ORIGINAL ARTICLE

Physician and nurse knowledge about patient radiation exposure in the emergency department

WJ Lee, SH Woo, SH Seol, DH Kim, JH Wee[1], SP Choi[1], WJ Jeong[2], SH Oh[3], YY Kyong[4], SW Kim[5]

Department of Emergency Medicine, Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, [1]Department of Emergency Medicine, Yeouido St. Mary's Hospital, College of Medicine, The Catholic University of Korea, [2]Department of Emergency Medicine, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, [3]Department of Emergency Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, [4]Department of Emergency Medicine, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, [5]Department of Emergency Medicine, Bucheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea

Abstract

Background: Imaging methods that use ionizing radiation in emergency departments (EDs) have increased with advances in radiological diagnostic methods. Physician and nurse awareness of the radiation dose in the ED and the associated cancer risks to which the patients are exposed were surveyed with a questionnaire.

Methods: A total of 191 subjects in six EDs participated in this study. ED physicians and ED nurses were asked about the risks and the radiation doses of imaging methods ordered in the ED. The differences between the two groups were compared using Student's *t*-test for continuous variables. A Fisher's exact and Chi-squared tests were used for categorical variables.

Results: A total of 82 ED physicians and 109 ED nurses completed the questionnaire; 38 (46.3%) physicians and 8 (7.3%) nurses correctly answered the question about the chest X-ray radiation dose. A question about the number of chest X-rays that is equivalent to the dose of a pelvic X-ray was answered correctly by 5 (6.1%) physicians and 9 (8.3%) nurses ($P = 0.571$). Questions regarding abdominal computed tomography (CT), chest CT, brain CT, abdominal ultrasonography, and brain magnetic resonance imaging were answered correctly more frequently by the physician group than the nurse group ($P < 0.05$). The risk of developing cancer over a lifetime due to a brain CT was correctly answered by 21 (25.6%) physicians and 30 (27.5%) nurses ($P = 0.170$). A similar question regarding abdominal CT was correctly answered by 21 (25.6%) physicians and 42 (38.5%) nurses ($P = 0.127$).

Conclusions: Knowledge of the radiation exposure of radiology examinations was lower in nurses than physicians, but knowledge was poor in both groups. ED physicians and nurses should be educated about radiation exposure and cancer risks associated with various diagnostic radiological methods.

Key words: Diagnostic imaging, emergencies, radiation dosage

Date of Acceptance: 23-Nov-2015

Address for correspondence:
Dr. SH Woo,
Department of Emergency Medicine, Incheon St. Mary's Hospital,
College of Medicine, The Catholic University of Korea,
#665-8 Bupyeong 6-dong, Bupyeong-gu, Incheon 403-720,
Republic of Korea.
E-mail: drme@catholic.ac.kr

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/1119-3077.183298

PMID: 27251968

How to cite this article: Lee WJ, Woo SH, Seol SH, Kim DH, Wee JH, Choi SP, *et al*. Physician and nurse knowledge about patient radiation exposure in the emergency department. Niger J Clin Pract 2016;19:502-7.

Introduction

A recent disaster occurred at the Fukushima nuclear power plant in 2011. As a result, concerns about radiation exposure and radiation-induced ionization have increased in South Korea. Given its close proximity to Japan, South Korea has activated mass media and Internet communications, and we are interested in radiation exposure in daily life as well as the high dose of radiation in the extensive use of computed tomography (CT) scans in the emergency department (ED).[1,2]

In recent years, studies have shown a lack of awareness among physicians and radiologists regarding the radiation exposure doses associated with diagnostic radiology procedures. Although many studies have investigated radiation exposure to radiologists and doctors during radiology procedures as well as the knowledge of radiation exposure in patients, there have been very few reports involving ED nurses.[3-7]

Imaging methods that use ionizing radiation have increased in EDs with advances in radiological diagnostic methods. In particular, the use of these modalities in pediatric emergency rooms has been higher than in other countries, which indicates that in pediatric emergency settings, the use of X-ray and CT scans for diagnostic purposes is closely related to the elevated exposure to ionizing radiation.[8] It is important that emergency physicians who order imaging tests are well trained in determining whether diagnostic imaging is required but also that emergency physicians have an accurate knowledge of the associated risks to patients. This is particularly important in the ED, where many radiological imaging tests are ordered and rapid decisions are needed.

The cooperation of nurses in the ED, who closely manage patients, is essential for performing radiological diagnostic procedures and for obtaining informed consent from patients and their families. Both physicians and nurses play important roles in the decisions regarding emergency diagnostic procedures and treatments.

However, despite the increased exposure of patients to radiation in the ED with advances in radiological diagnostic methods, radiation safety education is not standard in ED training programs in South Korea and may be lacking.

The aim of our study was to analyze and compare the awareness of ED physicians and nurses regarding the radiation doses and the associated cancer risks to which the patients are exposed due to radiological diagnostic procedures in the ED.

Methods

This study was conducted in the six EDs of the University Hospital in South Korea and was approved by the Institutional Review Board of the Catholic University of Korea. The doctors and nurses of ED (Incheon St. Mary's Hospital, Yeouido St. Mary's Hospital, St. Vincent's Hospital, Seoul St. Mary's Hospital, Uijeongbu St. Mary's Hospital, and Bucheon St. Mary's Hospital) were the subjects of this survey. The annual average number of visiting patients in Seoul St. Mary's Hospital and the other four EDs in Gyeonggi-do was greater than 50,000 and at Yeouido St. Mary's Hospital, it was over 35,000. Seoul and Incheon St. Mary's Hospitals are tertiary care hospitals and the other four hospitals are secondary care hospitals. These emergency centers are all teaching hospitals that provide medical care to pediatric, adult, and trauma patients.

The data were collected anonymously from 95 doctors and 124 nurses. In total, 24 did not agree to the survey; 4 replied incompletely and their partial responses were not included. A total of 191 subjects participated in the study, with 82 (42.9%) ED physicians and 109 (57.1%) ED nurses answering the questions.

The study consisted of questions regarding the participant's demographics and radiation knowledge, with 15 questions testing the actual knowledge of radiation doses [see Appendix]. Questions were designed by emergency physicians (staff, professors) and were agreed upon by all authors. The questions were in short answer and multiple choice formats, each with one correct answer. To assess the radiation dosing knowledge, participants were asked to estimate chest X-ray equivalents. Some questions also addressed organ sensitivity and the risk of fatal cancers from a CT scan. The dose and amount of radiation exposure from diagnostic imaging techniques in the ED may differ by hospital, rural area, urban area, and country. The survey questions were based on previously published studies.[3-7] Recruitment occurred between May and June 2012 in the six EDs. Responses to questions in a standard written form were completed in their ED of each teaching hospital under the strict control of coauthors. Each questionnaire was completed within 10 min without references or books. The research staff was excluded. Scoring of the survey was performed by an independent coordinator, unrelated to this particular survey.

SPSS software (SPSS, Chicago, IL, USA) was used for the statistical analysis. The differences between the two groups were compared using Student's *t*-test for continuous variables. Chi-squared and Fisher's exact tests were used to assess categorical variables. *P* values less than 0.05 were considered to be statistically significant.

Results

General characteristics of the subjects

Twenty-two (26.8%) of the physicians and 107 (98.2%) of the nurses were female. For the questions about natural

radioactivity, 81 (98.8%) of the physicians and 100 (93.5%) of the nurses recognized ($P = 0.031$). The mean age of the participants was 29.76 ± 5.98 years. The mean ages of the physicians and nurses were 31.12 ± 6.25 and 28.73 ± 5.57 years, respectively ($P = 0.006$). The employment duration was more than 5 years after graduation for 22 (26.8%) of the physicians and 44 (40.4%) of the nurses. The employment level of the physicians in this study revealed that 34 (41.5%) were interns, 26 (31.7%) were residents, and 22 (26.8%) were staff [Table 1].

The results showed that 27 (32.9%) physicians and 17 (15.6%) nurses had received education about the radiation doses that patients are subjected to and their potential risks within the past 5 years ($P = 0.005$).

Table 1: Distribution of the demographic features of the ED physicians and nurses

	Physicians (n=82)	Nurses (n=109)
Sex (n, %)		
Male	60 (73.2)	2 (1.8)
Female	22 (26.8)	107 (98.2)
Age (years)	31.12±6.25	28.73±5.57
Experience level (n, %)		
<5 years	60 (73.2)	65 (59.6)
≥5 years	22 (26.8)	44 (40.4)
Employment level (n, %)		
Intern	34 (41.5)	
Resident	26 (31.7)	
Staff	22 (26.8)	

The value in parentheses indicates percentage. ED=Emergency department

Table 2: Distribution of correct answers regarding the corresponding number of chest X-rays with respect to the received radiation doses during diagnostic imaging studies (n, %)

	Physician group (n=82)	Nurse group (n=109)	P
Abdominal X-ray	1 (1.2)	9 (8.3)	0.031
Pelvic X-ray	5 (6.1)	9 (8.3)	0.571
CT scan of the abdomen	20 (24.4)	7 (6.4)	<0.001
CT scan of the chest	16 (19.5)	7 (6.4)	0.006
CT scan of the brain	30 (36.6)	19 (17.4)	0.003
US of abdomen	78 (95.1)	60 (55.0)	<0.001
MRI of the brain	69 (84.1)	21 (19.3)	<0.001

The value in parentheses indicates percentage. CT=Computed tomography; US=Ultrasonography; MRI=Magnetic resonance imaging

Analysis of physician and nurse knowledge regarding radiation doses

The analysis showed that 38 (46.3%) physicians and 8 (7.3%) nurses correctly answered the question regarding chest posterior–anterior (PA) radiation dose ($P < 0.001$). The radiation dose in mSv from a single chest X-ray was overestimated by 18 (22.0%) physicians and 20 (18.3%) nurses ($P = 0.537$).

A question about the number of chest PAs that are equivalent to the dose of a pelvic X-ray was answered correctly by 5 (6.1%) physicians and 9 (8.3%) nurses, whereas 77 (93.9%) physicians and 97 (89.0%) nurses underestimated the radiation dose ($P = 0.262$).

In addition, 20 (24.4%) physicians and 7 (6.4%) nurses correctly answered the question about the corresponding number of chest X-rays with respect to the received radiation dose of an abdominal CT ($P < 0.001$). The same question regarding chest CT and brain CT was answered correctly more frequently by the physician group than the nurse group ($P < 0.005$) [Table 2]. Forty-five (54.9%) physicians and 83 (76.1%) nurses underestimated the radiation dose from brain CT scans ($P = 0.006$). Moreover, 49 (45.0%) nurses, 88 (80.7%) nurses incorrectly answered the question about the radiation dose of abdominal ultrasonography (US) and brain magnetic resonance imaging (MRI) ($P < 0.001$).

The lifetime risk of developing cancer due to a brain CT was answered correctly by 21 (25.6%) physicians and 30 (27.5%) nurses. The same question regarding abdominal CT was answered correctly by 21 (25.6%) physicians and 42 (38.5%) nurses; 43 (52.4%) physicians and 43 (39.4%) nurses overestimated the lifetime attributable risk of fatal cancer from a single abdominal CT scan ($P = 0.127$). However, the risk of a brain CT was underestimated by 42 (51.2%) physicians and 65 (59.6%) nurses ($P = 0.170$) [Table 3].

The optimal period of education of 1 year was identified by 37 (45.1%) physicians and 67 (61.5%) nurses.

In addition, 72 (87.8%) physicians and 78 (71.6%) nurses stated that they explain the risks of radiation to pregnant women in the ED prior to diagnostic radiological imaging [Figure 1]. However, regarding brain CT in pediatric patients, 4 (4.9%) physicians and 14 (12.8%) nurses stated that they do not agree that they explain the

Table 3: Distribution of correct answers regarding the lifetime cancer risk from CT

	CT scan of the brain			CT scan of the abdomen		
	Under	Correct	Over	Under	Correct	Over
Physician (n, %)	42 (51.2)	21 (25.6)	19 (23.2)	18 (22.0)	21 (25.6)	43 (52.4)
Nurse (n, %)	65 (59.6)	30 (27.5)	14 (12.8)	24 (22.0)	42 (38.5)	43 (39.4)
P	0.170			0.127		

Value in parentheses indicates percentage. CT=Computed tomography

radiation risks to patients adequately in the ED [Figure 2]. Regarding adult brain CT, 15 physicians (18.3%) and 14 (12.8%) nurses stated that they do not agree that the radiation risks are adequately explained to patients in the ED [Figure 3].

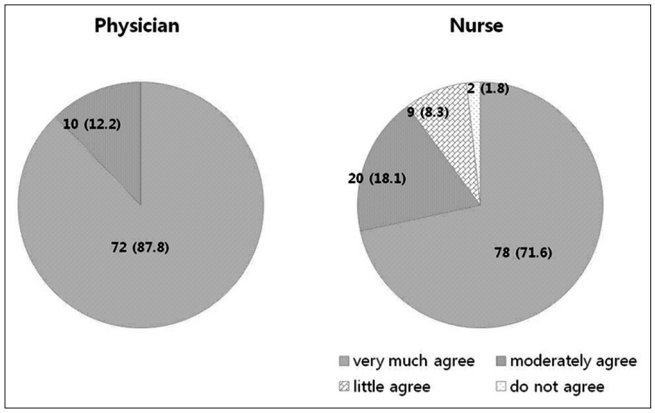

Figure 1: Regarding X-rays in pregnant patients, do you agree that we explain the radiation risks adequately in our emergency departments?

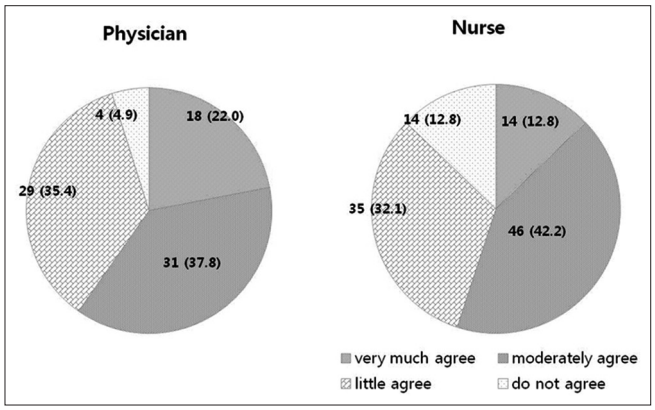

Figure 2: Regarding brain computed tomography in pediatric patients, do you agree that we explain the radiation risks adequately in our emergency departments?

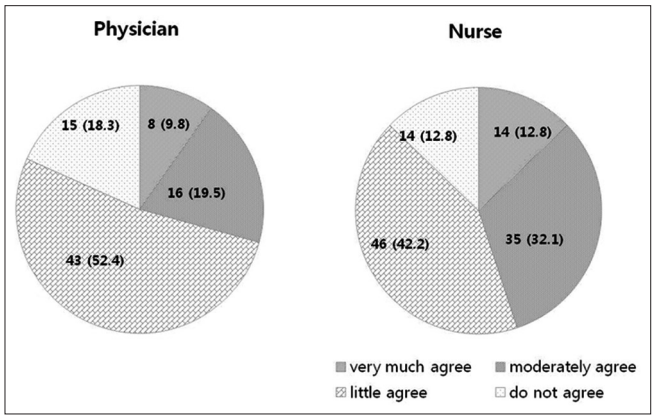

Figure 3: Regarding computed tomography in adult patients, do you agree that we explain the radiation risks adequately in our emergency departments?

Discussion

Recently, South Korea has shown a high interest in radiation exposure after the Fukushima nuclear plant disaster in Japan. Patients visiting the emergency room have a right to the facts about the radiation exposure amounts in diagnostic and therapeutic procedures. Therefore, emergency physicians and nurses should know about the radiation exposure doses of all diagnostic imaging procedures. In addition, an increased number of major trauma patients have increased radiation exposure because they require rapid CT for rapid diagnosis and active critical care.[9] A report by Ott *et al*., explained that the majority of minor trauma patients are exposed to too much radiation from X-rays and CT scans prior to their diagnosis; a reduction in the radiation exposure during diagnosis is necessary.[9] Therefore, radiation-based diagnostic procedures should be reduced to minimize the radiation exposure in the emergency room, and explanations should be provided to patients regarding the amount of radiation exposure and any related complications.

According to Lee *et al*., over 70% of radiologists and emergency physicians underestimate the amount of radiation exposure from CT scans, and 91% of emergency physicians explained that radiation exposure has no relationship to the increased cancer incidence rate, so that they ignore the radiation risks.[10] In this research, the majority of physicians and nurses acknowledged the risk of radiation exposure to fetuses and pregnant women and explained these risks before the radiology examinations. However, this was not the case for pediatric patients. Children may be exposed to more radiation as they grow, and they therefore need more attention when diagnostic X-rays or CT scans are required. The cumulative effects of radiation exposure over multiple diagnostic imaging methods affect the risk of cancer development in pediatric patients.[11,12]

Both the physicians and nurses underestimated the radiation dose of brain CT in this study. Adult and pediatric patients present to the ED because of blunt minor or major head trauma. Thus, primary physicians in the ED should employ brain CT for diagnosing major head injuries. In addition, they should consider the necessity for CT in mild head trauma in pediatric cases. The rate of abdominal CT use has been increasing due to the more accurate diagnosis of appendicitis in children.[13-15] Physicians should have sufficient knowledge about the radiation dose of diagnostic radiological examinations and work to decrease the radiation exposure of children in the ED.

Knowledge regarding the radiation dose for a abdominal CT, chest CT, and brain CT was evaluated in relation to the corresponding number of PA chest X-rays: 20 (24.4%), 16 (19.5%), and 30 (36.6%) physicians and 7 (6.4%),

7 (6.4%), and 19 (17.4%) nurses, respectively, correctly answered this question. An investigation of previous studies revealed that the ratio of the correct answers to these questions was as low as in our study.[3-5] Most patients or their guardians visiting the ED lack knowledge of the radiation doses that they may be exposed to during diagnostic radiological examination. Thus, to decrease the radiation exposure dose of the patient in the ED, everyone (physicians, nurses, patients, and their guardians) need to increase awareness of radiation risks. Exposure to radiation as a result of a radiologic examination in the ED may be associated with an increased risk of malignancy.[16,17] The risk of malignancy was overestimated in abdominal CT but underestimated in brain CT by both physicians and nurses. Emergency physicians order brain CT for the diagnosis of most major head trauma patients, but they underestimated the radiation exposure regarding the risk of malignancy in adults. CT is the source of increasing radiation exposure in the ED. Radiation-induced cancer risks from CT must be addressed more thoroughly in the ED.

There are several limitations of this study. The survey was performed only at university-affiliated teaching institutions in South Korea. Knowledge of the radiation dose in physicians and nurses may differ based on local variations in each institution's education program. The survey validation was limited to confirmation of the answers by the coauthors. In addition, the survey was performed at six teaching hospitals. Several participants did not complete the survey, leading to missing data. The estimated radiation dose of the diagnostic imaging technique and cancer risk showed controversial results in previous studies.[18-21] It may be difficult to assess the actual individual knowledge about radiation doses in the ED from this survey. Thus, we need further evaluation from a larger survey of ED personnel in the future. However, this study showed knowledge differences between physicians and nurses in the ED; the actual awareness of radiation exposure of radiologic examination might be lower in nurses than tested.

The question regarding the radiation dose of abdominal US and brain MRI was frequently answered incorrectly by the nurses. In the emergency room, physicians, nurses, and paramedics should work as a team in urgent clinical situations to rapidly diagnose and treat patients. Therefore, the nurses and paramedics who work in the emergency room should be educated about the differences in the radiation doses of different radiologic diagnostic evaluations. Our study indicates a need for additional education regarding radiation risks. Increased awareness of physicians and nurses regarding the radiation dose and radiation risks of radiological imaging methods may be achieved with a new education program in EDs.

Conclusions

In the emergency room, the awareness of radiation exposure of radiologic examination was lower in nurses than in physicians. However, the knowledge of ED physicians and nurses about the risks and doses from radiation exposure in the ED was poor. ED physicians and nurses may benefit from standardized continuing education programs about radiation exposure due to radiological diagnostic methods and their associated cancer risks.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. Broder J, Warshauer DM. Increasing utilization of computed tomography in the adult emergency department, 2000-2005. Emerg Radiol 2006;13:25-30.
2. Kalra MK, Maher MM, Rizzo S, Saini S. Radiation exposure and projected risks with multidetector-row computed tomography scanning: Clinical strategies and technologic developments for dose reduction. J Comput Assist Tomogr 2004;28 Suppl 1:S46-9.
3. Keijzers GB, Britton CJ. Doctors' knowledge of patient radiation exposure from diagnostic imaging requested in the emergency department. Med J Aust 2010;193:450-3.
4. Arslanoglu A, Bilgin S, Kubal Z, Ceyhan MN, Ilhan MN, Maral I. Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. Diagn Interv Radiol 2007;13:53-5.
5. Günalp M, Gülünay B, Polat O, Demirkan A, Gürler S, Akkas M, *et al.* Ionising radiation awareness among resident doctors, interns, and radiographers in a university hospital emergency department. Radiol Med 2014;119:440-7.
6. Divrik Gökçe S, Gökçe E, Coskun M. Radiology residents' awareness about ionizing radiation doses in imaging studies and their cancer risk during radiological examinations. Korean J Radiol 2012;13:202-9.
7. Ramanathan S, Ryan J. Radiation awareness among radiology residents, technologists, fellows and staff: Where do we stand? Insights Imaging 2015;6:133-9.
8. Oh HY, Kim EY, Kim JE, Kim YJ, Choi HY, Cho J, *et al.* Trends of CT use in the pediatric emergency department in a tertiary academic hospital of Korea during 2001-2010. Korean J Radiol 2012;13:771-5.
9. Ott M, McAlister J, VanderKolk WE, Goldsmith A, Mattice C, Davis AT. Radiation exposure in trauma patients. J Trauma 2006;61:607-9.
10. Lee CI, Haims AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: Assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. Radiology 2004;231:393-8.
11. Paterson A, Frush DP, Donnelly LF. Helical CT of the body: Are settings adjusted for pediatric patients? AJR Am J Roentgenol 2001;176:297-301.
12. Donnelly LF, Emery KH, Brody AS, Laor T, Gylys-Morin VM, Anton CG, *et al.* Minimizing radiation dose for pediatric body applications of single-detector helical CT: Strategies at a large Children's Hospital. AJR Am J Roentgenol 2001;176:303-6.
13. Fahimi J, Herring A, Harries A, Gonzales R, Alter H. Computed tomography use among children presenting to emergency departments with abdominal pain. Pediatrics 2012;130:e1069-75.
14. Hryhorczuk AL, Mannix RC, Taylor GA. Pediatric abdominal pain: Use of imaging in the emergency department in the United States from 1999 to 2007. Radiology 2012;263:778-85.
15. Tsze DS, Asnis LM, Merchant RC, Amanullah S, Linakis JG. Increasing computed tomography use for patients with appendicitis and discrepancies in pain management between adults and children: An analysis of the NHAMCS. Ann Emerg Med 2012;59:395-403.

16. Berrington de González A, Mahesh M, Kim KP, Bhargavan M, Lewis R, Mettler F, *et al.* Projected cancer risks from computed tomographic scans performed in the United States in 2007. Arch Intern Med 2009;169:2071-7.
17. Linet MS, Slovis TL, Miller DL, Kleinerman R, Lee C, Rajaraman P, *et al.* Cancer risks associated with external radiation from diagnostic imaging procedures. CA Cancer J Clin 2012;62:75-100.
18. Sodickson A, Baeyens PF, Andriole KP, Prevedello LM, Nawfel RD, Hanson R, *et al.* Recurrent CT, cumulative radiation exposure, and associated radiation-induced cancer risks from CT of adults. Radiology 2009;251:175-84.
19. Amis ES Jr, Butler PF, Applegate KE, Birnbaum SB, Brateman LF, Hevezi JM, *et al.* American College of Radiology white paper on radiation dose in medicine. J Am Coll Radiol 2007;4:272-84.
20. Brenner DJ, Hall EJ. Computed tomography – An increasing source of radiation exposure. N Engl J Med 2007;357:2277-84.
21. Brenner D, Elliston C, Hall E, Berdon W. Estimated risks of radiation-induced fatal cancer from pediatric CT. AJR Am J Roentgenol 2001;176:289-96.

Appendix

Questions about the radiation risk and doses

1. Age:———————

2. Sex: Male □/female □

3. Occupation: Physician □ (Staff □, Resident □, Intern □)
   Nurse □

4. Employment duration
   <5 years □ >5 years □

5. Did you receive education about the radiation doses and risks of diagnostic imaging techniques?
   Yes □ No □

6. If your answer is "yes" for question 2, when did you receive the education?
   a. <1 year
   b. 1–2 years
   c. 2–3 years
   d. 5 years
   e. >5 years

7. Do you know about natural background radiation?
   Yes □ No □

8. The effective dose of radiation a patient might be exposed to during a PA chest X-ray is
   a. 0.02 mSv
   b. 0.2 mSv
   c. 2 mSv
   d. 20 mSv
   e. I have no idea

9. What is the estimated dose of chest X-ray equivalents for the diagnostic imaging technique in the ED?

Chest X-ray	0-1	1-10	10-50	100-500	100-500	>500
Chest X-ray	V					
Abdominal X-ray			V			
Pelvic X-ray			V			
Abdominal CT					V	
Chest CT					V	
Brain CT				V		
Sonography of abdomen	V					
MRI of the brain	V					

CT=Computed tomography; MRI=Magnetic resonance imaging

10. What is your opinion about the estimated lifetime risk of inducing fatal cancer from brain computed tomography?
    a. <1/1,000
    b. 1/1,000–1/10,000
    c. 1/10,000–1/100,000
    d. 1/500,000–1/1,000,000
    e. I have no idea

11. What is your opinion about the estimated lifetime risk of inducing fatal cancer from an abdominal computed tomography?
    a. <1/1,000
    b. 1/1,000–1/10,000
    c. 1/10,000–1/100,000
    d. 1/500,000–1/1,000,000
    e. I have no idea

12. Regarding brain computed tomography in pediatric patients, do you agree that we explain the radiation risk adequately in our emergency department?
    a. Very much agree
    b. Moderately agree
    c. Little agree
    d. Do not agree

13. Regarding X-ray in pregnant patients, do you agree that we explain the radiation risk adequately in our emergency department?
    a. Very much agree
    b. Moderately agree
    c. Little agree
    d. Do not agree

14. Regarding computed tomography in adult patients, do you agree that we explain the radiation risk adequately in our emergency department?
    a. Very much agree
    b. Moderately agree
    c. Little agree
    d. Do not agree

15. What is your thinking about the optimal period of education about radiation doses and risks while using diagnostic imaging techniques in the emergency department?
    a. 6 months
    b. 1 year
    c. 2 years
    d. No need