A SYSTEM TO RECORD, VIEW, STORE, AND DISTRIBUTE NUCLEAR MEDICINE IMAGES AND RECORDS

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A system to record, view, store, and distribute nuclear medicine studies using 35-mm film is described. Advantages are record preservation, efficiency, convenience, and cost savings.

Many things happen to an image that depicts the distribution of radioactivity within a patient's body from the time it is recorded to the time it is filed. It is examined to assure adequate quality, interpreted by one or more nuclear medicine physicians, shown to one or more referring physicians, displayed at conferences, and finally stored for further reference in the department and/or the patient's record. Occasionally such studies are removed from the nuclear medicine department, for example, to the operating room. Images handled in so many ways are subject to many perils. They may be damaged, lost, or out of file for extended periods of time and hence unavailable for examination by anyone except the borrower. To avoid these problems, we have devised a system to record, view, store, and distribute nuclear medicine studies. The system is an improved version of one previously reported (*1*). A flow diagram of the system is shown in Fig. 1.

PROCEDURE

Both rectilinear scans and scintillation camera images are displayed on oscilloscopes and photographed on 35-mm film. Cameras are used that advance the 35-mm film only half of a full frame, permitting more efficient viewing and storing of images because the space between frames is reduced. Exposed film is developed in an automatic table-top processor. The quality of the study is checked before the patient leaves the department.

Scintillation camera images have been recorded on 35-mm film routinely in our laboratory for 4 years. The type of 35-mm film selected is based on its contrast and speed (*2,3*). Kodak high-contrast copy film or Dupont SF-2 film, because of its contrast characteristics, is used for static studies. When higher film speed or a wider gray scale is required, Kodak RAR 2498 is used. Computer-generated images are also recorded on 35-mm film.

Rectilinear scans are recorded as follows: Counts from the detector are processed through a pulse-height analyzer and photorecorder to which contrast enhancement or background erase can be applied. The distribution of radioactivity is then displayed

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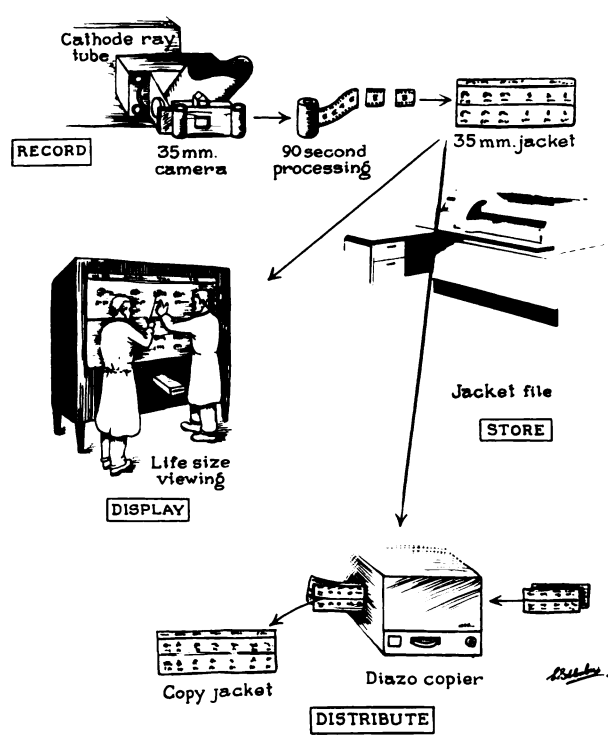

FIG. 1. Flow diagram of system.

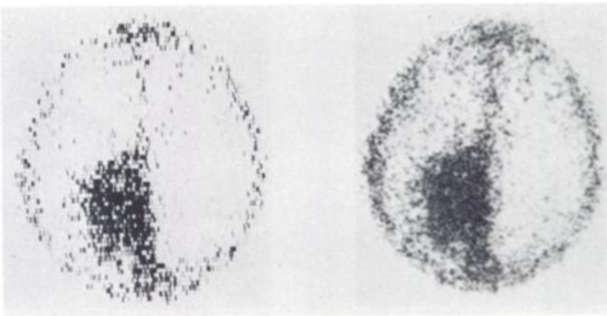

FIG. 2. Vertex views recorded simultaneously are shown above. Image on left was recorded in usual manner on 14 × 17 film and one on right on 35-mm film from oscilloscope screen.

on a cathode-ray oscilloscope. A Nikon M-35 camera records and integrates the flashes from the oscilloscope on Kodak RAR 2498 film during the scan. Film density is controlled by the intensity of the flashes on the CRT normalized according to the scan speed and counting rate. On any given scan, the density can be altered by lowering or raising the intensity setting on the cathode-ray tube. There is no noticeable loss in resolution or detail with scans recorded on 35-mm film. Figure 2 shows a comparison of a brain scan recorded on 14 × 17 film and on 35-mm film.

Patient reports, work sheets, radiographs, and any rectilinear scans recorded on 14 × 17 film are photographed on 35-mm microfilm using a camera distributed by the Micro-X-Ray Recorder Corporation (3755 Lawrence Ave., Chicago, Ill. 60625). This camera uses an extended exposure response film that produces excellent copies automatically. Film used in this camera is returned to Micro-X-Ray for processing. We have to date used this camera to record 150,000 images.

STORING

Radionuclide images, reports, work sheets, and radiographs, recorded on 35-mm film are mounted in clear plastic 3⅜ × 7¼ in. tab-sized microfilm jackets that will hold as many as 14 images. No special tools are required to insert the film into either of the jacket's channels. The jackets are kept in envelopes color coded with the patient's unit number. Envelopes are filed in a mechanized file that consists of a vertical arrangement of trays linked together in a revolving mechanism. Any one of the trays containing the envelopes is retrieved by means of push buttons and an electric motor-driven mechanism so that most of the work of filing is eliminated. The dimensions of the unit are 34-in. deep × 47-in. high × 100-in. long. This sized file has a capacity for 100,000 jackets.

Systems are available that permit completely automatic jacket selection. Most of these are characterized by edge coding, the mechanical notching of codes into the edge of jackets. Using a ten-button keyboard as input, the unit is capable of simultaneously searching all randomly filed cards in the system and instantly selecting those that match the input requests.

DISTRIBUTION

Original studies never leave the department. When a request is made to view a patient's study, a copy is made from the original jacket and sent to the requesting physician. Jackets containing up to 14 images are duplicated using a diazo copy process that produces a positive copy of the original. The copier duplicates the 35-mm images mounted in the jacket onto a 3⅜ × 7¼-in. diazo film, which uses an anhydrous ammonia developing process. A processing time of 10 sec will produce a copy with virtually the same quality as the original; if desired, the contrast of the copy can be changed by varying the development time. Because a high level of ultraviolet energy is needed to expose diazo films, they are not used as camera films. However, when diazo is used as duplicating medium, its relative insensitivity to light is an advantage; and since diazo microfilms may be processed in normal room light, no darkroom is required. Because development is accomplished with ammonia vapor, the need for water and plumbing is eliminated. The diazo film emerges from the developer dry and ready to view. The cost of a 3⅜ × 7½-in. sheet of diazo film is 4 cents. Because as many as 14 images can be copied on this size film, the cost per image can be as low as 0.003 cents.

DISPLAY

Interpretation of nuclear medicine studies is facilitated if all views are visualized simultaneously

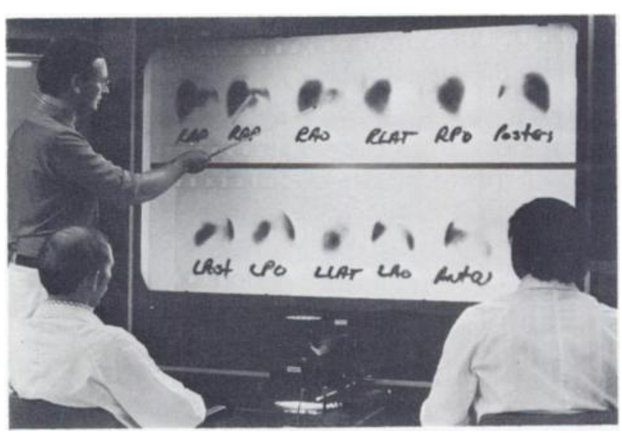

FIG. 3. Simultaneous projection of all 11 views of liver-spleen study being interpreted at nuclear medicine diagnostic conference.

TABLE 1. COST AND STORAGE REQUIREMENTS

	14 × 17	Polaroid	35 mm
Film cost per image	88¢	30¢	2¢
Cost of a duplicate	$1.00	30¢	4¢
Space required to file 1,000 images	3,456 cu in.	860 cu in.	42 cu in.

and in life size. We have recently had a viewer constructed* (Fig. 3) that projects the 35-mm images mounted in the 3⅜ × 7¼-in. jacket onto a 72 × 42-in. viewing screen. The overall dimensions of the viewer are 76-in. wide × 38-in. deep × 84-in. high. A 6-in. focal length lens is used in the projector to produce projected images with the same magnification factor (15X) as the reduction factor of the recording cameras. This results in life-sized images. Rear projection of the images is accomplished using a series of mirrors mounted internally. The images appearing on the screen are of suitable density with little loss of image brightness at viewing angles of as much as 45 deg. Small tabletop microfilm viewers that are primarily used to read microfilmed patient histories can also be used to project the type of nuclear medicine images described; but with this system only one image at a time can be seen. Viewers of this type are located throughout the hospital.

* This prototype was constructed by Muffoletto Optical Co., Baltimore, Md. 21206.

DISCUSSION

The system has been in use in our laboratory for 2 years and has many advantages. It avoids loss of the original data, facilitates retrieval and analysis, permits rapid duplication of results, saves space, and significantly reduces cost (Table 1).

REFERENCES

1. Langan JK, Wagner HN: A display and storage system for radionuclide images. *Radiology* 93: 1197–1198, 1969

2. Rudin S, Bardfeld PA: New system for replacing Polaroid with rapidly processed 35-mm film for radioisotope scan display. *Radiology* 100: 180–182, 1971

3. Payne JT, Loken MK: Selection of 35-mm film for scintiphotography: unpublished observations.