A County Health Department's Experience With a Radium Management Program

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RADIATION MATERIALS and equipment are used quite extensively in Jefferson County, Ala., which contains a large industrial center and the University of Alabama Medical and Dental Colleges and their related facilities. Concern about unnecessary exposure of the public to radiation led to the inclusion of a radiological health program in the activities of the county health department's bureau of sanitation in 1961.

To provide technical guidance, the Jefferson County Board of Health appointed an advisory committee of local experts in radiation. This committee, whose members represented both medicine and industry, played an important role in the formulation of regulations and standards under which the program operates. It is quite probable that the cooperation which the department has since received from medicine and industry is in large part due to the organization of this committee.

Regulations authorizing the control of all types of radiation were adopted by the board of health to become effective on January 1, 1961, and standards detailing these regulations were adopted soon after. Initial efforts were directed at control of machine-produced radiation, since this was the primary source of public exposure. Within the first 2½ years, all known existing installations had been visited, and most of these were found to comply with the regulations.

Radium Management Program

Because the eventual goal of the board of health was to achieve control of all unnecessary sources of human exposure to radiation, and since good progress had been made with X-ray machines, the board decided to extend the program to include radium. Although the existing regulations authorized control of all types of radiation exposure, the standards did not specify requirements pertaining to sealed radioactive sources. Therefore, these standards had to be revised. Again the advisory committee was called upon for assistance. The revised standards were drafted and formally accepted by the board of health on March 18, 1964. The regulations and standards adopted were not incongruous with any State or Federal rules and regulations.

The radium management program was a joint endeavor of the Public Health Service, the Alabama State Department of Public Health, and the Jefferson County Department of Health. The Public Health Service participated to obtain information on the methods of initiating and conducting a radium management program at a county level, and the State health department was interested in the possibility of expanding it to a statewide program.

A written protocol entitled, "Radium Management Project," contained the overall objectives, methodology, and the duties and responsibilities of each participating agency. It was invaluable, not only as an organizational tool, but also as a reference guide. Much confusion was avoided by having specifically defined in the protocol the exact responsibility of each agency.

Contingent to the protocol was the training

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of two persons, one with the county health department and one with the Public Health Service, in the properties and handling of radium. This training was obtained through a short course given by the Public Health Service, visits to companies dealing with radium, and an extensive review of the literature.

Locating radium users. Because no local regulatory control had been imperative for radium, we anticipated that locating radium users might be difficult. Our first attempt was made through letters to all known radium suppliers in the United States requesting the names of persons or firms within Jefferson County with whom they did or had done business. Most of these suppliers responded to our request; however, one of the major suppliers to local recipients did not respond. We then sent letters, with appropriate forms enclosed, to all industrial and medical installations within the county that might possibly possess radium. This method proved more successful than the first approach, and all but one of the local radium users were located. This nonregistrant was discovered during the subsequent survey. A total of 10 facilities were eventually registered as radium users.

Design of survey form. Before field contact was made with the registered radium users, a suitable survey form had to be designed. Inasmuch as this was a pilot project, considerable data had to be collected, necessitating a lengthy form. On the other hand, in order to gain the cooperation of the user, the form had to be reasonable in length. Although a requisite of the type of detailed information needed was that it be adaptable to automatic data processing, the final form contained a moderate degree of subjectivity. After a cogent appraisal by the surveyors, the form proved suitable for installations of varying sizes.

Surveys. With all known radium users registered and a survey form available for use, appointments for surveys were made with the registrants by telephone. In arranging the appointment with each person, we explained that the survey would require that the radium be out of service for 24 hours and that two visits to the facility would be necessary. We planned that the initial visit would consist of an interview with the individual responsible for the radium and a preliminary survey of the environment in the storage area. Naturally, the amount of detail sought in the interview was attuned to the schedule of the person being interviewed. Some effort was made in each instance to give this person a brief explanation of the purpose of the project and the possible hazards associated with the use of radium. In this manner, health education became an integral part of the project.

The survey team consisted of at least three members for most visits. On entering the radium facility, a surveyor turned on the gamma survey instrument and allowed it to warm up. Meter readings observed while walking through corridors were often enlightening because indications were obtained as to whether shielding was adequate. The alpha survey instrument was assembled and allowed to warm up while the person responsible for the radium at the facility was being interviewed. After explaining the procedure to be followed during the survey, the surveyor checked the radium sources and storage area. By checking these items first, he could learn much of the information needed by observation in lieu of extensive questioning.

Storage receptacles ranged from a lead "pig" sitting in the open to a specially constructed concrete vault. As soon as he entered the storage area, the surveyor made a sketch of the room. If significant gamma or alpha readings were found, he noted them on the sketch with a brief description of their location. He then made a thorough study of contiguous areas to determine if any gross contamination existed. If there was no gross contamination, the storage container was surveyed. When contamination was detected in the storage container, contamination was also found on some or all of the other radium sources.

Even though contamination existed in some installations, the radium sources were prepared for leak testing. (The method used is described later.) Before the radium was removed from the storage container, consideration was given to possible exposure of surveyors and facility personnel during the leak-testing procedure. Shielding available, number of sources per container, and other pertinent factors were con-

sidered. Paper toweling was spread in a convenient working area and the sources transferred to glass jars, one at a time. Performing all work with the sources on toweling minimized the possibility of spreading contamination. Proper identification of each source was recorded on the survey form. After tightly sealing all sources in the jars and placing them in an adequately shielded area, but not in their original storage container, the surveyor took gamma readings in the area to determine the exposure rate during the 24 hours in which the radium would have reduced shielding. Improvement of the shielding was required if the rate was found excessive.

Readings in the now empty storage container were taken with the alpha instrument to give further indication of source contamination. Again, if the precise storage space where the radium sources lay was contaminated, the sources were usually found to be leaking or contaminated, or both. The final items checked for alpha contamination were portable transport carriers and the hands of persons handling the radium. If any person who handled the radium showed signs of contamination, he was asked to wash the affected area immediately.

The total time required for completion of the first visit, including survey and interview, was a maximum of 1½ hours, even at the larger installations. This was accomplished by careful planning and constructive action on the part of each team member. Before leaving an installation, a surveyor informed the person responsible that the final phase of the work would be completed on the following day.

When they returned to the installation the following day, the surveyors checked the radium sources for leakage. If no contamination or leakage was indicated, they returned the sources to their original storage space and gave a satisfactory report to the proper authority. If the sources indicated contamination or leakage, they were returned to their storage space, but the owner was requested not to use them until they were decontaminated or re-encapsulated. The surveyors requested that such action be taken at once to assure the safety of everyone concerned. They explained the situation in detail, so that facility personnel completely understood what had to be done. Thereafter, a followup survey was made of corrective action taken by facility personnel.

We anticipated in the beginning that considerable apathy on the part of the radium users would be encountered during the course of the program. On the contrary, there were only two instances of indifference and the attitude of these users soon changed to lively interest when their radium sources were found to be contaminated. In general, the program was welcomed. Radium users within the county apparently desired information on the condition of their radium.

The condition of the radium sources should be the prime consideration in a radium management program. However, three other factors—storage, handling, and recordkeeping—can make a bad situation of a good one, and, if neglected, a desperate situation of a bad one. If the radium source is in satisfactory condition but stored inadequately, moved inefficiently, or lost through poor recordkeeping, the situation is bad. Furthermore, when a leaky source is poorly stored, poorly handled, or misplaced, the situation is indeed dangerous and in urgent need of correction. We found that these three factors needed attention and improvement in Jefferson County.

The leak test method. A new method, called the "jar test," was used to determine leaking sources. This method was developed in the radiological health service section of the Georgia Department of Public Health. (The jar test is now being used in a statewide radium management program by the Georgia Health Department. More complete information and data, including comparisons between this test and other methods will be available when the Georgia program is completed.) As a field procedure, the jar test is systematic and not too delicate. It proved successful during our program. Although the procedure was designed basically for field use, it can easily be applied to laboratory evaluation of radium leakage. We should like to point out, however, that the jar test is incapable of discrimination between surface contamination and radon and its daughters emanating from a fissure of the needle or the source itself.

The procedure followed in the jar test consisted of placing the radium source into a glass

jar with a screw cap that was tightened to form a seal. The glass jar was placed in a shielded area right side up to prevent the radium from touching the lid. The source was allowed to remain in the shielded area for 24 hours, to permit radon buildup. Then the lid was removed and placed in such a position that counts could be taken with an Eberline PAC–3G survey meter. This instrument is gamma insensitive and will discriminate between alpha contamination and the gamma field which exists in radium storage.

The jars measured approximately 3 inches in diameter and 2 inches in height. This size was considered small enough for adequate sensitivity, and it was found to be large enough for all but two sources. The corresponding lid was tinplate with a coating of commercial lacquer on the inside. The lid also had a rubber seal to insure a tight seal. The two sources that would not fit into the jars were long-stemmed nasopharyngeal applicators. The same method of testing was used, but commercial olive jars were substituted to accommodate these longer sources. When placed in these jars, the source was inserted so that the end with the radium was nearest the jar lid.

Findings. Although the Jefferson County project was small, the findings should prove enlightening to persons concerned with radium management. The facilities using radium within the county were: one industry, three hospitals, two otolaryngologists, one dermatologist, and two groups of radiologists with storage at three locations. When the survey began there were 140 sources in the form of needles, cells, plaques, nasopharyngeal applicators, and a plumb-bob-shaped object. These sources contained a total of 1,343 milligrams of radium. The users owned 648 milligrams and the remainder of the total was leased. Four of the 10 installations had 446 milligrams of radium in 48 sources that were considered unsafe. A single leaking source at each of the four installations was responsible for contamination of most of the other sources.

An interesting aspect of the findings was that contamination was found in each type of facility: one hospital, one industry, one radiologist group, and one practitioner. In no instance was contamination widespread.

Readings from the jar lids observed on the alpha instrument tended to cluster about four levels:

1. 75,000–100,000 counts per minute or greater, technically considered to represent definite leakage. This may, however, represent major surface contamination.
2. 10,000–40,000 counts per minute, considered to be a result of possible cross-contamination or slow leakage.
3. About 500 counts per minute, possibly as a result of old contamination with the appearance of terminal radium products or decay of small amounts of radium entrapped in a weld.
4. Zero or very low readings which, of course, represented no contamination or leakage.

Cooperation from the radium users in eliminating the contamination was excellent. The industry terminated its lease on radium in its possession and returned the radium to the owner. One of the users traded all the radium in his possession for new sources of the same strength. Another user exchanged a portion of his radium for smaller sized needles. At the final check with all users, there were 1,288 milligrams, less than the original amount. The users seemed to welcome the radium management program because of interest shown in the condition of their radium. Most medical users felt that there was no suitable substitute for radium in their work. This was true even after they learned the possible costs that would be incurred if an accident were to happen which could put their practice in jeopardy. We mentioned this possibility to the users, in light of the four contaminated installations plus others that were deficient in handling, storage, and recordkeeping.

Inadequacies in handling were usually obvious. Personnel required to handle radium were found to lack proper training in techniques. Because of this deficiency, respect for the dangers of radium was lacking. This should not be considered of small significance because it could mean the difference between a safely or dangerously functioning organization.

With regard to handling of radium by experienced personnel, it should be mentioned that nonchalance is one of the daughter products of familiarity, and constant reminders of the dangers appear to be the only solution. In a sur-

vey of handling techniques, the adequacy of transport carriers should also be considered. In this project, carriers were considered adequate in relation to quantity of radium carried, length of time exposed, and other variables. Such variables were reviewed at the time of the survey.

Storage facilities in Jefferson County ranged from good to bad. The largest radium user had an almost ideal installation, with concrete vaults for the lead pigs. However, some of the smaller users had their radium in a lead pig resting on a table or in an unlocked cabinet. A definite distinction was observed between the smallest and the largest users; the smallest had the poorest storage facilities and the largest had the best.

A variety of recordkeeping methods was observed. The amount of radium used and the frequency of use had to be considered in determining the adequacy of the record system for the installation. The largest user had close to an ideal system with good cross-checks. Several installations kept track of their radium by entries on indivdual patient records. This system was considered adequate in a small private office but not in the hospital or radiologists' offices where the radium was used frequently. An inadequate record system in one facility had resulted in the loss of a needle on two occasions within an 18-month period.

With one exception, adequate instrumentation was not available at the various facilities. In most cases, someone with instruments and the technical knowledge to use them was on call for emergency situations. The survey team suggested that the health department be notified in the future if any emergency, either actual or possible, arose.

Cost and time analysis. A cost and time analysis of such a project is quite difficult to assess. Many preliminary items are always so intangible that their value cannot be estimated. The amount of time spent in planning, preparing the final protocol, and scheduling field work is nebulous; only the actual time spent in performing the fieldwork is easily determinable.

Considering these facts, we estimated man-days and the cost of this time. However, the bulk of this time was actually spent in the field, and the survey team consisted of at least three members on practically every field visit. The number of man-days was about 200, and the approximate cost for this time was $4,000. This figure excludes the time of administrative personnel with the health department and the time lost by facility personnel while the survey team was at work, although the latter was not substantial. Instruments and other equipment and supplies are also excluded from the estimate. Therefore, although the estimate of cost and time is not absolutely conclusive, the results obtained and the interest stimulated by the project was well worth the cost and time.

Conclusions

The final survey form used in the project proved workable but not perfect. Because of its subjectivity, it was easily adapted to various situations encountered in facilities of differing sizes. It was somewhat unwieldy for the surveyor when collecting technical information relative to radium sources. Some questions which seemed clear during design proved not to be so conclusive during actual questioning.

It was shown, after using both methods, that making an appointment with radium users to conduct the survey was best handled by telephone rather than mail. However, this may not be feasible in a larger program.

The jar test employed in checking for leaking sources of radium was evaluated as successful in this project. As a field test, this method is extraordinarily simple, sufficiently sensitive, and rapid. It's simplicity allows inexperienced personnel to become reasonably competent in its use with little training. The sensitivity of the method is encouraging and it appears to be a test with reasonable reproducibility. Reproducibility, of course, can be greatly enhanced by the consistent geometry of the jars, the cap area, and the distance from the cap to the instrument window. This method is also advantageous to the radium user, since the radium is never removed from his charge and is out of use only 24 hours unless leakage is found.

Because of the apparent sensitivity of the method, an arbitrary limit was established to distinguish between contaminated and noncontaminated sources. This limit was 1,000 counts per minute using the PAC-3G instrument be-

cause we felt that sources yielding counts higher than 1,000 should be decontaminated by appropriate means and surveyed further. If an increased leakage value was obtained at this time, re-encapsulation would be indicated. More data would be desirable to confirm this point. Naturally, we hope that this field method will undergo more experimentation to determine further its value and usefulness in detecting radium leakage.

In view of the cooperation received locally, it might be surmised that radium management programs will be welcomed wherever attempted. The responsibility of decontamination, of course, should be accepted by the radium user. The sole responsibility of the public health agency is to point out deficiencies and see that corrective action is taken by installation personnel.

Finally, it was again demonstrated that local, State, and Federal levels of government can operate together quickly, efficiently, and comfortably to bring about improvements in the field of public health.

Registry of Tissue Reactions to Drugs

The Food and Drug Administration, U.S. Department of Health, Education, and Welfare, the American Medical Association, and the Pharmaceutical Manufacturers Association are jointly sponsoring a Registry of Tissue Reactions to Drugs to supplement present adverse drug reaction reporting programs.

First proposed by the Drug Research Board of the National Academy of Sciences-National Research Council, the Registry will be established within the Armed Forces Institute of Pathology. Twenty-eight other registries, known as the American Registry of Pathology, already exist as joint activities of the AFIP and sponsoring professional societies.

The purpose of the Registry will be to obtain autopsy or biopsy tissue specimens in cases of suspected adverse drug reaction. The material will be thoroughly studied and monthly summary reports made to the three sponsoring agencies. Results will also be reported to the local pathologists who furnish the study material, and important information will be disseminated to the medical community.

The Registry will augment the drug reaction reporting programs now maintained by the AMA and FDA. Reports are made to FDA by about 500 cooperating Federal and military hospitals and 110 civilian hospitals under contract. The AMA receives reports of suspected adverse drug reactions from physicians in private practice, a number of hospitals not reporting to FDA, and other sources.

In 1966, the first full calendar year of operation, the expected costs of the Registry will be about $100,000. They will be borne equally by the three sponsors through a fund administered by the Universities Associated for Research and Education in Pathology, Inc.