ORIGINAL ARTICLE

Physician Knowledge of Radiation Exposure and Risk in Medical Imaging

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Abstract

Purpose: Medical imaging is an increasingly important source of radiation exposure for the general population, and there are risks associated with such exposure; however, recent studies have demonstrated poor understanding of medical radiation among various groups of health care providers. This study had two aims: (1) analyze physicians' knowledge of radiation exposure and risk in diagnostic imaging across multiple specialties and levels of training, and (2) assess the effectiveness of a brief educational presentation on improving physicians' knowledge.

Methods: From 2014 to 2016, 232 health care providers from multiple departments participated in an educational presentation and pre- and postpresentation tests evaluating knowledge of radiation exposure and risk at a large academic institution.

Results: Knowledge of radiation exposure and risk was relatively low on the prepresentation test, including particularly poor understanding of different imaging modalities, with 26% of participants unable to correctly identify which modalities expose patients to ionizing radiation. Test scores significantly increased after the educational presentation. Radiologists had higher prepresentation test scores than other specialties, and therefore less opportunity for improvement, but also demonstrated improvement in radiation safety knowledge after education. Aside from radiology, there was no significant difference in initial knowledge of radiation exposure and risk among the other specialties.

Conclusions: Providers' knowledge of radiation exposure and risk was low at baseline but significantly increased after a brief educational presentation. Efforts to educate ordering providers about radiation exposure and risk are needed to ensure that providers are appropriately weighing the risks and benefits of medical imaging and to ensure high-quality, patient-centered care.

Key Words: Radiation, exposure, safety, physician, knowledge

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INTRODUCTION

Medical imaging has become an increasingly important source of radiation exposure. A recent study of imaging utilization found that from 1996 to 2010, the mean per capita radiation exposure from CT examinations doubled [1]. The number of patients receiving high (20-50 mSv) and very high (>50 mSv) annual radiation doses also doubled. The National Council on Radiation Protection and Measurements reported a 7-fold increase in public exposure to ionizing radiation due to medical imaging from the 1980s to 2006 [2].

High-dose radiation exposure increases lifetime risk for death of cancer, but the adverse effects of low-dose medical imaging are not well established [3,4]. Conflicting opinions have been published in recent years, highlighting the need for referring providers to understand the true risks associated with medical imaging. Although organizations of medical physicists have cautioned against estimating the health effects of low-dose medical imaging [5,6], some sources estimate that low-dose radiation exposure from medical imaging may in the future account for up to 2% of cancers nationwide [7,8]. It is vital that heath care providers who supervise, perform, or request radiologic examinations have knowledge about radiation exposure and risk and be able to discuss the risks and benefits with their patients. Because nearly every health care provider currently utilizes medical imaging in his or her practice, a basic

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understanding of radiation safety is necessary for all providers.

Previous studies suggest that nonradiologist physicians are underinformed of the risks associated with commonly ordered imaging tests and that they have a tendency to underestimate radiation dose and associated risk and fail to adequately communicate risks to their patients [9-16]. Recent studies have stressed the need for providers to incorporate the risks of radiation exposure into clinical and imaging decisions [17-20] and demonstrated that an appropriate understanding of radiation exposure influences the number of imaging examinations requested by physicians [21].

The aims of our pilot study were to analyze physicians' knowledge of radiation exposure and risk in diagnostic imaging across multiple specialties and levels of training and to assess the effectiveness of a brief educational presentation on improving physicians' knowledge of these topics. We hypothesized that nonradiologists would have lower radiation exposure knowledge at baseline compared with radiologists and that knowledge would improve for all providers after participating in our educational presentation.

METHODS

Study Design

This pilot study was institutional review board approved. We created a questionnaire that included provider characteristics (specialty, rank or level, and years of practice) and a nine-item multiple-choice test covering knowledge of the risks of ionizing radiation, the relative radiation exposure of different imaging examinations, the relative risk of radiation exposure in patients of different ages, and practical considerations for incorporating radiation exposure and risk information into clinical practice. Our test was brief to ensure participation. We developed a 15-min educational presentation covering these radiation topics. This presentation provided general knowledge of radiation exposure and risk but did not provide direct answers to the test. Participants included faculty members, fellows, residents, and advanced practice providers from the department of radiology and from the primary care specialties of internal medicine, family medicine, emergency medicine, and obstetrics and gynecology at a large academic institution. Primary care specialties were included because they constitute a majority of providers who order imaging studies. Because radiation exposure and associated risks differ between pediatric and adult populations, we chose to focus our content and participants within adult care.

The questionnaire and presentation were delivered at routinely scheduled departmental meetings for each department. Providers were allowed to opt out of participation in the questionnaires; however, all providers participated. Participation in this project was anonymous. The questionnaire was administered before the educational presentation (the pretest), and again immediately afterward (the posttest) to allow us to compare pretest and posttest responses without collecting identifying information.

Statistical Methods

Descriptive statistics were produced for participant characteristics. For each test question, the proportion of correct responses (pre- and posttest) and corresponding exact binomial 95% confidence intervals were calculated. To evaluate provider characteristics associated with radiation safety knowledge and the impact of the educational presentation on these relationships, we used generalized estimating equation (GEE) regression. This approach accounts for correlated outcomes for a given participant on the pretest and posttest and allowed us to evaluate the significance of provider characteristics. We fit a model with the outcome of proportion of correct answers. As predictors, we included provider specialty, interaction terms between provider specialty and postpresentation status, provider level, interaction terms between provider level and postpresentation status, and a binary indicator for postpresentation status; the reference groups were radiology for specialty, resident for provider level, and pretest for time (i.e. the intercept represents the mean proportion correct for radiology residents on the pretest). This specification allowed providers to have different baseline knowledge and also have different knowledge gains specific to their specialties and levels. From the model, we produced estimates of the proportion of answers correct, corresponding 95% confidence intervals and *P* values for each specialty pre- and posttest. The 95% confidence intervals for the proportion of correct answers were compared to determine pretest-posttest differences within specialties and differences across specialties.

One question evaluated perceived risk for cancer death due to radiation exposure. The calculations required to derive the correct answer were relatively complex, and it was not expected that the participants would respond accurately solely on the basis of the information included in the educational presentation. This question was intended to reveal participants' perception of the harmfulness of the doses of radiation in diagnostic radiology. This question was not counted toward overall proportion correct. To evaluate the change in perceived