# Article Excerpts:
## Radiation protection concerns among staff performing Fluoroscopic procedures.

***• E.P./Cath Lab***
***• Pain Management***
***• Radiology***

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***Interventional Radiology Carries Occupational Risk for Cataracts***
*RSNA News, June 2004*

Interventional Radiologists are at high risk of radiation-induced eye injury and should consider eye protection to avoid posterior subcapsular (PSC) cataract formation, according to research released at the Society of Interventional Radiology (SIR) annual meeting in March.

The researchers found that the frequency and severity of PSC cataracts increased with age and years in practice. Dr. Ziv J. Haskal, M.D. is urging interventional radiologists to more seriously consider wearing high-quality radiation eye protection.

The researchers found that nearly half of the interventional radiologists screened had signs of radiation-related lens changes. "This study combined with other research shows that people are developing cataracts at much lower radiation doses than permissible limits allow," says Basil V. Worgul, Ph.D., a professor of radiation biology in ophthalmology and radiology at Columbia University College of Physicians and Surgeons in New York City.

"One of the most important findings was that the changes observed were found in interventional radiologists in their mid-40s," says Anna Junk, M.D., lead author and ophthalmologist at Albert Einstein College of Medicine. “Interventional radiologists need 20/20 vision in both eyes to have excellent stereopsis and to perform the delicate procedures demanded in their occupation

***Download the entire RSNA article at www.barrieronline.com***

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***Radiation Protection in Interventional Radiology***
*Interventional Radiology, Vol. 1, Second Edition*

“Interventional radiology procedures can require substantial amounts of ionizing radiation and therefore necessitate particularly close attention to radiation protection…

Because cinefluorography (cine) is an extension of fluoroscopy, all of the previous radiation protection considerations apply; however, radiation exposure is significantly higher for the patient as well as the staff…

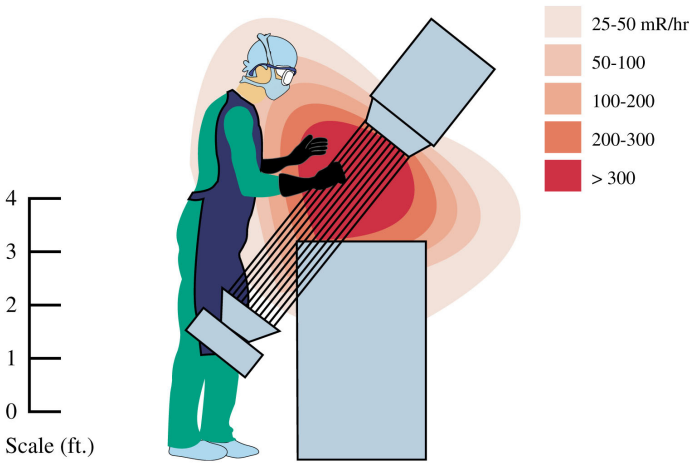
The scattered radiation levels shown in Figure 1.4 (next page) were obtained with skin entrance exposure of 2.8 R/min; to depict the cine scattered radiation exposure, the values in the figure should be multiplied by a factor of seven to 32!

**Figure 1.4: Maximum Number of Fluoroscopic Procedures in a 3-Month Period without exceeding Eye Exposure of 1.25 R/Quarter**

*Fig 1.4*

| Fluoroscopic Time per Procedure (hr) | Radiation Exposure at Eye Level (mR/hr) 10 | 25 | 50 | 100 | 200 | 300 |
|---|---|---|---|---|---|---|
| 0.10 | 1250 | 500 | 250 | 125 | 62 | 41 |
| 0.25 | 500 | 200 | 100 | 50 | 25 | 16 |
| 0.50 | 250 | 100 | 50 | 25 | 12 | 8 |
| 0.75 | 166 | 67 | 33 | 16 | 8 | 5 |
| 1.00 | 125 | 50 | 25 | 12 | 6 | 4 |
| 1.50 | 83 | 33 | 16 | 8 | 4 | 2 |
| 2.00 | 62 | 25 | 12 | 6 | 3 | 2 |

Eye Exposure = 110mR/hr

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***Potential Biological Effects Following High X-Ray Dose Interventional Procedures***
*Journal of Vascular and Interventional Radiology,*
*January-February 1994*

"Absorbed doses from ionizing radiation administered during some fluoroscopically and fluorographically guided interventional procedures, such as electophysiologic ablations, transjugular intrahepatic porosystemic shunt (TIPS) procedures, and embolization of aneurysms and arteriovenous malformation, are among the largest from medical applications other than those from radiation oncology."

"With the expanded and sometimes prolonged uses of fluoroscopy and Fluorography, we considered it important to review the potential for stochastic and deterministic effects that could occur from very high absorbed doses."

**Chronic irradiation of physicians' hands**
"Late determination effects to skin of the hands are principal radiation concern of radiologists and are more important than the risk of skin cancer."

**Skin Cancer**
"Radiation-induced skin cancer is a concern for both the patient who receives a high dose in one session and the physician who accumulates a high dose to the hand over an extended period of time. Skin cancer can be induced from long-term accumulated doses that do not cause acute erythema or epilation."

**Cataracts**
"Radiation-induced cataract is a deterministic effect. The minimum latent period for the detection of radiation-induced cataracts is approximately one year, and they initially begin in the posterior pole of the lens. Younger individuals appear to develop cataracts earlier with more rapid progression…Leaded protective lenses with side shields may help or may even be necessary, in this regard."

**Reducing Personnel Exposure**
Minimizing doses to patients is usually and effective way to help keep exposures to personnel acceptably low, but it is not sufficient. Professional radiation safety practices of monitoring doses, shielding personnel, managing radiation delivery, and maintaining quality improvement programs are also essential."

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***Radiation Exposure During Radiofrequency Catheter Ablation of Accessory Atrioventricular Connections***
*Circulation, Vol. 84, No.6, December 1991*

**Background**
Catheter ablation of accessory atrioventricular (AV) connections has been demonstrated to be effective in more than 85 percent of patients. One of the risks of this procedure is radiation exposure during the fluoroscopic imaging necessary to guide catheter ablation and to estimate the resultant somatic and genetic risks.

"The greatest radiation dose to the operator was recorded at the left hand (99mrem). Mean radiation dose to the operator's eyes was 38 mrem."

"A potential source of risk to the physician performing the procedure is the radiation exposure from fluoroscopic imaging required to guide the catheter manipulation."

"The radiation exposure received by the operator's left hand was much greater than that reported during PTCA procedures, reflecting the constant placement of the operator's left hand on the ablation catheter as it enters the body from the left femoral area."

**Physician Radiation Risk**
"The current guidelines limit the annual whole body (head and trunk) dose to five rem; the dose to the lens of the eye to 15 rem; and the dose to other organs, including the skin, extremities, breast, thyroid and gonads, to 50 rem… Further reduction to the radiation exposure received by the physician can be accomplished by wearing leaded glasses."

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***Surface Shield: Device to Reduce Personnel Radiation Exposure***
*Radiology, Vol. 159, No. 3, June 1986*

"There has been increasing concern regarding exposure of radiology personnel to scatter radiation during interventional procedures…

Absolute radiation levels remain higher during oblique fluoroscopy results in higher k Vp and/or mA levels, which increase tube output and, therefore, scatter radiation levels…Oblique fluoroscopy results in higher k Vp and/or mA levels, which increase tube output and, therefore, scatter radiation levels."

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***Radiation Exposure in Endovascular Surgery of the Head and Neck***
*AJNR, November 1994*

"Conclusions: The total doses at the operator's eyes and left hand during the course of a year may exceed the dose limits recommended by the International Commission of Radiological Protection. Operators should wear not only body protectors, but also thyroid protectors and lead glass spectacles. The equivalent dose at the right temporal area of the patient may exceed the deterministic dose fro transient or erythema or alopecia of the skin even in one endovascular procedure."

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***Technical Note: An assessment of X-ray Protective Gloves***
*The British Journal of Radiology, Vol. 68, No. 812, August 1995*

Abstract
"An assessment of X-ray protective gloves is reported which demonstrates that a significant degree of protection from X-ray exposure can be offered by these gloves. The need for such protection, together with the method of assessment is discussed. It is recommended that X-ray protective gloves are considered when undertaking image intensifier work."

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***X-Radiation***
*The Art and Science of Medical Radiography, Seventh Edition*

"The *rem* is the 'radiation equivalent man' and quantifies radiation dose for human beings. The rem takes into account the biological effectiveness of different types of radiation. The rem finds its major application in recording doses from radiation monitoring devices…

With the use of higher kVp, the number of Compton interactions will increase. This increases personnel exposure for those in the room during the exposure. This primarily occurs during fluoroscopy or mobile radiography. One must remember that a photon scattered as much as 90 degrees retains most of its energy. This indicates the need for good radiation protection techniques…

Glasses with lead-impregnated lenses can significantly reduce the dose to the eyes…

In an effort to minimize occupational injury as a result of occupational exposure, the maximum permissible dose (MPD) has been established for various parts of the body based on radiosensitivity. The whole body MPD is five rem annually.

Other MPDs are as follows:

**Sample Maximum Permissible Doses**

| | |
|---|---|
| Combined whole body occupational exposure | 5 rem in any one year |
| Lens of the eye | 15 rem in any one year |
| All others (e.g. red bone marrow, breasts, lungs, gonads, skin, and extremities | 50 rem in any one year |
| Human fetus during pregnancy | 0.5 rem in gestational |

Since radiation has cumulative effect, a cumulative MPD has also been established. The cumulative MPD has historically been based on age and the

whole body MPD. The historic MPD assumed no occupational exposure occurred before the age of 18 and was expressed:

**5(N-18)+135 rem**

Therefore, the cumulative MPD for a 45 year-old technologist is:

**5(45-18)+135 rem**

In 1987, the National Council on Radiation Protection changed the cumulative MPD recommendations to one rem times the age in years (NCRP Report No. 91). The new cumulative MPD recommendation is expressed as:

**1 x N=MPD (where N = age)**

Therefore the cumulative MPD for a 45 year-old technologist using the recommendation is:

**1 x 45=45 rem**

Obviously, the new recommendations result in a significantly lower cumulative MPD than was recommended for the previous method of calculating the cumulative MPD."

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***Implementation of the Principle of as Low as Reasonably Achievable (ALARA) for Medical and Dental Personnel***
*NCRP Report No. 107, December 1990*

"The use of fluoroscopy for diagnostic imaging represents the largest source of occupational exposure in medicine. Some additional imaging procedures such as cardiac catheterization constitute a potential source of high occupational exposures…

Cardiac catheterization can result in elevated personnel monitoring results. Like other vascular procedures, fluoroscopic times are long, personnel are in close proximity to the patent, and scatter shielding is difficult…

The use of cinefluorography during cardiac catheterization results in higher personnel exposure…

The dose equivalent to the operating during percutaneous transluminal coronary angioplasty was 93 percent greater than from routine coronary angiography."