal dose per X-ray examination by type of examination and by sex. Western Region, Puerto Rico-1968.
- Table 5 W: Computation of the mean per capita gonadal dose due to a selected group of genetically hazardous abdominal diagnostic X-ray examinations. Western Region, Puerto Rico-1968.
- Table 6 W: Per capita, per annum mean gonadal dose due to genetically hazardous abdominal and thoracical X-ray examinations. Western Region, Puerto Rico-1968.
- Table 7 W: Genetically significant doses in millirads by type of examination. Western Region, Puerto Rico-1968.

TABLE 1W  
 NUMBER OF ABDOMINAL X-RAY EXAMINATIONS BY TYPE  
 OF EXAMINATION, AGE AND SEX  
 WESTERN REGION PUERTO RICO—1968

AGE	ABDOMEN		CHOLECYSTO- GRAPHY		LUMBAR SPINE		GASTROINTEST SERIES		BARIUM ENEMA		I. V. P.		PELVIS		HIP JOINT		PELVIMETRY		SUB TOTAL		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	T
0-14	60	40	—	—	20	10	15	20	2	2	17	9	49	19	9	4	2	172	106	278	
15-29	2,891	2,489	1,038	1,425	2,162	1,500	2,412	2,046	1,666	472	1,449	1,966	875	230	378	1633	2,243	11,871	13,004	24,875	
30-44	4,528	2,652	2,099	1,286	3,239	945	2,166	2,974	425	686	1,189	1,795	493	1,698	853	161	1,238	13,952	14,433	29,425	
45+	72	50	15	25	31	20	25	101	3	5	100	50	100	61	70	40	18	416	370	786	
GRAND TOTAL	7,551	5,231	3,152	2,736	5,452	2,475	4,618	5,141	2,096	1,163	2,755	3,820	1,517	2,008	1,310	838	3,501	28,451	26,913	55,364	

TABLE 2 W  
 NUMBER OF THORACICAL X-RAY EXAMINATIONS  
 BY TYPE OF EXAMINATION, AGE AND SEX  
 WESTERN REGION, PUERTO RICO-1968

AGE	CHEST		PHOTOFLUOROGRAPHIES			TOMOGRAPHIES			GRAND TOTAL	
	Male	Female	Total	Male	Female	Total	Male	Female		Total
0-14	4,426	7,868	12,294	712	842	1,154	-	-	-	13,848
15-29	14,961	16,529	31,490	4,310	5,152	9,462	45	30	75	41,027
30-44	8,282	9,657	17,939	3,488	2,516	6,004	56	31	87	24,030
45 +	7,397	9,528	16,925	928	500	1,428	-	-	-	18,353
GRAND TOTAL	35,066	43,582	78,648	9,438	9,010	18,448	101	61	162	97,258



TABLE 3 W  
 MEAN GONADAL PER EXAMINATION DOSE DUE TO EACH THORACICAL X-RAY EXAMINATION

	WESTERN REGION, PUERTO RICO-1968										GRAND TOTAL
	Chest		PhotoFluorography		Tomography*		Total		Male	Female	
	Male	Female	Male	Female	Male	Female	Male	Female			
Mean exposure per examination mRs.	2	1	0.25	0.5	37.2	5.4	1.7	.92			1.25
Mean absorbed dose per examination mRads.	1.84	.92	.21	.14	34.2	4.9	1.56	.848			1.14
Total number of thoracical examinations	35,066	43,582	9,438	9,010	101	61	44,605	52,653			97,258
Global irradiation dose to all examined patients mRads.	64,521	40,095	1,981	1,261	3,454	298	69,956	41,654			111,610

\* The exposure in tomographies per film was 6.2 mR to the testes and .9 to the ovaries. The average tomography consists of six exposures. The data for the chest was obtained by taking a few of the same exposures and dividing the sum of mR by the number of exposures.

TABLE 4-W

MEAN GONADAL DOSE PER X-RAY EXAMINATION BY TYPE OF EXAMINATION AND BY SEX.  
WESTERN REGION, PUERTO RICO-1968

Type of Examination	Millirads per examination	
	Male	Female
Chest	1.81	.92
Photofluorography	.21	.14
Tomography	-	-
Abdomen	88	226
Cholecystography	9	168
Lumbar Spine	69	1,334
Gastrointestinal Series	144	632
Barium Enema	1,232	1,971
I.V.P.	386	821
Pelvis	904	49
Hip Joint	702	251
Pelvimetry	-	1,014

TABLE 5 W.

COMPUTATION OF THE MEAN PER CAPITA GONADAL DOSE DUE TO A SELECTED GROUP  
OF GENETICALLY HAZARDOUS ABDOMINAL DIAGNOSTIC X-RAY EXAMINATIONS,  
WESTERN REGION, 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.	96	88	7,551	664,488
	F.	246	226	5,231	1,182,206
Cholecystography	M.	10	9	3,152	28,368
	F.	183	168	2,732	459,648
Lumbar Spine	M.	73	69	5,452	376,188
	F.	1,450	1334	2,475	3,301,650
Gastrointest Series	M.	157	144	4,618	664,992
	F.	687	632	5,141	3,249,112
Barium Enema	M.	1,340	1,232	2,096	2,582,272
	F.	1,033	1,971	1,163	1,129,273
I.V.P.	M.	420	386	2,755	1,063,343
	F.	893	821	38,210	3,136,220
Pelvis	M.	983	904	1,517	1,327,072
	F.	53	49	2,008	125,342
Hip Joint	M.	763	702	1,310	919,620
	F.	273	251	838	210,338
Pelvimetry	F.	1,103	1,014	3,501	3,550,014
Total	M.	274.04	252.12	28,451	7,173,344
	F.	660.08	607.28	26,913	16,343,803
GRAND TOTAL		461.70	424.77	55,364	23,517,147

TABLE 6 W

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

WESTERN REGION PUERTO RICO - 1968

	GLOBAL ANNUAL IRRADIATION DOSE TO ALL PATIENTS MRADS	POPULATION WESTERN REGION PUERTO RICO - 1968	PER CAPITA PER ANNUM MEAN GONADAL DOSE MRADS
MALE	7,334,814	2,058,898	35.6
FEMALE	16,375,614	2,143,302	76.4
TOTAL	23,710,428	4,202,200	56.4

Using the Global Irradiation Dose in Table 6-W with the proper population figures, the per capita annual average irradiation dose due to all the genetically hazardous abdominal and thoracical X-ray examinations in the Western Region of Puerto Rico in 1968 is computed in Table 6-W as:

- 35.6 mrad per person per year for males,
- 76.4 mrad per person per year for females,
- 56.4 mrad per person per year for both sexes.

TABLE 7 W

GENETICALLY SIGNIFICANT DOSES IN MILLIRADS BY TYPE OF EXAMINATION  
WESTERN REGION, PUERTO RICO-1968

Type of Examination	GENETICALLY SIGNIFICANT DOSE IN MRADS PER FUTURE OFFSRPING		
	Male	Female	Total
Abdomen	2.6	5.0	3.84
Cholecysto- graphy	0.10	2.0	1.0
Lumbar Spine	1.6	15.8	8.7
Gastrointest. Series	0.95	14.8	7.89
Barium Enema	15.1	4.6	9.87
I.V.P.	6.24	15.2	10.73
Pelvis	6.68	1.02	3.85
Hip Joint	3.20	1.9	2.56
Pelvimetry	-	.015	.015
<u>Subtotal</u> All Abdominal Examinations	36.4	58.4	48.4
<u>Subtotal</u> All Thoracical Examinations	0.2	0.1	.2
<u>Total</u> All Thoracical and Abdominal Examinations	36.6	58.5	48.6



## THE X-RAY TECHNICIAN

This appendix considers the operating personnel of medical X-ray units in Puerto Rico.

There are more than one thousand X-ray operators on the island. Approximately six hundred are licensed and the remainder lack formal training; more often than not, their knowledge of the principles and practices involved in efficient radiation protection is inadequate.

In the course of the present survey, we found operators who have been working in this field for more than twenty years, still unlicensed.

In radiography, approximately ninety percent of the exposures are made by the X-ray technician upon the written request of the physician. The amount of radiation received by the patient, the shielding of the testes and collimation used are a direct result of the knowledge, conscientiousness and preparation of the technician. Lack of knowledge on the part of the technician may result in the most tragic consequences.

Recently, one acquaintance was severely injured in a traffic accident. Although X-ray technicians are taught that a long bone of the human body should never be photographed without including the joint, in this case the operator radiographed the broken femur only. An operation was performed. Two days later, due to complaints of the patients, further radiographs were made to include the joint of the femur, which was found to be badly damaged. This necessitated a second operation which resulted in enormous suffering to the patient and was a probable cause of the development of bilateral pneumonia. We cite this example, from among many others, to illustrate the responsibility of the technician and the necessity of proper training.

The best X-ray equipment is of no use if it is used by operators who are uninformed as to the potential hazards of X-ray techniques necessary for the reduction of unnecessary exposure. A nurse or a medical assistant--not licensed as an X-ray technician--cannot be expected to attain competency after brief instruction given by a doctor or a salesman. X-ray technology is a complex field, which requires specific training and experience, especially in the more advanced techniques. To our knowledge only a few states require the licensing of every X-ray technician for the sake of public safety.

The role of X-rays in diagnostics and in therapy is of extreme medical significance. However, since extreme health hazards may be the result of incorrect application, the

operation of medical X-ray units in public and private institutions should be restricted by law to technicians educated and licensed under the close supervision of the Department of Health.

The Health Department of the Commonwealth of Puerto Rico is presently trying to improve the economic and professional level of island technicians, to establish uniform Commonwealth standards, and regulations to protect patients and occupationally exposed personnel.

Following is a brief history of the development of The X-ray Technicians Association in Puerto Rico, based upon information given by the Association President, Mrs. Ana C. López de Cruz.

A small group of technicians organized for the first time in 1948. The Association was registered at the office of the Executive Secretary of Puerto Rico, Department of State, April 27, 1949.

The group immediately became the standard-bearer of a profession that claimed to be legally recognized and regulated under the laws of Puerto Rico. The preparatory school on the island at that time offered a substandard course. Only those interested in the field as a profession entered the Bayamón District Hospital and San Juan City Hospital as students. After completing their island studies, many continued to study and practice in the United States, increasing their professional knowledge.

In subsequent years, the Association strived to interest the Puerto Rican Legislature in approving a law which recognized and regulated the profession. In 1963, the Legislature approved a Bill, which became Law 78.

Two X-ray technicians were added to the Board of Examiners as the result of an amendment to Law 78 approved by the Legislature in 1967.

Members of the Board of Examiners are:

1. Dr. José T. Medina, President
2. Dr. José Tomé
3. Dr. José Correa
4. Dr. N. Pagán Saez
5. Ana C. López de Cruz, X-ray Technician and President  
of the Association
6. Heidi Pabón, Physicist
7. Sonia Soto, Radiotherapist

Several courses are conducted on the island to prepare X-ray technicians for licensing. The Association now hopes to raise professional standards to the university level, since more sophisticated curriculum is required by complex modern X-ray units.

The following list shows the X-ray technicians licensed since the Board of Examiners began in 1964. An estimated 500 are working in Puerto Rico.

There are approximately 400-500 technicians working with X-ray units in private offices with only a practical background.



LICENSED X-RAY TECHNICIANS IN PUERTO RICO

Name	Issue Date	License No.
Abreu Doval, Heriberto	7/15/64	1
Acevedo Nieves, Carmen Socorro	"	2
Acevedo Rodríguez, María C.	"	3
Acosta, Carmen Delia	"	4
Alcalá Frasqueri, Rafael	"	5
Allende, Olga	"	6
Alicea Cartagena, Juan Bautista	"	7
Almodóvar Rosado, Miguel	"	8
Alvarez Cabrera, Lydia	"	9
Andaluz de Claudio, Rosario	"	10
Andino de Alvarez, Sara	"	11
Arroyo Sierra, Juanita	"	12
Arocho Valentín, Rubén	"	13
Arroyo Velázquez, Efraín	"	14
Avila Justiniano, María Luisa	7/22/64	15
Báez Huertas, Carmen	"	16
Benítez Figueroa, Carmen	"	17
Berrios Pizarro, Serafina	"	18
Berrios Rivera, Delia	"	19
Borrero Martínez, Luis Alfredo	"	20
Calderón Calderón, Hilda D.	"	21
Caraballo Soto, Luz María	"	22
Córdova, Carlos	"	23
Carlo, Osvaldo	"	24
Carrillo Elvira, María Luisa	"	25
Carrillo Infante, Raúl	"	26
Castro Encarnación, Marcelo	"	27
Castro, María Magdalena	"	28
Castro González, Carmen Lydia	"	29
Castro de Thomas, Alejandrina	"	30
Castro de Varela, María Ramonita	"	31
Centeno, Rosa María	"	32
Chinea Rivera, Jesús	"	33
Cintrón, Alma Margie	"	34
Collazo González, Pablo T.	"	35
Collazo de Rivera, Maris	"	36
Colón Gómez, Ana María	"	37
Colón Rodríguez, Manuel	"	38
Cordero Rodríguez, Carlos Juan	"	39
Correa Encarnación, Juana	"	40
Cortés, Carmen Iraida	"	41
Costa Gómez, Rosa Milagros	"	42
Crespo Romero, Ildegarda	"	43

Name	Issue Date	License No.
Cruz Carmona, Ana Luisa	7/22/64	44
Cruz de Esquerdo, Elena	"	45
Cruz García, Ana Elsa	"	46
Cruz Torres, Emérida	"	47
Cruz Rivera, Fermina	"	48
De Arce Ortíz, Florencio	"	49
Dávila Galarsa, Ramón M.	"	50
De Jesús González, Secundino	"	51
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De la Cruz Fonrodona, Juan	"	54
Delgado Crespo, William	"	55
Del Valle de Martínez, Carmen G.	"	56
Dessus Medina, Víctor	"	57
Díaz Abraham, Manuela	"	58
Díaz Gabriel, Yanina	"	59
Díaz Medina, Evangelina	"	60
Díaz de Palacios, Ana Trinidad	"	61
Domenech Mestre, Adela	"	62
Echevarría, Teresa	"	63
Echevarría de Torres, Dominga	"	64
Falcón Rivera, Susana	"	65
Feliciano, Rosa Iris	"	66
Félix Fonseca, Angel Luis	"	67
Fernández Rivera, Angel S.	"	68
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Figuroa Montañez, Justo	"	70
Figuroa Reyes, Rosalina	"	71
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Figuroa Reyes, Sonia	"	74
Figuroa Rodríguez, Marta	"	75
Figuroa Román, Lydia	"	76
Flores Isaac, Juanita	"	77
Flores Santoni, Carlos Ernesto	"	78
Font Llacer, José	"	79
Fuentes, Luz M.	"	80
García Rivera, Sonia	"	81
Garrido, Guillermina M.	"	82
Guittens, Ruby C.	"	83
González, Alma Iris	"	84
González de Báez, Ana	"	85

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González Pérez, Mariano	"	88
Gotay Romero, Celio	"	89
Hernández, Adelaida	"	90
Hernández, María del Pilar	"	91
Hernández Montalvo, Gabriel	"	92
Hernández, Priscila	"	93
Irizarry de Vélez, Agripina	"	94
Jusino de Arroyo, Petra A.	"	95
Labrador, Angela, Helen	"	96
Laboy Paggie, Noel	"	97
Lebrón, Luis H.	"	98
León Orozco, Pablo Juan	"	99
López de Hernández, Antonia	"	100
López Acosta, María Dolores	"	101
López Méndez, Abrahím	"	102
López, Olga E.	"	103
López de Román, Evangelina	"	104
López Silva, Lydia	"	105
López Vellón, Delia	"	106
Luciano, José Angel	"	107
Lupiáñez Santiago, Fernando Luis	"	108
Maldonado Blondet, Judith	"	109
Maldonado Ferrer, Domingo	"	110
Maldonado de Hernández, Celia	"	111
Marin Cuevas, María Luz	"	112
Marrero Ortíz, Elba Iris	"	113
Marrero Rodríguez, Dolores	"	114
Martínez, Ana Iris	"	115
Martínez Fortys, María V.	"	116
Martínez, Livia Luz	"	117
Martínez de Morales, Eulalia	"	118
Martínez Ojeda, Rafael	"	119
Martínez Ortíz, César E.	"	120
Matos Nieves, Ramón	"	121
Matos Ortíz, Irma T.	"	122
Maysonet de Batista, Hilda	"	123
Medina Rivera, Miguelina	"	124
Mejías de Dávila, Isabel María	"	125
Meléndez, María T.	"	126
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Milán, Luz María	"	131
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Moreno Garnell, Eusebio	"	134
Monserrate Miranda, María M.	"	135
Montero Cruz, María Dolores	"	136
Morales Andino, Héctor	"	137
Morales de Cardona, Leticia	"	138
Morales de Díaz, Marta	"	139
Morales de Machargo, Enriqueta	"	140
Morales, Emma Encarnación	"	141
Morales Ortíz, José N.	"	142
Morales de Ramos, María M.	"	143
Morales Rosa, Aida Esther	"	144
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Muñoz Orza, Felipe	"	146
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Negrón, José M.	"	149
Nieto de Alvarez, María A.	"	150
Nieves, Ricardo, Jr.	"	151
Nieves Báez, María Socorro	"	152
Nieves de Pintado, Ana Irene	"	153
Nieves Santiago, Awilda	"	154
Núñez Rivera, Nelly	"	155
Ocasio Bermúdez, Aurora	"	156
Ocasio Vázquez, Pedro Juan	"	157
Olivero, Priscilla B.	"	158
Ortega de Reyes, Carmen E.	"	159
Ortíz de Carlo, Ana M.	"	160
Ortíz Espinosa, Juanita	"	161
Ortíz de Falcón, Marta	"	162
Ortíz, José Ernesto	"	163
Ortíz, Luis Felipe	"	164
Ortíz Quiles, Reinaldo	"	165
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Padilla González, Miriam	"	167
Pagán Valle, Asunción	"	168
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Planas Sosa, Raquel	"	180
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Prieto de Dávila, Edelmira	"	182
Quintero de Delgado, Carmen	"	183
Raldiris, Juan A.	"	184
Ramery Baró, Luis E.	"	185
Ramírez Almodóvar, Fernando L.	"	186
Ramírez, María Teresa	"	187
Ramírez de Rivera, Miguelina	"	188
Ramos Ayala, Juan	"	189
Ramos Cabán, Milagros	"	190
Ramos Calderón, Rosa	"	191
Ramos, Carmen Iraida	"	192
Ramos Colón, Eva	"	193
Ramos Figueroa, Erasmo	"	194
Reyes, Carmen L.	"	195
Rijos de Melecio, Carmen Luz	"	196
Reyes Reyes, Luis Donato	"	197
Rivera Borges, Hermes Oliva	"	198
Rivera Castro, Nilda	"	199
Rivera Colón, Angel Luis	"	200
Rivera Cuadrado, Aníbal	"	201
Rivera Esquilín, Justina	"	202
Rivera García, Julio	"	203
Rivera García, Pedro	"	204
Rivera Guadalupe, Ismael	"	205
Rivera, Isabel	"	206
Rivera, María Isabel	"	207
Rivera López, María G.	"	208
Rivera Martínez, Héctor Luis	"	209
Rivera Meléndez, Olga	"	210
Rivera Carmona, Modesta	"	211
Rivera, Pedro L.	"	212
Rivera de Rosario, Carmen L.	"	213
Rivera Sanjurjo, Gloria Dolores	"	214
Rivera Suárez, Milagros	"	215
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Rodríguez, Edna Raquel	"	219
Rodríguez de Encarnación, Norma I.	"	220
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Rodríguez Hernández, Ida Zoraida	"	222
Rodríguez Jiménez, Griselda	"	223
Rodríguez de Rivera, Laura	"	224
Rodríguez, Matilde	"	225
Rodríguez Rodríguez, Margarita	"	226
Rodríguez de Toledo, Edith	"	227
Rodríguez de Torres, Francisca	"	228
Rodríguez Torres, Lydia E.	"	229
Rodríguez Vargas, María J.	"	230
Rodríguez, Victor M.	"	231
Román Archeval, Elvira	"	232
Román de Rodríguez, Minerva	"	233
Romero Rosado, Raquel	"	234
Rosa, David	"	235
Rosario de Borges, Eulalia	"	236
Rosario Iglesias, Zoila	"	237
Rosario Martínez, Harry	"	238
Rosario Santos, Isabel	"	239
Rosario Viera, Victoria	"	240
Roselló Febus, Ramona	"	241
Rosso Ferraivoli, Carlos	"	242
Ruiz Castrello, Aida Luz	"	243
Sánchez González, José A.	"	244
Sánchez Rosario, José Luis	"	245
Santiago Cruz, Lydia Esther	"	246
Santiago Porrata, Luis	"	247
Santiago Rivera, José Aníbal	"	248
Santiago Rodríguez, Concepción	"	249
Santiago Rodríguez, Iris M.	"	250
Santiago Rodríguez, Sara	"	251
Santiago Rolón, Aurelio	"	252
Santos Rivera, Carmen Asmidia	"	253
Serrano Sáez, Juanita	"	254
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Soria Salaberry, Oscar	"	261
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Tapia Cruz, María del P.	"	268
Texidor Bonilla, Alicia	"	269
Sisco, Antonio	"	270
Toledo Alayón, Milton	"	271
Torres de Blanco, Ursula María	"	272
Torres Flores, Elba	"	273
Torres, José Miguel	"	274
Torres Montalvo, Juan Francisco	"	275
Torres, María Mercedes	"	276
Torres Naveira, Elisa	"	277
Torres Rosado, Francisco	"	278
Torres Soto, Jorge	"	279
Torres Villafañe, Juan Amador	"	280
Valentín, Néctar V.	"	281
Valdés Fernández, Josefa	"	282
Vargas Cortés, Juan	"	283
Vázquez Jiménez, Carmen I.	"	284
Vázquez Rodríguez, Carmen	"	285
Vázquez Espinosa, Gloria M.	"	286
Vázquez Ramos, Félix	"	287
Valentín Miranda, Ramón L.	"	281
Falentin, Néctar V.	"	282
Valdés Fernández, Josefa	"	283
Vargas Cortés, Juan	"	284
Vázquez Jiménez, Carmen I.	"	285
Vázquez Rodríguez, Carmen	"	286
Vázquez Espinosa, Gloria M.	"	287
Vázquez Ramos, Félix	"	288
Vecchini, Alicia	"	289
Velázquez Crispín, María Socorro	"	290
Vega Capis, William	"	291
Velázquez Rojas, Dolores	"	292
Velázquez Zayas, Mercedes	"	293
Vélez Pagán, Paulina	"	294
Vigo Vigo, Antonia	"	295

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Zeno Figueroa, Reinaldo	"	296
Barbosa Acevedo, Monserrate	"	297
Andino Dávila, José	8/19/64	298
Colorado González, Julia	"	299
Faulkner Adolfo, Edison	"	300
Figueroa Romero, Carmen María	"	301
González, Isaura	"	302
Guzmán Russell, Luis M.	"	303
Irizarry Hernández, Carmen	"	304
Landín de Román, Eda Carmen	"	305
López Sánchez, Ana Hilda	"	306
Montalvo de Rodríguez	"	307
Núñez Cruz, Armindo	"	308
Ortiz de Pabón, Ana María	"	309
Pérez García, Agustín	"	310
Ramírez Córdova, Eulalia	"	311
Rodríguez Torres, Clara	"	312
Torres Collazo, Paulita	"	313
Amaro Martínez, Rubén A.	9/2/64	314
Cruz, Luz Elenia	"	315
Monge Gómez, Ana Luz	"	316
Sánchez Lebrón, Estebanía	"	317
Brito Caballero, Beda	"	318
Ayala Jiménez, Ana María	"	319
Cruz Rivera, Victoria	"	320
Alvarez, Rose A.	10/21/64	321
Benítez, Miguel C.	"	322
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Colón de Pagán, Adelaida	"	324
Medina Rivera, María Luisa	"	325
Maldonado, Luis Antonio	"	326
Olmo de Falero, Cándido	"	327
Osorio Díaz, Marta	"	328
Ortiz, Gloria María	"	329
Quiñones de Oramas, Lillian	"	330
Rivera Reyes, Julio César	"	331
Rodríguez Cedrés, Milton A.	"	332
Silva Fernández, Carmen A.	"	333
Viera Arizmendi, Zulma J.	"	334
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Pérez de Lespier, María	"	337
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Román Morales, Elsie	"	339
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Cintrón Ortíz. Fredeswinda	"	342
Concepción de Rivera, Olga	"	343
Félix Vázquez, Josefina	"	344
Guzmán Rivera, Roberto	"	345
Hernández Quiñones, Vivian	"	346
Lozano Rodríguez, Wilfredo	"	347
Maldonado, José	"	348
Ramos Cruz, José A.	"	349
Ugarte Pellot, Ramón Alberto	"	350
Rodríguez, Agustín	"	351
Valentín Thillet, Jenny	"	352
Valle de Salabarrías, Gladys	"	353
Vega Lebrón, Natividad	"	354
Wiedemann, Elsie T.	"	355
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García López, Luz María	"	358
Jusino López, Evangelista	"	359
López de Cruz, Ana	"	360
Morales Morales, Luz V.	"	361
Rodríguez Cardona, Haydeé	"	362
Pellot Rodríguez, Zoraida	"	363
Rodríguez Robledo, Sonci	"	364
Arroyo Rodríguez. Leonor	3/10/65	365
Suárez Williams Bruce	"	366
García Delgado, Carmen Victoria	"	367
Santiago Hernández, Fidel	"	368
Antonmatiei, Sadi	4/14/65	369
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Díaz, Carmen Lydia	"	371
León Cuadrado, Aurea	"	372
López, Dennis George	"	373
Morales, William L.	"	374
Ortega, Gloria Esther	"	375
Pabón Reyes, Emérita	"	376
Pagán Sáez, Pablo	"	377
Ramos Lamboy, Ana Esther	"	378
Rivera, Ida Luz	"	379
Rosario Viliáli, Angel	"	380
Rodríguez Cases, Vicente	"	381
Torres, Lydia María	"	382
Arizmendi de Guzmán, Ana L.	1/13/65	383
Rodríguez, Miguel Angel	"	384
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Ramos Medina, Monserrate	"	387
Torres Alemán, Roberto	"	388
Arias Rodríguez, Eddie	9/15/65	389
Carrasquillo Díaz, Modesto	"	390
Carrillo García, Asturiano	"	391
Colón Ayala, Apolonia	"	392
Colón Suárez, Antonia	"	393
Cuevas Ortíz, Lionel	"	394
Díaz Matos, Luisa	"	395
Falú Semidey, Carmen J.	"	396
Flores Adorno, Milagros	"	397
Iglesias Vidal, Mercedes	"	398
Matos Rivera, Juanita	"	399
Mojica Nieves, Olga	"	400
Monest Cuadrado, María A.	"	401
Oyola Alvarez, Blanca L.	"	402
Pagán Pérez, Marta Irene	"	403
Parrilla Gerena, Clara	"	404
Parrilla Rosa, Ramonita	"	405
Pérez Pabón, José Manuel	"	406
Ramos García, Rosa María	"	407
Resto Nevárez, Genoveva	"	408
Reyes Boria, Santiago	"	409
Rivera Delfiz, María	"	410
Rodríguez, Carmen Julia	"	411
Rosa Suárez, Aida Luz	"	412
Sánchez Vega, Pedro J.	"	413
Santana Santiago, Olga N.	"	414
Torres Alvarado, Migdalia	"	415
Villegas Tanco, Rosa	"	416
Vizcarrondo, Carmen	"	417
Vendrell, María Victoria	"	418
Cajigas Javier, Irma L.	"	419
Levest Delgado, Amelia	"	420
Olivencia Ortíz, Reinaldo	"	421
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Lugo Quiñones, Germán	"	423
Román, Julio	"	424
Hernández de Ford, María I.	8/2/66	425
Espinosa de Castillo, Elsie	2/15/66	426
Rodríguez, Blanca Gloria	"	427
Latorre López, René F.	5/24/66	428
García López, Iris Socorro	6/28/66	429

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Keller, Alida R.	9/27/66	430
Benítez, Gilberto	"	431
Barrero Báez, Luz Selenia	"	432
Delgado, María Teresa	"	433
Martínez Cruz, Cecilio	"	434
Medina Muyet, Antonio	"	435
Méndez, Neida	"	436
Montañez Rivera, Carmen M.	"	437
Negrón Rivera, Olga I.	"	438
Ortíz Otero, María E.	"	439
Rivera Mercado, Alejita	"	440
Rivera de Torres, Leonor Clorinda	"	441
Ruiz Osuna, Luz C.	"	442
Santiago Martínez, Julio	"	443
Vega Rodríguez, Wilfredo	"	444
Rivera Estrada, Santiago	"	445
Tirado Vega, José A.	1/10/67	446
Márquez de Castillo, Guillermina	"	447
Fuentes, Hilka María	"	448
Rosario, Cynthia I.	"	449
Calero Pellot, Judith	3/25/67	450
Maldonado Miranda, Olga	"	451
Pérez Hidalgo, Segunda	"	452
Rodríguez Medina, Mirta Iris	"	453
Ruiz Crespo, Eva Nydia	"	454
Sosa Villa, Carmen Ana	"	455
Soto González, Samuel	"	456
Vargas Rodríguez, Víctor M.	"	457
Santiago, Vicente	6/13/67	458
Arocho Bubrín, Carmen	9/27/67	459
Avilés Cruz, María Antonia	"	460
Baez López, Gladys Nilda	"	461
Berrios de Estrillón, Edna	"	462
Colón Santiago, Samuel	"	463
Cruz Rosado, Esther	"	464
Flores Ramos, Mercedes	"	465
González Loperana, Ana Celia	"	466
González Molina, Angel Custodio	"	467
Hernández García, Arminda	"	468
Hernández Vázquez, Manolo	"	469
Latorre, Efraín	"	470
Maldonado Torres, Alejandro	"	471
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Ortiz Vitali, Carmelo Domingo	"	475
Pizarro Torres, Marta	"	476
Polanco Martínez, Egna	"	477
Ramos Cruz, Jaime	"	478
Rodríguez, Jesús M.	"	479
Rivera Corredor, Lydia	"	480
Rodríguez Echevarría, Radamés	"	481
Rodríguez Rodríguez, Carmen J.	"	482
Rosado Olán, René	"	483
Serrano Justiniano, Luz Mercedes	"	484
Torres Vélez, Luis	"	485
Velázquez Pérez, Zoraida	"	486
Hershberger, Mervin L.	"	487
Pinzón de Lugo, Francisco	"	488
Montañez Barrio, Carmen	11/28/67	489
Ocasio Guzmán, Juan Manuel	"	490
Carbonell, Juvencio	3/26/68	491
Vélez, Isidoro	"	492
Ware, Rosa M.	"	493
Rodríguez, Widna	"	494
Rivera Defendini Evelyn	"	495
Pérez Santiago, Rosa M.	"	496
(none)	(none)	497
Mercado Arroyo, Angel Luis	3/26/68	498
Martínez, Nilda Iris	"	499
Guzman, Hilda L.	"	500
Gonzalez Torres, Ana Iria	"	501
Figueroa Tejada, Ramón	"	502
Sor Fernández, Gregoria	"	503
Cortés, Iris M.	"	504
Cordero Miranda, Rexaida	"	505
Centeno Rodríguez, Gladys	"	506
Alcalá Collazo, Daniel	"	507
Rosado Santiago, Agueda	"	508
Román, Luz Onerida	"	509
Ruiz Aponte, Josefina	"	510
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Santiago, Rosa Melania	"	512
Serrano Monche, Rubén	"	513

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Mendez Clara Adela	"	516
Alvarez, Julio	"	517
Parrilla Maldonado, Rubén	"	518
Díaz, Carmen Delfina	"	519
Parissi Ruiz, Irma	"	520
Rivera González, Olga Iris	"	521
Angleró, Alma de Lourdes	9/25/68	522
Casaigne, José Luis	"	523
Calderón Pérez, Juan	"	524
Cochran, Carlos	"	525
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Franceshini Pérez, Marisel	"	527
Martínez Rodríguez, Gilda	"	528
Martínez Millán, José B.	"	529
Marquez, Ramón	"	530
Monserrate Olmo, Pedro	"	531
Ortega, Ana Iris	"	532
Rosado Barreto, Gloria	"	533
Román, Elsa Iris	"	534
Vázquez Velázquez, Santa I.	"	535
Vázquez, Loida Elsa	"	536
Figuroa Santiago, Margarita	"	537
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Ramos Pérez, Mario	"	539
Arana, José A.	1/9/69	540
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Batista Cruz, Mercedes	"	542
Beltrán, Julia Esther	"	543
Caro Caro, Nélica	"	544
Chamarro Rivera, Flor	"	545
Colón Alvarez, Amalia	"	546
Cott Rodríguez, Milka	"	547
Cruz Maldonado, Angela	"	548
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Ducós Nieves, José Rafael	"	550
Erazo Rivera, Silvia R.	"	551
Figuroa Rosario, Tomás	"	552
Flores Rodríguez, Libia	"	553
Flores Burgos, Nélica G.	"	554
García Leduc, Litza M.	"	555
Gastón Cabrera, Miriam	"	556
Ojeda Cabrera, Miriam	"	557
Pacheco Moret, Julio	"	558

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Pinto Cruz, Brunilda	1/9/69	559
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Rivera Márquez, Pedro	"	561
Santana Vera, Eunice	"	562
Santiago Seda, Wilfredo	"	563
Santiago Márquez, María	"	564
Serrano López, Victor M.	"	565
Torres Medina, Nilda	"	566
Viera de Rodríguez, Neftalí	"	567
Marichal Colón, Neftalí	"	568
Negrón Luciano, Octavio	"	569
Carrasquillo, Phyllis	"	570
Colón González, Awilda	"	571
Ramos Ríos, Juanita	"	572
Inchaustegui Rojo, Nicolás	"	573
Valentín Vega, Matilde	7/5/69	574
Santiago, Ruth E.	"	575
Sánchez, Juan José	"	576
Cuevas Martí, Oscar	10/29/69	577
González Morales, Luz Delia	"	578
Meléndez, Carmen	"	579
Albino Vázquez, Sonia	"	580
Bonilla Vargas	"	581
Camacho Román, Myriam	"	582
Cubero Romero, Angel M.	"	583
Díaz Morales, Aníbal	"	584
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