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Fears, Feelings, and Facts: Interactively Communicating Benefits and Risks of Medical Radiation With Patients

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Abstract

OBJECTIVE—As public awareness of medical radiation exposure increases, there has been heightened awareness among patients and physicians of the importance of holistic benefit-and-risk discussions in shared medical decision making.

CONCLUSION—We examine the rationale for informed consent and risk communication, draw on the literature on the psychology of radiation risk communication to increase understanding, examine methods commonly used to communicate radiation risk, and suggest strategies for improving communication about medical radiation benefits and risk.

Keywords

communication; effective dose; radiation safety; risk perception

The mention of the word “radiation” often evokes fear in patients, families, and health care professionals alike. Radiation is perceived as a unique hazard. This perception has many sources, including public information about real radiation injuries, fear of nuclear weapons or dirty bombs [1], Chernobyl [2], and comic book characters such as Spider Man and Teenage Mutant Ninja Turtles. The resultant “radiophobia” needs to be recognized and properly managed, especially with regard to medical radiation decision making.

There continue to be large increases in medical radiation use, most of which is attributed to increased utilization of CT. The National Council on Radiation Protection and Measurements recently noted that 24% of the total collective dose in the United States can be attributed to CT [3–6]. This dramatic and ongoing escalation in the medical use of diagnostic radiation has caused some authors to express concern over the growing radiation exposure of the population [5, 7–9]. Media reports often transform scientific concerns into facts [10–12], and the sensationalized reporting of a few radiation overdoses [13–19] has catalyzed public unease, regulatory scrutiny, and legislative interest [20–22]. At the same time, recent surveys have indicated that a surprising percentage of examinations may not be clinically justified [23–25] and that there is a large variability of radiation dose associated

with diagnostic examinations [26–29]. This finding suggests that some examinations are not optimized to reduce radiation dose without degrading their clinical value [30].

The confluence of these concepts has triggered a classic media-driven social amplification [31] of the perceived seriousness of an accident or normal clinical practice. This can result in the stigmatization of radiation in medicine [32], which may result in a loss of public confidence and reluctance of patients to undergo necessary examinations or treatments [20–24].

As public awareness of medical radiation exposure has increased, there has been heightened awareness among patients, physicians, and regulatory agencies of the importance and need for holistic benefit-and-risk discussions [33] as the basis of informed consent in medicine. Communicating benefits and risks in a comprehensible manner while presenting and discussing complex technical material with associated uncertainties is a challenge that could result in potential harm if the patient avoids appropriate and medically necessary imaging because of misunderstanding or unfounded fears [34–38].

The purposes of this article are to examine the rationale for informed consent and risk communication, to draw on the literature on the psychology of radiation risk communication to increase understanding, to examine methods commonly used to communicate radiation risk, and to suggest strategies for improving communication about medical radiation benefits and risk.

Shared Medical Decision Making and Informed Consent

Prudent and ethical medical practice requires close communication between the patient and the physician. Both the American Medical Association and the American College of Radiology note that informed consent is more than simply getting a patient to sign a written consent form; it is a process of communication [39, 40]. Clearly, shared medical decision making requires a dialogue between patients and their health care providers [41]. Therefore, risk communication should include other interactions that incorporate and respect the perceptions of the information recipients [42]. The ultimate goals of radiation imaging medical decision making are sharing knowledge and building trust, while influencing the attitudes, beliefs, and behaviors [43] of patients who may be apprehensive or even fearful about the impact such imaging will have on their bodies and who are typically unaware of the immediate or long-term benefits.

Psychologic Aspects of Radiation Risk Communication

At least two issues immediately impair our ability to discuss radiation detriment with the public. First is the public's total lack of familiarity with radiation dose measurement. The second issue involves an attempt to link an understanding of the amount of radiation dose to an understanding of the detriment or risk. In addition, patient perception and acceptance of risks are determined not only by outcome probabilities but also by other characteristics such as benefits, uncertainties, and emotions. These other qualities may be just as important, perhaps more important, to the patient and should not be ignored.

It is worthwhile to review what psychology and cognitive neurosciences reveals about medical risk communications in general. The following concepts are especially important when communicating medical radiation risks and are briefly discussed in the following sections: affect and reason, anxiety and decision making, dread from unknown hazards, anticipated regret and side effect aversion, information source perception, and competence and care issues.

Affect and Reason

All medical decision making is influenced by cognitive and affective responses. The complex interaction between the two has been referred to as a “dance of affect and reason” [44], whereby the cognitive aspects bring logic, reason, and scientific deliberation to bear, while the affective responses result in fast, instinctive, and intuitive reactions to perceived dangers. Indeed, facts may not be the most important aspect of patients’ assessments of risk, which have been shown to be primarily determined by emotions [45, 46].

Affect influences virtually every aspect of human functioning, such as perception, attention, inference, learning, memory, goal choice, physiology, reflexes, and self-concept [47]. Many medical decisions involve intense affective states such as fear, anxiety, pain, discomfort, and diverse other moods and emotions [47]. These very real, rapid, and automatically experienced feelings are often used as information in the decision process [42, 44] and subsequently guide information processing and judgment. As such, they may skew an understanding of the facts, impairing the ability to make objective decisions about medical radiation.

Anxiety and Decision Making

Medical decision making would typically involve conscious decisions taken after much thought and discussion [48]. However, it is important to recognize that when we make decisions, we often choose an option as soon as we find one that is satisfactory, just as patients often extract the gist of any information rather than the details [49]. In high-stress situations, such as learning that one may need a medical procedure, especially one involving radiation, people may experience “mental noise,” an emotional block that can make it difficult to hear, understand, or remember information [50]. Such an affectively laden situation creates insensitivity to the often relatively low risks associated with the imaging [33, 44]. Anxieties can result in an inability to understand the information being conveyed and may result in a reduction of a patient’s ability to attend to and retain information; in contrast, a risk taken voluntarily is less frightening than an imposed risk, and the more patients feel they can control unfamiliar situations, the less afraid they may be of the situation [42].

Dread From Unknown Hazards Plus Outrage

Feelings of dread and the unknown are major determiners of public perception and acceptance of risk for a wide range of hazards [44, 51] and may also be associated with factors such as voluntariness, controllability, lethality, and fairness [52]. Some researchers have suggested [52–54] that the perception of risks should be viewed as being based on hazard (danger) plus outrage (affective emotions about actions). Therefore, a mere presentation of technical facts alone will not necessarily give patients what they need or want.

Anticipated Regret and Side Effect Aversion

Anticipated regret (based on a patient’s predictions of option, outcome, or process regret before the choice and before outcomes occur) has been shown to influence medical decision making [48]. Cancer is such a feared event that anticipated regret may be influential in medical radiation imaging, even though risks are generally low. A patient under the influence of anticipated regret might think, “If I decide to have this series of imaging scans, I will surely regret getting cancer 20 years from now, even though I realize the chances are very low from the procedure. Therefore I better not have the scans, because I don’t want to seriously regret this decision later.” Some patients may actually assume that all cancers in the future are attributed to the imaging and discount the large natural risk of cancer [33].

Many patients also have a general side effect aversion or an excessive sensitivity to negative side effects of medical treatments, which may lead them to refuse beneficial therapies [55], especially when those side effects are more difficult to evaluate, as in medical radiation imaging. Similarly, time perceptions while differentiating between short-term costs and benefits versus long-term benefits and risks play a role in medical radiation decision making [56].

Information Source Perceptions

The source of the information itself will often carry an innate bias [57]. Physicians typically know much about medical benefits and express benefits and risks in terms of medical results. Physicists typically know much about imaging and radiation delivery, focusing on keeping doses as low as reasonably achievable. Epidemiologists know much about risks and effects, often expressing risk in terms of effects in a population (not to an individual). Patients themselves may have individual bias because they may rely on non-traditional sources of information, particularly Internet sources of varying validity [58]. Although it is often acknowledged that health professionals typically provide the technical knowledge and patients provide the values, beliefs, and emotions, it is also true that medical professionals also have values, beliefs, and emotions that subtly affect how risks are communicated, and patients may also have some level of information, especially in this Internet age [59–61].

Competence and Care Issues

Covello has aptly stated that “people want to know you care before they care what you know” [43]. A medical professional should strive to display both a competent and caring approach, citing basic risk data in general terms, explaining the justification logic, addressing probabilities for benefit and risk outcomes, and expressing encouragement and hope [45, 62]. When evaluating risk perceptions, the most consistent dramatic finding appears to be the impact of trust and confidence on acceptability [43, 63]. The higher the level of trust, the lower the estimate of risk and the higher the estimate of benefits [64]. Indeed, if feelings toward medical radiation imaging are favorable, patients are likely moved toward judging the risks as low and the benefits as high; if their feelings toward it are unfavorable, they tend to judge the opposite—high risk and low benefit [44].

Typical Medical Radiation Risk Communication Approaches

Several approaches are typically used when attempting to communicate medical radiation risks, each with its associated pros and cons. The following methods will be discussed: paternalistic approach, risk comparisons only approach, risk numerology approach, and the quality assurance approach.

Paternalistic Approach

In an earlier era, the physician advised the patient what procedures and treatments were recommended, and the patient was expected to unquestionably follow such advice [58]. Such an approach can be summarized as the “you should have this procedure because I’m your doctor” method. Although it may be true that, in some situations where the patient is in an affectively aroused state, the more dispassionate perspective of a physician may provide a more stable basis for decision making and lead to decisions that are more consistent with the long-term interest of the patient [47], such an approach is no longer considered to be the standard of care [39, 40].

Risk Comparisons Only Approach

Attempts to overcome the public’s total lack of familiarity with radiation have included risk comparisons using the concept of effective dose, which was introduced by the International

Commission on Radiologic Protection in an attempt to provide a relative risk of radiation exposure [65–67]. Several comparison approaches are used, including comparisons with the background equivalent radiation time [68] in the United States or in Denver, Colorado; comparisons with the number of cross-country airplane trips; expressing the dose as some multiple of a common examination, such as a chest radiograph; and by comparing an examination's dose to the safety levels prescribed for occupational exposures. Table 1 gives examples of such approaches for a chest radiograph and a CT scan of the abdomen.

There are obvious problems with each comparison. For example, background radiation dose rates can be highly variable; elevation changes cosmic radiation exposure during air travel; and the effects of a onetime exposure can be expected to differ from the effects associated with long-term low-level exposures such as the occupational dose limits. Although such risk comparisons may provide illustrations to assist in comprehension of dose magnitude, they do not educate effectively because, from the standpoint of the individual, averages do not adequately capture the essence of such risks [20].

Risk Numerology Approach

Many research institutions have developed lengthy “informed consent” forms that include a fair amount of what can be termed “risk numerology” (e.g., relative risks, excess cancer rates, increased rates over background levels, and log-based hazard comparisons). Many investigators have used a factor for the increased risk of cancer on the order of about 5% per sievert, a value initially based on overall population averages and prudence in safety guideline setting [33, 69]. In addition to offering an incomplete picture, there are difficulties with strict risk numerology. Even highly educated patients sometimes find it difficult to understand basic probability concepts or to perform even simple mathematic operations, such as comparing the magnitudes of two probabilities [55], and some patients neglect or are insensitive to probabilities altogether [44], perhaps basing decisions solely on the perceived numbers of listed benefits and harms [55]. In addition, comprehension becomes increasingly difficult as risk probability increases. For example, a probability of 1 in 2 with no background seems simple enough to understand, whereas the additional risk of 1 in 2000 on a background risk of 3 in 5 is difficult, if not impossible, to grasp.

Framing effects, which arise depending on the perspective from which data are presented, can influence the perception of risk. Wagner uses the following example [57]: After a pelvic CT scan of a pregnant woman, which statement delivers the most appropriate message about risk? “This study could perhaps double the risk that your child will develop cancer before age 19 (0.6% vs 0.3%),” or “The risk of adverse outcome is very small and the likelihood of normal development is nearly the same as it is for any child (96.7% vs 96.4%).” Both statements are technically accurate. The first focuses on the risk magnification that could result from the procedure. The numeric risk estimates attached to the statement support the assertion that risk is doubled but require interpretation by the patient to appreciate the relatively low level, both before and after, of risk magnification. In the second statement, the patient is assured that the overall risk of an adverse outcome is low, and the likelihood of a normal outcome is emphasized. Any deliberative framing of information raises ethical questions about the right to manipulate a patient's preferences in such a way [44].

Quality Assurances Approach

Some institutions rely on what can be called “quality assurances” while communicating benefit and risk in medical radiation. Quality assurance statements such as, “We have the newest state-of-art imaging models,” “We test our machines in accordance with the American Association of Physicists in Medicine guidelines,” “We meet the American College of Radiology guidelines,” “The doses you will receive in our clinics are less than

the typical average levels in the industry,” or “Our protocols are designed to deliver doses as low as reasonably achievable so you don’t really need to worry about it” will not convey the proper overall perspective. Although these statements may indeed be true and may represent a healthy continuous improvement culture in the institution, they do not address benefits or risks in a quantifiable manner. As aids to understanding the active risk management posture of a radiology department, however, they may be reassuring.

Suggestions for Improved Benefit and-Risk Communication

Recognizing the limitations of the approaches discussed above and with an increasing understanding of the underlying psychologic factors, physicians and other medical professionals should adopt fundamental and practical strategies for interactively communicating benefits and risks with their patients.

Give Simple Clear Messages

It is important to develop simple clear messages at a sixth-grade reading level, devoid of jargon, technical terms, and acronyms [43, 70, 71]. In general, there should be no more than three key messages. Key points should be repeated frequently and should explicitly convey the conclusion [72]. The aim should be to simplify language and presentation, not content. Patients do not need to understand benefits and risks at the same level as the medical professional, but they do need to understand them well enough to assist them in making an informed decision [61].

Use Numbers and Visuals

Rather than avoiding the use of numbers, numbers and visual aids should be used extensively. Several communication alternatives have been shown to significantly increase the ability to evaluate a risk probability tradeoff: requiring less cognitive effort, using a graphical display [73], and expressing numbers in percentages rather than frequencies [72]. When communicating risks with patients, Paling [45] suggests that it is important to elaborate and provide estimated numbers, to avoid using descriptive terms only, to use standardized risk vocabulary, to use a consistent denominator, to offer both positive and negative outcome information [55], to use absolute numbers (rather than relative risks), and to use visual aids for probabilities. Using visual aids also helps to foster good physician-patient partnerships and can help the viewer to see the risk numbers in context, thus providing information and not simply data.

A visual aid may be very helpful in improving the dialogue about such risks, especially those based on dose proportions (ratio to a reference) [74], or what some have termed a “Richter Scale of Risk” [75], using a factor of 10 approach. Indeed, when discussing radiation risks, these should be described using broad categories such as those shown in Table 2 (e.g., negligible, < 0.1 mSv; minimal, 0.1–1 mSv; and minor, 1–10 mSv) [76–78].

Dialogue With the Patient

Medical professionals should strive for an interactive dialogue between the medical professional and the patient. In addition to being credible and knowledgeable about the topic area, medical professionals should ideally be skilled in interpersonal communication, be able to convey empathy, use active and effective listening strategies, and be respectful of patient’s concerns [71].

What the public or a patient may wish to know, and often has trouble absorbing, is the answer to specific questions such as, “Should I get this CT scan?” or “Should I agree to this radioactive stress test?” or “Is it OK for my 3-year-old to have another CT scan to rule out

appendicitis?" [20, 79]. The answers to such questions are far more complex than estimates of the radiation detriment associated with the examination in question and need dialogue. The patient needs to understand the medical indication for the procedure, and referring clinicians should participate in the explanations as part of medical imaging decisions. The potential benefits of modern medical imaging procedures, which almost always far outweigh the associated risks, also need to be clearly discussed.

One approach is to explain what information might be obtained from the study and how not having the study could affect the patient. For example, to the patient who asks, "Should I agree to this cardiac stress test, which uses radioactivity?" one could answer that certain patient symptoms or risk factors have suggested that cardiac ischemia might be present. Modern imaging techniques permit us to obtain images of the heart at rest and after stress, and these images can be used to diagnose cardiac ischemia. If cardiac ischemia is diagnosed, doctors can plan further treatments aimed to treat the abnormality, including potentially life-preserving interventions. If cardiac ischemia is not present, doctors may need to pursue other diagnostic considerations to help the patient. A potential benefit of having the procedure is, therefore, obtaining a diagnosis for which a treatment strategy can be devised, possibly prolonging life. Conversely, the risk of not having the procedure might be failure to obtain this diagnosis.

Evaluate Patient Understanding

It is important to capture and maintain the patient's attention. This is facilitated by using the strongest points at the beginning of the message and repeating them at the end of the message. During the dialogue, it is important to evaluate the patient's understanding. The medical professional should check the patient's eye contact to ensure that the person is still listening, be aware of postural changes in the patient, and obtain periodic feedback from the patient to ensure comprehension. When actively evaluating patient understanding, the medical professional is better able to hear and address emotions behind specific patient concerns.

Summary

The way we communicate benefit and risk can affect a patient's perceptions and decision making. It is clear that better information and education about medical radiation and the associated benefit and risk consequences are needed, as well as a deeper understanding of the psychology of risk communications. There are several simple and practical strategies that can be used successfully to improve interactive communication of benefits and risks with patients. Physicians need to give simple clear messages, use numbers and visuals, have a dialogue with the patient, and evaluate patient understanding.

Much has yet to be learned about the role of affective and cognitive aspects in radiation imaging-related decisions, and indeed there is clearly a need for systematic theory-based approaches that illuminate the informed decision-making process [41] and serve to facilitate shared medical decision making. Several research developments are needed to resolve important questions. How effective are strategies (e.g., dialogue, visual aids, and risk scales) for helping patients understand benefit and risk? Is the training that radiologists and other physicians receive in communicating benefit and risk to patients adequate? How can such training be increased and improved? What cultural, age, sex, or other factors play a role? How do we most effectively tailor our approach for different populations?

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TABLE 1

Typical Comparison Approaches for Communicating Medical Radiation Risk

Comparison	Chest Radiograph (~0.1 mSv)	CT Scan of the Abdomen (~10 mSv)
Equivalent to how many chest radiographs	1	100
Background equivalent radiation time United States ^a	12 d	3.3 y
Background equivalent radiation time Colorado ^b	9 d	2.5 y
No. of flights from New York to Seattle ^c	3.6	360
Fraction of occupational dose limit (50 mSv/y)	0.002	0.2

^aData are from [80].^bData are from [81].^cData are from [82].

TABLE 2

Sample Visual Aid Chart for Use When Discussing Radiation Imaging Procedures

Imaging Examples	Effective Dose Range (mSv)	Background Equivalent Radiation Time	Radiation Risk Descriptor ^a	Probability of Cancer From Imaging (%)	Probability of No Cancer From Imaging (%)
CT scan or nuclear medicine scan	1–10	Years	Minor	~0.05	~99.95
Abdominal radiograph	0.1–1	Months	Minimal	~0.005	~99.995
Chest radiograph or mammogram	< 0.1–0.1	Days to weeks	Negligible	~0.0005	~99.9995

^aDescriptors are from [78].