min per day (Ref. *5*, Table 1). Such a schedule would, in effect, take a camera out of service for almost a whole day and this would, we are sure, be unacceptable in most busy departments—particularly when such tests are unlikely to yield information that will result in substantial clinical benefits.

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REPLY: In response to the letter from Drs. Cradduck and Busemann-Sokole, we offer the following comments:

Our paper does not address any specific deficiencies of the NEMA standards. Our goal was to demonstrate that a set of traceable standards could be used for daily quality assurance. Other papers (*1*,*2*) have addressed deficiencies and recommended changes in the standards; these changes would not influence the measurements discussed in our paper (3).

TABLE 1
Integral and Differential Uniformity in % Using NEMA Definition (GE-400 AT)

Integral uniformity		Differential uniformity	
UFOV	CFOV	UFOV	CFOV
5.77 ± 0.37	4.39 ± 0.35	4.35 ± 0.44	2.6 ± 0.17

Drs. Cradduck and Busemann-Sokole identify certain topics (count density of the flood image and ambiguity about the number of pixels to be used in the calculation of the differential uniformity) that they believe are deficiencies of the NEMA protocol. In Fig. 1 of their reference it is difficult to detect an absolute minimum for integral uniformity. Our data reveal an uncertainty of 6% or less in the integral uniformity at 4000 counts/pixel. These data are presented in Table 1, where 18 uniformity measurements are reported for the same camera.

The daily monitoring of differential and integral uniformity revealed considerable fluctuations (up to 11%), as described in Fig. 2 of our paper. No more than 1% of the fluctuation in integral uniformity is attributable to random variation. In our paper we mention possible deficiencies in the NEMA description of differential uniformity under Ref. *19*. Whether the differential uniformity is computed from five or six pixels does not influence the practicality of the computation.

We agree that one major performance check (uniformity) should be performed daily and that other procedures can be performed less frequently, but we disagree that it should be done preferably according to a decision-tree structure. One drawback of this approach is the subjective nature of the decision to initiate additional performance tests. Tests of parameters such as linearity and resolution are not difficult if one or a few NEMA phantom images are analyzed by computer. We believe that a department should be able to spare 5 hrs monthly for quality-assurance work in addition to the 15-30 minutes designated daily for routine monitoring.

In our paper we are concerned with NEMA standards (4) that have been established for U.S.A. manufacturers of imaging equipment. Our recommendation is that NEMA protocols be adopted for quality assurance and acceptance testing of cameras that carry NEMA-based performance specifications. We disagree that visual evaluation of a flood image is imperative, especially if uniformity can be monitored with a simple number in a manner traceable to NEMA. The latter approach is much more likely to reveal a degradation in performance before the performance becomes a detriment to the diagnostic process.

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Radionuclide Imaging in Pulmonary Edema

TO THE EDITOR: The studies in dogs by Slutsky and Higgins (*1*) with oleic acid injury to the lungs was an outstanding investigative work on acute respiratory distress syndrome (ARDS). It is now clear that increased thallium-201 (Tl-201) lung uptake may be seen in patients with ARDS and in patients with LV failure (*2,3*). While the animal study was well conducted and the data obtained were valuable, we feel the authors may have overextended the possible clinical applications of these findings. A cautionary note is warranted before an expensive test is utilized and judgments are made without further experimental evidence to substantiate the validity of this test in this specific clinical setting.

The authors suggested that serial pulmonary imaging may provide useful noninvasive monitoring of therapeutic results in patients with ARDS. Presumably this would be an indirect way of measuring decreases in extravascular lung water (EVLW) as the ARDS resolves due to proper therapeutic intervention. The problem we have with this suggestion is that while EVLW is increased in ARDS, disturbances in gas exchange are not characterized by similar changes in EVLW content. In fact, animal studies in sheep with endotoxin-induced ARDS showed that the EVLW bore no relationship to the measurement of gas exchange expressed as the alveolar-arterial (A-a) oxygen gradient (*4*).

The primary danger to the patient with ARDS is organ damage due to severe hypoxemia from the large R-L shunting caused by blood perfusing poorly ventilated or unventilated, liquid-filled lung units. Hence, the first step in managing the patient with ARDS is to improve gas exchange, usually by ventilatory support, oxygen, and PEEP. This treatment modality is known to improve gas exchange and promote survival, but not directly by decreasing EVLW, as has been well documented experimentally (*5*). In fact, PEEP may actually promote an increase in the EVLW even though gas exchange is improved (*6*). Other effects of PEEP, such as a decrease in the cardiac output, require that careful hemodynamic monitoring be utilized while high levels of PEEP are employed. To promote the use of lung Tl-201 measurements of EVLW in such a setting could lead to erroneous or confusing data regarding the clinical response to treatment.

A similar cautionary note is warranted for the suggestion by the authors that a dual-radionuclide study might be used to examine noninvasively the pulmonary fluid shifts in cardiogenic pulmonary edema. The use of such a technique for clinical research is acceptable, but the use of radionuclide pulmonary imaging as a clinical tool to characterize the flux of lung fluids in cardiogenic pulmonary edema seems unnecessary. Accurate hemodynamic monitoring is essential and limited information is available noninvasively with the use of radionuclide cardiac angiography or nuclear probe. On the other hand, since these fluid shifts often lag behind the hemodynamic changes, pulmonary radionuclide imaging would be an expensive means for yielding the same information that the stethoscope and chest radiography have provided for years.

We would like to stress that the study by Slutsky and Higgins was confined to dogs and should not be extrapolated to humans without first confirming that pulmonary Tl-201 imaging in cardiogenic and noncardiogenic pulmonary edema gives clinically useful and reliable information that is not otherwise easily available.

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REPLY: While the initial comments by Drs. Movahed and Wait were gratifying, the majority of their comments made me feel a bit like the innocent man asked to state when he'd stopped beating his wife. In fact, I feel somewhat like a "straw man" for expensive medical technology, who neither volunteered for the job nor asked to stand in the "cornfield." I reread the article in question and believe that Drs. Movahed and Wait have made their assertions based on comments in the article on the potential clinical uses (all of which would need any variety of clinical studies involving many possible questions).

It should be pointed out that Dr. Higgins and I are quite familiar with the effects of PEEP (*1*), therapy (*2*), and phase lag (*3-5*) on pulmonary congestion and gas exchange. Furthermore, we are also familiar with the potential problems with scintigraphy in hydrostatic pulmonary edema (*6*). We alluded to these concepts, pitfalls, and potentials in the discussion of our article.

Drs. Movahed and Wait are kind enough to review the standard clinical approaches to medical management of ARDS and cardiogenic edema. While undoubtedly familiar to most