The Radiation Control Program

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IN MARCH 1958 the New York City Board of Health adopted a new section of the city's sanitary code intended to cover all radiation hazards (*1*) and required registration of radiation sources—a few small sources were exempt—by October 1, 1958.

Because it was difficult to obtain the services of a full-time radiation expert, the city's commissioner of health arranged for the temporary assistance of a radiation specialist (the chief of the Radiation Branch, Health and Safety Laboratory, Atomic Energy Commission) in planning the registration and inspection of X-ray equipment and radioactive materials. At the end of 3 months, this specialist became director of the office of radiation control, New York City Department of Health, and assumed full-time responsibility for directing the radiation control program.

To obtain scientific advice, the mayor appointed a Mayor's Technical Advisory Committee on Radiation, composed of distinguished scientists in radiation and atomic energy and practicing medical and dental radiologists. The chairman of this committee was the director of medical education for the Rockefeller Foundation. The mayor also appointed an Interagency Council on Radiation, composed of the heads of all city agencies concerned with radiation such as the hospitals and the fire, police, water supply, and health departments. The commissioner of each department designated a technical representative to attend meetings and work on committees to formulate policies on the radioactive contamination of water, the handling of radioactivity accidents, and other incidents involving radioactive material.

About 8,000 medical installations and 7,000 dental installations, with about 17,000 X-ray machines, were registered. Training enough men to inspect all these installations within a reasonable time presented a formidable task. Only a few inspectors had experience in radiation problems. Inservice training courses were organized, and the inspectors were encouraged to take college and public health service courses.

The New York City health code requires that the mandatory recommendations of the National Committee on Radiation Protection and Measurements be followed at radiation installations in the city (*2–4*). These recommendations cover many aspects of the design, installation, and use of X-ray equipment and radioactive materials. The recommendations have been studied carefully to distinguish the primary and secondary requirements so that the worst hazards of the equipment can be detected during the initial inspections.

Many aspects of the radiation hazards of an X-ray installation can be evaluated only by a highly trained and experienced radiation physicist. The presumed intent of the national committee was that the owner of each radiation

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installation should engage a consultant physicist when necessary to evaluate these hazards. Therefore, if the structural shielding of an X-ray installation is found to be inadequate, the office of radiation control advises the owner to engage a consulting physicist to make a complete radiation survey and submit a report. This procedure has met with remarkable success.

The office also seeks the cooperation of organized medical societies. Early in the program, the director communicated with every county medical society and radiological and dental society in New York City. He visited most of them and sought invitations to address regular meetings to explain the program. The societies cooperated by urging their members to comply with the requirements of the code.

To foster this spirit of cooperation, the office of radiation control never imposes additional restrictions without first requesting the views of each society on the hardships that might be caused by the proposed restrictions. For example, when the Mayor's Technical Advisory Committee on Radiation recommended amendment of the code to require periodic (annual) calibration of every X-ray therapy machine, the proposed change was explained to the appropriate societies to obtain their reactions. Similar communications have been sent to the professional societies concerning additional rules to reduce the number of losses of radium and the need for closer supervision by physicians in ordering X-ray examinations of patients.

Inspection of X-ray Machines

The health department's radiation control organization was established January 26, 1959, in two units: a technical unit known as the office of radiation control and an inspection unit known as the radiation inspection division of the bureau of sanitary inspections. The principal duty of the inspection division was to enforce the radiation section of the health code (before October 1, 1959, the sanitary code) by appropriate means, including especially the inspection of radiation installations, in accordance with policies formulated by the director of the office of radiation control. (By executive order October 5, 1960, the radiation inspection division was made a part of the office of radiation control.)

Eighteen sanitarians have been assigned to the radiation inspection division: a chief, 3 senior public health sanitarians, and 14 public health sanitarians. These sanitarians inspect every nonindustrial X-ray facility in New York City.

When the office is notified by a dealer, owner, or any other source that an X-ray machine has been installed or relocated or that ownership has been changed, the sanitarian assigned to the postal zone is requested to inspect the installation and the new owner is advised to register the equipment.

The sanitarians make two types of inspections, which may be distinguished as complete and partial. On the first visit they record all the required information on the facility and the X-ray equipment. They draw a diagram of each room and, using standard symbols and an approximate scale, show the relationships and distances between X-ray tubes and designate anything that in their judgment is needed to evaluate the installation.

A supervisor reviews the record, decides on a planned reinspection date depending on the severity of the deficiencies, and sends a form letter or a composed letter notifying the owner of such deficiencies and requesting corrections or stating that no deficiencies were found.

After a reasonable time, usually about 6 months or sooner if an owner reports that he has corrected the specified deficiencies, the installation is reinspected. Guided by the original inspection papers, the sanitarian reinspects only those items that required correction. If the installation complies with code requirements, a form letter advises the owner. If even one deficiency remains, the sanitarian gives a copy of the deficiency sheet to the owner and holds the inspection papers for a future reinspection, usually within a few weeks. If no deficiencies are found, the installation is not visited until the next full inspection, usually 2 years later. Hospitals, health centers, radiologists' offices, and installations classed as "busy" are inspected annually.

In 20,604 complete inspections of X-ray machines in New York City to June 1963, about 36 percent were free of deficiencies. The following deficiencies were found to be the most common:

Equipment (number inspected)	*Percent*
Fluoroscopes (5,300) :	
X-ray beam not limited adequately by shutters	64
Inadequate filtration	26
Medical radiographic units (4,921) :	
Chest X-ray beam not limited to area of clinical interest (percent of 3,432 units used for chests)	64
Inadequate protection for operator (exposure switch operable outside shielded area)	70
Inadequate filtration	29
Dental radiographic units (8,984) :	
X-ray beam not limited to area of clinical interest (diameter of useful beam at cone tip greater than 3 inches)	25
Inadequate filtration	28
X-ray therapy machines (807) :	
Inadequate identification of filters	13
Inadequate protection for operator	8
Mobile radiographic units (592) :	
Inadequate filtration	28
Inadequate protection for operator	16

This information is based on at least one inspection of nearly all the X-ray machines in the city and more than one inspection of a small number of machines. Cumulative results have not been computed beyond June 1963, but the program has continued at the same pace, in general, as before 1963. Although a radioactive materials license requires more elaborate control measures than an X-ray installation, the ratio of registered X-ray installations to isotopes licenses (other than for radium) is about 20 to 1; and X-ray control remains the main part of the program. Its annual costs are estimated at $330,000, and the costs of radioactive materials control, at $110,000.

Regulation of Radioactive Materials

The legal bases of radiation control in New York State (*5*) are the State sanitary code, the State industrial code, and the New York City health code. Changes in these codes, drafted by the three regulatory agencies in cooperation with the New York State Office of Atomic and Space Development, have achieved an integrated program of radiation control covering not only activities over which authority has been discontinued by the Atomic Energy Commission but also activities over which State agencies have exercised exclusive jurisdiction, such as the use of naturally occurring and accelerator-produced radioisotopes and X-ray equipment.

The State aimed toward achieving compatibility between its radiation control program and the Atomic Energy Commission's program for the regulation of like radioactive materials, as required by section 274.d(2) of the Atomic Energy Act of 1954, as amended. The radiation protection standards used in the program are based on the guides of the Federal Radiation Council, as approved by the President, and the pertinent recommendations of the National Committee on Radiation Protection and Measurements. Modeled after the Atomic Energy Commission's licensure regulations, modified codes were written and made effective October 15, 1962.

The office of radiation control was prepared to assume the regulatory authority within the city of New York over nonindustrial radioactive materials, with exceptions such as construction and operation of nuclear reactors and "special nuclear materials" in quantities sufficient to form a critical mass. The radioactive materials unit of the office of radiation control was created and staffed with radiation inspection division employees who had been trained with the help of the Atomic Energy Commission.

All existing commission licenses within the city of New York for the use of radioactive materials in medicine and in educational and research institutions were converted to health department licenses. All applications for new licenses, amendments, or renewals of expiring licenses are processed by the radioactive materials unit.

An important part of the program is the licensing of radium to private physicians and hospitals. Radium had not been subject to Atomic Energy Commission licensure and regulation but had been subject, like X-ray equipment, to New York City Department of Health regulation and inspection. Since October 1962, every radium user must hold a New York City license, and the conditions imposed are similar to those required of users of other gamma-emitting sealed sources such as cobalt 60, cesium 137, and iridium 192. These conditions include the necessity of keeping accurate records of the issuance and return of sources and periodic testing of the sources to determine leakage and contamination of storage areas.

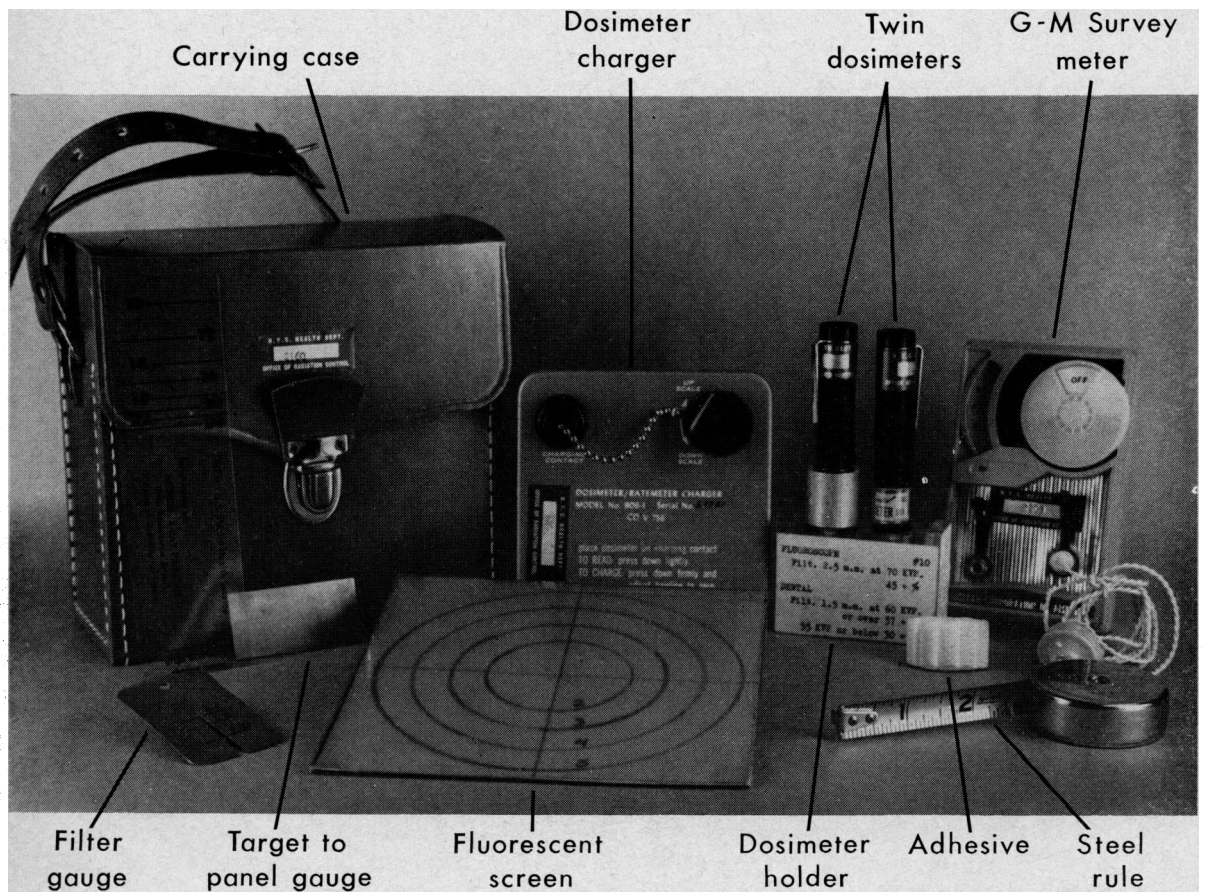
We believe that licensing and regulating the use of radium is as important as licensing and regulating the use of other radioactive materials—and perhaps more so. The use of radium never had been regulated before as had the use of byproduct, source, and special nuclear materials. Initial inspections showed that radium was being improperly stored and handled by private physicians as well as physicians in hospitals. Our goal is tighter control so that the hazards of mishandling radium may become minimal.

Radium is owned and used by approximately 100 private physicians and 75 hospitals in New York City. Not all have been licensed, but we are working toward total registration. Many more physicians rent radium, and they, too, need to be licensed. From October 1962 through October 1965, the office of radiation control issued 507 licenses other than for the use of radium.

The inspection phase of the program, although slow in starting because of the lack of trained staff, is now progressing well. The office has instituted a program to train one public health sanitarian each month to inspect the use of radioactive materials. At the end of March 1965 the equipment of 136 licensed users of radioactive materials had been inspected.

Activities of Physics Section

The physics section is staffed by two senior physicists, an assistant scientist, and a laboratory aide. It encompasses a radioisotope laboratory, a maintenance shop, a darkroom, and radiographic, fluoroscopic, and dental X-ray rooms. Its main function is to support the inspection and isotopes divisions in their enforcement of the radiation provisions of the New York City health code. This includes devising methods and instrumentation to improve the



X-ray inspection kit used in New York City radiation control program

efficiency and accuracy of inspections and recommending improvement in operating techniques to reduce the exposure of patients and operators.

Instrumentation. Survey instruments are stocked, maintained, and calibrated to cover nearly every contingency in health physics. These instruments include ionization-rate meters and dosimeters; Geiger-Mueller, proportional, and scintillation counters; "handie-talkies" (two-way radios); portable air samplers; and film packets.

A dosimeter and a film packet are issued to each inspector and physicist for his own protection, and read every 2 weeks.

Research. A number of research projects have been launched, usually with the cooperation or under the direction of other agencies. Some of the evaluations include: the relative light intensity from fluoroscopic screens (Division of Radiological Health, Public Health Service), the use of Polaroid films in dental surveys (Harvard School of Dental Medicine), and the use of lithium fluoride capsules as monitoring devices (Public Health Service).

Research into the dose rates from radium in watches led to an amendment of the health code limiting the use and permissible dose rates for these devices (*6*).

Inspections and tests. Each inspector has been equipped with a field kit, designed by the physics section, consisting of a camera case with a hand strap and a shoulder strap (see photograph). Into the case go a miniature transistorized G-M survey meter, a pair of plastic-walled pocket chambers, a charger and a plastic holder for the chambers, a wad of adhesive putty, a fluorescent screen, a 6-foot steel measuring tape, a plastic rule for target-to-panel measurements on fluoroscopes, and a filter thickness gauge.

The kit was developed to make the inspector as self-sufficient as possible when making inspections. The survey meter is the size of a small transistor radio and has a range of 0–100 r per hour in four scales. Its primary purpose is to check the attenuating quality of the leaded glass on fluoroscopes, although other applications have been found. The pocket chambers were manufactured especially for the office of radiation control. Of the pair, one dosimeter has been equipped with an aluminum band around the chamber to simulate the "cap on-cap off" method of determining filtration. The unbanded dosimeter records the roentgen output and, because of the plastic chamber wall, energy independence is fairly good for the energy range of interest.

Wipe tests, performed by the radioactive materials unit, are monitored in a two-pi alpha scintillation counter.

The physics section has other responsibilities not directly related to the inspection services. An air-monitoring station is maintained as a part of the Public Health Service network. Samples are collected daily and read for gross beta activity. A continuous air monitor, which monitors the air outside the laboratory window, measures the alpha and beta-gamma activity and the alpha to beta-gamma ratio. A laboratory of the New York State Department of Health furnishes monthly averages of strontium 90, strontium 89, and iodine 131 in samples of New York City milk.

Miscellaneous services. Employees of the physics section act as consultants to employees of the inspection division and radioactive materials unit on other than routine health physics problems. On occasion, a physicist will accompany a sanitarian during inspections to aid in making precise measurements or to evaluate the possible hazards from an unusual condition.

Lectures and exercises in health physics are provided by the staff of the physics section for health department and other government employees, foreign visitors, and university students; and scheduled talks are given to medical and dental societies.

Personnel-type monitoring films that have been placed on the walls of X-ray installations where protection is questionable are processed by the physics laboratory after 2 weeks.

The physicists and inspectors frequently succeed in finding in incinerators, dumps, and other places radium and other radioactive sources reported lost by hospitals and radiologists. Unknown radioactive materials picked up by the inspectors are identified commonly by means of the gamma scintillation spectrometer. Other objects, which may range from rocks to dishes, are brought into the laboratory by anxious citizens inquiring about possible radioactivity.

Training Program

Early experience in the New York City program suggested a need, on the part of health agencies generally, for formalized training courses in the technology of inspections for radiation hazards. This need manifested itself in a number of ways:

- Employees informally trained in the office of radiation control frequently have accepted positions, including supervisory positions as health physicists in other health agencies and in industry. The turnover has been greater than anticipated, and shows the need for trained men in other agencies. Our agency often has to train replacements.
- A number of other agencies have requested assistance in training and planning programs.
- Our inability to train more than a few men at a time has resulted in inefficiency.

These problems partly motivated the formal training program in inspections and surveys for radiation hazards, and the administration of a radiological health code. The course was given for 1 full year. A senior scientist was designated as the assistant director for training. The selected students were health agency employees with college degrees in a science or its equivalent in education and experience. Many were public health sanitarians with no background in the problems of radiation. The program was presented twice a year for 15 weeks of full-time work; thus it was adequately comprehensive and yet short enough to encourage health agencies to release employees for that period.

Sixteen students (eight each session) were trained during the first year. These students were affiliated as follows: New York City Department of Health, 10; New York State Department of Labor, 5; and Government of Peru, 1.

The New York University Medical Center and the New York State Department of Labor cooperated in the instruction. It was supported by a Public Health Service grant of $42,820 to the New York City Medical and Health Research Association. Of this amount, $16,000 was expended the first year. There was no tuition, and a stipend was available to out-of-town students.

The following nine courses—seven lecture courses, one laboratory course, and one field course—were required of each student. They were scheduled to allow basic instruction in the subjects requiring such material as a foundation.

Course	*Lecture hours*
Public health aspects of radiation control	24
Origins and characteristics of ionizing radiation	24
Uses of radiation and radioactive materials	22
Radiation measurement and radioactive materials sampling	30
Biological effects of radiation and maximum permissible doses	14
Radiation shielding and contamination control	14
Radiation inspection and reporting	32
Measurement and sampling laboratory	44
Radiation inspection and reporting (field)	48

A less formal training program for the inspection and technical staffs of the office of radiation control was scheduled to begin in December 1965. Its principal activities include the discussion of pertinent articles in the scientific literature and periodic reviews or lectures presented by guest speakers.

Cooperation With City Agencies

Communication and cooperation among city agencies interested in some aspects of radiation control have been effected by the Interagency Council on Radiation through subcommittees on (*a*) radioactive water contamination, (*b*) radioactive wastes, (*c*) radioactive materials accidents, and (*d*) transportation of radioactive materials through the city. The water supply subcommittee, representing the board of water supply, the department of water supply, gas and electricity, the health department, and the city administrator, carefully maintains a radiological surveillance of the water supply.

Discussions on industrial radioactive wastes have been held with representatives of the State department of labor and the city department of sanitation because of their concern about possible exposure of employees to hospital wastes that may contain radioactive materials. Discussions have been held with employees of the borough presidents' offices about possible overexposure of sewer workers. In all instances, the representatives concluded that radiation hazards were unlikely.

An emergency plan has evolved from a plan set up 6 years ago (*7*). Alarms concerning radioactivity accidents or fires are passed on by the receiving agency (fire or police department) to other agencies in the plan. One of the equipped emergency vehicles of the office of radiation control responds where needed. Eight senior staff members also have radiation-detection instruments at home, and the health department's poison control center, operating around the clock, may notify one of these men of an emergency in his neighborhood outside of working hours.

The health code requires shippers of certain classes of radioactive material to notify the office of radiation control at least 2 weeks before shipping and to describe the shipment, vehicle, routing, and timing. This information is relayed to the police and fire departments to alert them. Such notifications have increased from 1 or 2 to 20 or 25 a month. It has become evident that the requirements may be relaxed. During the 6 years of the program, no fire or accident involving a shipment has released any radioactive material.

The city administrator recently appointed a committee, with the fire commissioner as chairman, to arrive at a coordinated plan for regulating the transportation of radioactive materials—especially because the mayor has declared New York City a "nuclear port," and large shipments of spent fuel through the city are expected. It has been agreed to prescribe certain routes for such shipments and to redefine the class of notifiable radioactive materials.

Summary

The legal authority for the radiation control program of the New York City Department of Health is the health code. Since 1958 it has required registration of radiation installations and compliance with requirements of the National Committee on Radiation Protection and Measurements. Since 1962 the code and an agreement between New York State and the Atomic Energy Commission have provided for the regulation of radioisotopes.

The program is administered by the office of radiation control of the New York City Department of Health, which inspects the equipment and safety practices of nonindustrial users of radioisotopes and about 17,000 X-ray machines in the city, processes licenses for the use of radioisotopes, responds to calls for help in radiation accidents, develops instruments and techniques, air-monitors the environment, and with a Public Health Service grant provides instruction courses for radiation-control employees in addition to those restricted to New York City.

The Mayor's Technical Advisory Committee on Radiation provides expert advice. A subcommittee reviews license applications for human uses of radioisotopes. The mayor's committee, the office of radiation control, and the Interagency Council on Radiation were organized in 1958 and 1959. The council consists of the heads of appropriate city agencies who coordinate such matters as monitoring the radiological levels of water and transporting radioactive materials.

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