

Patient Preferences for Diagnostic Imaging: CTA vs MRA When Diagnosing Pulmonary Embolism

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ABSTRACT

Objective: To identify preferences regarding choice of diagnostic imaging (computed tomographic angiography [CTA] vs magnetic resonance angiography [MRA]) for the evaluation of pulmonary embolism.

Methods: We conducted 4 focus group discussions with residents of 2 Wisconsin cities. Community members ≥ 18 years old were recruited via telephone using a commercially available telephone database. The discussions were audio recorded and professionally transcribed. Three investigators (a research specialist, emergency physician, and qualitative methodologist) independently analyzed these transcripts using inductive thematic coding to identify the overarching themes and underlying concepts. Intercoder discrepancies were resolved through consensus discussion by the reviewers.

Results: Focus groups were held over a 3-month period and included 29 participants (16 female). Ages were well represented: 18-30 (n=7), 31-40 (n=8), 41-55 (n=6), and 56+ (n=8) years old. Analysis revealed 3 central themes: time, risk, and experience. Participants who preferred CTA commonly cited the need for immediate results in the emergency department. When nonemergent scenarios were discussed, the option to undergo MRA was considered more strongly; participants weighed additional details like radiation and diagnostic accuracy. Regarding risks, discussants expressed concerns from multiple sources, including radiation and intravenous contrast. However, understanding of this risk varied across the groups. Prior experience with medical imaging—both personal and indirect experiences—carried considerable weight.

Conclusions: Preferences regarding imaging choice in the diagnosis of pulmonary embolism were mixed, often reliant on vicarious experiences and an exaggerated notion of the difference in timing of imaging results. Participants frequently used incomplete or even incorrect information as the basis for decision-making.

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INTRODUCTION

Chest pain and shortness of breath are 2 of the most common presenting complaints for patients seen in the emergency department (ED), accounting for 10.8 million of the 136.6 million ED visits in the United States annually.¹ Concern for possible pulmonary embolism (PE) in these patients is historically driven by the dire effects that may result from missing the diagnosis, namely heart failure and death.²⁻⁴ Though the incidence of venous thromboembolism (VTE) is substantial (900,000 cases in the US annually),⁵ most patients who undergo diagnostic imaging for the evaluation of possible PE end up not having this disease. In fact, PE is only present in 5% to 10% of the patients undergoing imaging evaluation, which is usually computed tomographic angiography (CTA) of the chest.⁶ Though CTA has high diagnostic accuracy for the diagnosis of PE,⁷⁻⁹ it is associated with 2 potentially hazardous exposures: ionizing radiation and intravenous iodinated contrast.

More recently, magnetic resonance angiography (MRA) has emerged as an ionizing radiation-free imaging alternative to CTA. Due to several studies reporting that its sensitivity is inferior to CTA, particularly the PLOPED III trial,¹⁰ some have advised that MRA be reserved for use at centers that routinely perform MRA well and only for patients with contraindications to CTA. This has greatly limited the potential for wide-scale adoption of MRA as a first-line imaging test for suspected PE. However, other diagnostic efficacy studies evaluating the accuracy of MRA for the diagnosis

of PE have shown that “diagnostic quality” images are obtained as frequently for MRA as they are for CTA, and the accuracy of MRA is similar to that of CTA.^{11,12} In fact, when accounting for patient-oriented clinical outcomes (ie, death, missed VTE, and major bleeding), data from the University of Wisconsin (UW) – Madison show that patients fare better after MRA than CTA.¹² The discrepancy between the PIOPED III findings and those at UW likely have origins in the treatment of subsegmental pulmonary emboli (SSPE), a vascular filling defect commonly missed by MRA but more frequently visualized by CTA.¹³

Recently, the American College of Chest Physicians has called into question the value of universally treating these clots, identifying risk groups in which clinical surveillance is recommended over anticoagulation.¹⁴ Additionally, the Society for Academic Emergency Medicine Consensus Conference in 2015 (Diagnostic Imaging in the Emergency Department: A Research Agenda to Optimize Utilization) recommended that alternative diagnostic strategies to the current standard of CTA for the diagnosis of PE should be investigated in an effort to decrease the burden of harmful exposures associated with such scans.¹⁵

Given the paucity of evidence regarding the patient-oriented benefit of treating SSPE, this area of clinical equipoise would benefit from studying patient preferences regarding the choice of medical imaging, particularly MRA versus CTA, when patients are tested for possible PE. Specifically, it would be valuable to know how patients value the small long-term risk associated with CTA use compared with the unknown, but likely low, risk associated with not diagnosing SSPE. There have been no studies to date answering this question. Therefore, the purpose of this study was to ascertain patient perceptions of PE and the differences between MRA and CTA, as well as assess their preferences regarding imaging modality selection in the diagnosis of PE.

METHODS

Study Design

This study sought to understand the knowledge and opinions regarding the use of diagnostic imaging tests (ie, MRA and CTA) in the context of being evaluated for PE in the ED. Due to the limited availability of existing literature on this topic, we took an exploratory, qualitative approach. Focus group discussion was chosen as the best method to elicit a wide range of opinions, while giving participants the opportunity to discuss the presented topics in depth. We consciously chose not to enroll patients in the ED for 2 reasons: (1) time constraints and potential privacy issues of interviews in the ED would yield suboptimal conditions, resulting in limited exploration of discussants’ perspectives; and (2) we did not want to interfere with individual provider’s decision-making (be it shared or not) regarding the diagnostic evaluation being pursued in the ED. This study was approved by the institutional review board of the coordinating university.

Table 1. Gender and Age Range of Participants

Age Range (years)	Men	Women	Age Range Totals
18-30	3	4	7
31-40	3	5	8
41-55	3	3	6
56+	4	4	8
Gender Totals	13	16	29

Study Setting and Population

This study used a purposive sampling strategy in order to recruit a diverse range of ages and equal gender representation. Participants were drawn from the general public of each city, though were required to be English-speaking adults. Since anyone could be faced with an emergent problem that would require an ED visit for diagnostic imaging, we did not constrain recruitment beyond these basic demographics.

Recruitment took the form of telephone calls to a randomized list of known telephone numbers purchased from a professional sampling firm (Survey Sampling International; Shelton, CT). The telephone sample consisted of a mix of landline and cellular telephone numbers of current residents of either Madison or Milwaukee, 2 metropolitan areas in Wisconsin. The recruiters were professional telephone interviewers at the University of Wisconsin Survey Center. The telephone recruiters called the selected telephone numbers, explained the study objectives and the focus group format, and invited eligible candidates to participate. Confirmation letters were sent to the participants via US mail and reminder telephone calls were made 24 hours before the focus group discussions. Each participant was compensated \$50 at the end of the discussion. By design, 11 participants were recruited for each focus group, with the anticipation that 6 to 8 people would actually attend each group. Table 1 shows the gender and age range of the 29 individuals who attended the groups; 2 were held in Madison and 2 in Milwaukee.

Study Protocol

The principal investigator (MDR), in collaboration with co-investigators with expertise in conducting focus group discussions (KDC, EAJ, MNS), created a discussion guide (Appendix), which was used in all groups. Each discussion lasted approximately 90 minutes. Initial questions in the discussion were open-ended, eliciting participants’ knowledge/experience regarding the diagnosis and treatment of PE, as well as with CTA and MRA. We then used the deliberative discussion method to introduce participants to the pros and cons of CTA and MRA,¹⁶ including the potentially harmful exposures of CTA scans and the risks of missing and not treating a PE, particularly as it relates to MRA. In addition, to provide context for participants to render an opinion, the guide included discussion of a clinical vignette about a hypothetical 22-year-old woman presenting to the ED with chest pain and trouble breathing. Participants were asked whether they would

Table 2. Quotes Exemplifying the Major Theme of Time

Subtheme: Emergencies

1. “Yup, and for me, that’s what it’s going to come down to. How much time do I have before this could potentially be fatal? Do what’s quickest, what’s most expedient.”
2. “Yeah, and if she does develop cancer, deal with the cancer later. Deal with the patient now.”
3. “I agree with everybody that you want to be involved, but I think, like you said, if it’s that emergency, going back to your emergency room situation, chest pain, whatever, I’m just whatever the doctor says, just do it.”
4. “... but if it was him [the doctor] coming in and saying, we’re just going to do a CT scan just to figure out what’s going on, I would be gung-ho for it, just because it’s in the chest area. I have four kids. I’m not ready to go yet.”

Subtheme: Nonemergent

5. “I was just going to say I would think it’s kind of, consider also the situation. If you come into an emergency room, you don’t have time to go through a whole big MRI. And the CT scan, the speed, the quickness of it, sounds like you’ve got to make a decision quick. But, if you had, well, ‘we’re trying to diagnose something, let’s see what this is’ then maybe the MRI would be, you know, a little more efficient.”
6. “Yeah, but it’s clear to me, I think they got more information because they were doing a breast MRI. So there was much clearer information than, well, mammography...”
7. “I guess it would depend on, you know, the situation and which test. Sometimes you hear things that, oh, well, they didn’t see anything. I can think of a situation with a cousin where he had cancer of the pancreas. They did not see anything on the CT, and then I think something came out on the MRI. So then in my mind I’m thinking, okay, well, in some situations maybe the CT isn’t the answer, and then you have to go to the MRI.”

Abbreviations: MRI, magnetic resonance imaging; CT, computed tomography.

choose CTA or MRA for the vignette patient. One of the authors (KDC) moderated all groups, and at least 2 of the authors were always present.

Measurements

Principal data of interest were the themes that emerged based on participant responses and opinions derived from the moderator-guided focus groups. All discussions were audio recorded and professionally transcribed. Secondly, the age and gender of each participant was documented.

Data Analysis

The analysis team consisted of a research physician with expertise in radiology and emergency medicine (MDR), a research specialist (RLB), and a qualitative research methodologist with extensive experience in focus group facilitation and analysis (KDC). The electronic transcripts were compiled and organized by discussion guide question and then imported into Dedoose qualitative analysis software (version 7.5.9, SocioCultural Research Consultants; Los Angeles, CA).¹⁷ All transcripts were coded – that is, participants’ verbatim transcript responses were assigned to 1 or more categories of similar responses. Coding was done inductively and independently by all authors, using conventional content analysis to identify major themes in the responses to each question.¹⁸ This

method of analysis derives the codes directly from the raw transcripts rather than using codes generated *a priori*. The coding team met regularly to compare their independent coding and to develop consensus codes and themes.

RESULTS

Characteristics of Study Subjects

Twenty-nine individuals participated in this research project: 15 from Madison and 14 from Milwaukee. Participant age and gender details are shown in Table 1.

Main Results

After thorough collaborative analysis of the transcripts from the 4 focus groups and resultant coding structures, 3 central themes emerged: time, risk, and experience.

Theme 1: Time

Discussants frequently noted time differences between acquiring the images for MRA versus CTA as an element that influenced their decision-making. Notably, we did not provide this information in the deliberative discussion; participants came with this as a preconceived notion. In emergencies, participants believed the time spent in the scanner (CTA or MRA) to be a variable that had a significant impact on a patient’s outcome. In these time-sensitive instances, we observed partiality towards CTA because of its perceived speed. One participant said, “I like the speed of the CT scan. It seems to be much, much quicker for the patient.”

The importance of time persisted, even as the facilitator—following the discussion guide—described some of the risks of CTA, such as radiation exposure and iodinated intravenous contrast administration. These risks did not affect some participants, as one said, “I guess to me, since I don’t have a preference about radiation, I would probably go with the faster, hypothetically faster operation.” Many participants reiterated the idea that fast results were a top priority. One group member said, “I think the reward is more worth the risk, because it’s that time, those couple of minutes, that it might take to transport her from one to the other—those couple of minutes, you know, while she’s in the MR machine could be the end for her.”

As the facilitator further described the clinical vignette, the element of time continued to be considered. Participants were asked to decide which imaging modality should be used in this fictional scenario. Among those wanting to pursue CTA, 1 person said, “She had trouble breathing. Right then and there, you’ve got to go for the quick solution.” As the conversation progressed, the facilitator helped participants explore their decision-making process for nonemergent events. In these scenarios, many participants said they felt that MRA would be a better option. One participant believed MRA to have better diagnostic capabilities, as they described their thoughts regarding when each of the imaging options should be used (Table 2, quote 5). Other references to nonurgent MRA experiences were described, including a partici-

pant who said, “I had an MR for my left knee. It was a small meniscus tear. That was my experience with it. Pretty short and sweet.”

Theme 2: Risk

Participants referenced multiple sources of perceived risk within the discussions. The most commonly discussed subthemes were radiation, iodinated contrast, interpretation of risk, and patient anxiety. Regarding radiation, generally the participants either were explicit about desires to avoid it or they did not believe they would be affected by the exposure (Table 3, quotes 1-4). For example, 1 participant said, “...I don't really have enough...radiation. I would assume that my body would, you know, get rid of it eventually or not have any serious negative effects...”

Within 1 discussion, the relative radiation dose of a single CT scan was shared (ie, 1 CT scan of the abdomen/pelvis delivers the same amount of radiation as 100 to 500 chest x-rays).¹⁹ This new knowledge caused some participants to change their mind about which scan they would prefer. Specifically, 1 participant commented, “Yeah. I'd have changed my opinion if I had known the 500 x-rays. I didn't know it was that much.” Another said, “And I guess if the doctor would have said to me, it's 100 to 500 chest x-rays, then I would have chosen the MR because I didn't know that when I answered the question in the beginning.” Participants with strong wishes to avoid radiation shared comments such as, “Even though I don't like MRs and they're very uncomfortable, I would definitely choose the one without radiation.” Radiation risk was a prominent topic within these discussions, with participants ranging in their degree of exposure avoidance.

Iodinated intravenous contrast administration elicited similarly strong opinions from participants. Frequently, they stated 1 of 2 sentiments: either they wanted to avoid contrast entirely or they did not believe they would be harmed by the injection. Persons with previous experi-

Table 3. Quotes Exemplifying the Major Theme of Risk

Subtheme: Radiation

1. “[when asked about getting a CT scan] I think it would be a chance I'd want, might have to take because if there was really considerable seriousness of this and that it's really not going away and there's nothing else to try, because again, like you said, if you do the MRI, you may end up having to do the CT scan anyway. So I guess I would chance it.”
2. “So I kind of feel like I wouldn't be worried about radiation. We've been doing MRIs and using radiation for x-rays for quite a long time now...”
3. “But if they can detect the stuff with an MRI, probably go with that first because it gets rid of the radiation and stuff, you know. Gets that out of the picture.”
4. “Yeah, I'd have changed my opinion if I had known the 500 x-rays. Wow. I didn't know it was that much.”

Subtheme: Iodinated Intravenous Contrast

5. “...the stuff they put in my arm that made me feel really warm and like I was chewing on a penny and I didn't like the feeling.”
6. “But the CT was a little scary because of the injection.”
7. “Maybe I, you know, having had both, if I don't have to have that stuff injected, I mean, that's creepy.”
8. “CT is tricky for me because they can't put iodine dye in me, so they don't tend to use, find the X-rays particularly useful.”
9. “But the kidney damage, I'm not really as worried about. Because on one of the things the doctors stress when you get a CT scan is to, afterwards, drink plenty of water to flush out the dye out of your kidneys and stuff. And if you're doing what the doctor tells you, and you're flushing your kidneys out, I don't think there's that high of a chance of getting kidney damage from it.”
10. “I mean, if it were me, I would probably want to get to the bottom of it, and my kidneys are the least of my issue if I have healthy kidneys to begin with. So I would go with the CT scan.”

Subtheme: Interpretation of Risk

11. “I think if the doctor is recommending this new MRI scan that would catch even small ones potentially, that might be a good option for somebody who had that sort of a risk just to at least consider just because they could catch it, you know, and then there wouldn't be the extra added risk of cancer.”
12. “So I'm assuming that like she's got a problem here, and that probably means she has a big blood clot, or it wouldn't be this much of a problem. So I would say, go with the MRI because it's going to catch the big clot, and it has no other risks. So if I were to go with the CT, maybe it will catch everything, but I also have the chance of getting radiation and cancer later on or kidney damage later on when I think the MRI could probably catch what it needs to.”
13. “I think she should have the CT. For one, she's her age, she's 22, and she's having chest pains at 22 years of age. You know, so that would be really good for her to get the CT, so they can catch it right away. It's one of the best ways. You know, she may be exposed to a little radiation. However, they say it's safe levels of radiation. You never know. It all depends on the body...some people don't get, they don't get the exposure to the radiation sometimes. It may not affect them, so I think the CT would be good for her because of her age too.”
14. “So if it's a very, very small chance of that, I'm wondering, I would definitely go with that, because the likelihood is very, if it's very, very rare, I want the most, you know, I want detection... [regarding picking CT]... Because if it [downstream risk of cancer] is something very, very rare, which I don't know if we can confirm or deny that, but I would want the CT...”
15. “Well, if it were me, I would be clear with the doctor. I would say, use whatever gives you the absolute best, most information no matter what these minor risks are. I would absolutely say that. In your judgment, what is the absolute best for you to find whether there's a problem or not? It doesn't matter which one. That's what I would say absolutely.”
16. “I guess I feel like since there's, I mean, and like she was saying, like [name redacted] said, some of them, sometimes there's one that, you know, is going to be able to find something that the other scan might not. So, if it comes down to having both, you know, I'll have both.”
17. If you don't find anything, keep testing.”

Subtheme: Patient Anxiety

18. “I needed the anti-anxiety because I am claustrophobic, and that's like the worst.”
19. “Maybe that's something we should be offering to everybody going in. Some kind of anti-anxiety...”
20. “When I was younger, I didn't have claustrophobia. Now that I'm older I have developed it somehow, so being in there for a while, having to lay still, even though it only went up to my knees, if it had gone for much longer or they had pushed me in any further, I would have started to feel a little anxiety.”
21. “I'd rather be with the CT scan... scary inside that tunnel [referring to MRI].”

Abbreviations: MRI, magnetic resonance imaging; CT, computed tomography.

Table 4. Quotes Exemplifying the Major Theme of Experience

Subtheme: Direct Experience

1. "I don't have a preference. I am under the impression that, and not for any kind of scientific reason, I'm under the impression that the MRI is better. It's like a better picture. It's more detailed. It shows the soft tissue. Again, I have no idea if that's right, and so at the end of the day, I would do whatever my doctor told me to do. I don't really have enough...radiation. I would assume that my body would, you know, get rid of it eventually or not have any serious negative effects..."
2. "But you know, I've never really heard of anything, and I've never, when I got my MRI, they didn't say, well, we're going to use this much radiation, so they didn't even explain those risks to me. It was more important to have the MRI. So I kind of feel like I wouldn't be worried that much about the radiation. We've been doing MRIs and using radiation for x-rays for quite a long time now."
3. "And then the interesting thing is they always ask you if you have any metal, you know. I'm not sure if I have like shrapnel or anything in me, and then they have to kind of figure out whether it's worth it to go and do the scan or to not do the scan. So it's kind of frightening in that sense. And then they injected some liquid into me like with that but just to be able to see something better in the frame. That's my experience with it. It wasn't really fun, but it wasn't as bad as I thought it was going to be."

Subtheme: Indirect Experience

4. "I can think of a situation with a cousin where he had cancer of the pancreas. They did not see anything on the CT, and then I think something came out on the MRI."
5. "Men, you know, don't go to the doctor. They don't want to hear. They don't want to deal with the problem. They'll just go right through it. My mom went right through her problems. She wasn't going to go back. I mean, one of the things happens is if have a bad experience one time, you know, with one of these techniques, for whatever reasons, you're very shy about doing that again. And so it's what you're willing to, you know, a lot of people just go right on and don't want to have to deal with it either from an emotional standpoint or a financial standpoint or whatever. They can live with the pain or their inconvenience."
6. "I know there's open MRIs, so I haven't really experienced the open one yet, but just the noise itself being so loud, I think I would prefer maybe the CT better."
7. "Just heard of them, and, you know, seeing the MRI thing like in the movies, whatever. How realistic that is, I don't know."

Abbreviations: MRI, magnetic resonance imaging; CT, computed tomography.

ence receiving contrast shared vivid descriptions of these events. One participant said, "I felt like I was wetting my pants. It was kind of disturbing" while another said, "But then they put that injection, yeah, it felt like my whole body was on fire." These participants were clear that receiving contrast was not an enjoyable experience (Table 3, quotes 5-7). Others mentioned existing medical conditions for which receiving contrast was contraindicated (Table 3, quote 8). In each group, however, there were members present who did not share these concerns about contrast. They believed following their physician's orders regarding postscan care would be enough to keep their kidneys healthy (Table 3, quotes 9-10).

Beyond radiation and contrast administration risks, another subtheme present was interpretation of risk. The facilitator told participants that the health risks associated with missing a SSPE by either CTA or MRA was unknown, though CTA scans could

detect smaller PEs with greater accuracy than MRA. Participants were then asked to opine on 2 scenarios: being able to detect SSPEs more accurately but requiring exposure to ionizing radiation (the case of CTA) versus an unknown risk of a false-negative test result regarding the presence of a small clot (SSPE) but with no ionizing radiation exposure (the case of MRA). The influence of this unknown risk on participants' perceptions varied (Table 3, quotes 11-15). During discussions about the clinical vignette, a participant voiced the following concern, "What if it's like a tiny blood clot—really, really small—and that new MR doesn't catch it in time, and then she just... those precious moments are like gone." Others had more confidence in MRA. One said, "... would still say go with the MR, because I don't feel like the smaller ones would be as important." As might be expected, those participants preferring CTA were anxious about the possibility of missing any sized PE. One participant said, "So it just seems to me, why would you take a chance with the MR if you have like 100% certainty with the CT scan?"

The last prominent subtheme of risk discussed in the focus groups was anxiety. Participants expressed anxiety towards both imaging modalities; however, MRA received more scrutiny as it was regarded as more involved than CTA. Like the difference in image acquisition time mentioned previously, the process of image acquisition was not discussed by the facilitator. Nonetheless, participants had preconceived notions of what each imaging modality entailed. The design of an MR scanner (mostly enclosed space) was a major limitation for many due to being claustrophobic. The severity of claustrophobia among participants varied: for some, it was a significant concern; for others, the fear could be easily managed with medication (Table 3, quote 18). In 1 group, participants discussed the idea of a prescan sedative. They recommended medication be available as an option for all patients undergoing MR imaging (Table 3, quote 19). A few people also described having an easier time managing their claustrophobia when in an "open" MR scanner (Table 3, quote 20). Regarding their own size, 1 participant commented, "And because I'm big, you don't fit in the tube so well. You've got to go in the big tube." Participants expressed important hesitations over different components of MR scanning, which inevitability factored into their decision-making process (Table 3, quote 21).

Theme 3: Experience

Participants' prior experience with diagnostic imaging was the final theme to have an influence on their decision-making. Within each of the groups, discussants' experiences and impressions of these imaging events varied greatly. Some had absolutely no experience, while others had significant experiences to share. Those with repeated experiences typically had chronic medical conditions or employment in health care, though none were physicians or nurses. Among the participants who identified as having no experience with imaging, 1 person shared that for no particular

reason, he believed MRA to be better than CTA (Table 4, quote 1). Another participant, with experience undergoing both kinds of imaging, said, “That was just my experience with MRs is they’re noisy coffins. CT scans are relatively easy. They’re open. Other than that, they are what they are. They’re very loud.” Sometimes, participants’ experience with medical imaging led to them gaining misinformation. In particular, a comment was made about the radiation dose received during an MR exam (Table 4, quote 2). Not all experiences were negative; 1 participant spoke favorably about their experiences, saying, “And I’ve had experiences with people that were really good, like the first CT, you know, the guy just explaining, okay, this is exactly what’s going to happen. This is how you’re going to feel.” Others also mentioned being similarly surprised when their MR experiences did not meet their negative expectations (Table 4, quote 3).

The most common indirect imaging experiences referenced in discussions were those of friends and family members (Table 4, quotes 4-5). These events held particular weight for those without direct experience. One participant referenced a sister’s experience saying, “So I just like experienced all of this stuff in the hospital being there with her. I mean, I haven’t experienced an MR personally myself, but just knowing how beneficial it was for her, because she was really sick.” Knowledge of these indirect experiences frequently motivated participant preferences (Table 4, quote 6). While deliberating the risks of CTA, 1 participant said, “It’s hard to say. Me personally, wanting to do less-invasive stuff because there is cancer in some of my immediate family, that’s what I’ve always leaned away from.” It was common for participant decision-making to reflect the positive or negative perception that they observed indirectly in another person’s imaging event. Other indirect experiences mentioned were social media, television, and movies, but these sources generally had neutral effects on participant opinion (Table 4, quote 7).

DISCUSSION

In this study, we sought to identify preferences and opinions held by the general public about diagnostic imaging for PE. Specifically, we aimed to ascertain what their preconceived notions were about MRA and CTA, as well as assess their preferences for choice of imaging test after we provided basic information about the potential benefits and drawbacks of each imaging technique. Across all 4 focus group discussions, the major themes present were time, risk, and prior experience (either direct or indirect). Participants frequently used these themes to develop or rationalize their decision-making process.

Frequently, discussants would allude to their impression that people coming to the ED needed immediate imaging since they could be facing a life-threatening emergency (Table 2, quote 4). We observed participants placing a high degree of importance on finding any abnormality that could explain their symptoms while discussing the mock scenario (Table 3, quotes 14-15). Interestingly, the possibility of false-positive findings did not enter

the narrative at any point. Further, discussants seemed to conceptualize PE as 1 uniform disease process, ie, a potentially deadly clot that causes severe symptoms. The full spectrum of disease—particularly the entity of SSPE—was not in their awareness until we disclosed it later during the deliberative discussion. Moreover, discussion regarding the costs associated with medical imaging was limited, even though discussants suggested potentially undergoing both imaging tests in tandem to fully ensure that PE was not present (Table 3, quotes 16-17).

When we presented participants with the fact that PE exists on a spectrum of severity and that physicians do not have a uniform approach for the treatment of SSPE, many of the discussants changed their preference from CTA to MRA (Table 3, 4). Posed with this additional background information, several participants simply stated that they would trust whatever the doctor recommended, while others wanted to be more engaged in the decision-making process. The shift in preference from CTA to MRA given the new information underlines the importance for shared decision-making in clinical contexts such as this, where there is more than 1 reasonable choice of diagnostic evaluation. In fact, a recent survey of emergency medicine physicians reported that there was more than 1 acceptable treatment option for over half of their patients, yet the shared decision model was applied in only 58% of those cases.²⁰

Further echoing this concept, Rodriguez et al investigated patient opinions regarding CT imaging and radiation exposure. They proposed a variable threshold for what patients determined to be an acceptable risk of CT radiation.²¹ Within our focus group discussions, participants demonstrated a similar shifting tolerance for risk acceptance. Multiple factors influenced the theoretical circumstances in which they would accept or reject increased risks, namely either radiation from CTA or the possibility of a false-negative MRA result. These findings suggest that providing patients with more information regarding their diagnostic imaging choices may be necessary in order for them to meaningfully participate in shared decision-making.

A previous study regarding patient knowledge of risks and radiation dose of medical imaging reported only 14% understood the relative radiation exposure of a CT scan compared to a chest x-ray, and 23% were aware that MR scans did not use radiation.²² These data continue to highlight the problem that patient awareness of radiation exposure from CTs and their long-term risks is low. For imaging events such as SSPE, wherein the increased benefit of a CT scan is unclear, patients need to have an informed understanding of the potential health costs of undergoing such imaging. Working to increase public knowledge surrounding diagnostic imaging risks and benefits stands to have significant impact on overall public health.

There are several limitations to our study. First, participants were not screened for prior visits to the ED, whether they worked in health care or had prior experience with diagnostic imaging, and we acknowledge these experiences may have been factors in the

decision of whether or not to participate in the study. Secondly, since the discussants represent only 1 state, the opinions presented here may have been geographically homogenous. Third, though we observed many redundant experiences and opinions in our discussions, we did not conduct a formal assessment of thematic saturation prior to ending the study. Finally, the use of the deliberative discussion method – which, for our objectives, required the explanation of complex topics such as the risks of PE and the pros and cons of diagnostic imaging – may have introduced bias. However, under the direction of our qualitative research experts, every attempt was made to introduce concepts in a neutral and comprehensible way. Respondents were encouraged to discuss the issues thoroughly and to arrive at their own conclusions. Finally, though “groupthink” is sometimes observed in focus group discussions, we attempted to limit this by restricting the number of participants per discussion group.

CONCLUSIONS

We found that patients often have preconceived notions of the potential benefits and drawbacks of imaging tests, particularly MRA and CTA, and frequently rely on both personal and vicarious experiences to inform these opinions. Not surprisingly, these are often based on incomplete, and at times inaccurate, information. Their perception of underlying potential disease processes appears to be skewed to the direst of circumstances, perhaps in contradiction to the belief of the treating physician. Once people learn that diseases—particularly PE—exist on a spectrum of severity and, therefore, do not usually pose an imminent life threat, patients’ preferences for medical imaging modalities may change.

In clinical circumstances where there is a reasonable choice of diagnostic imaging strategies, as in the case of the evaluation of PE, we suggest that engaging patients in shared decision-making is both possible and desired by patients. When pursuing this, however, the burden to confirm that patients are utilizing accurate information falls on the physician. Therefore, it is advisable to have an open discussion with patients regarding their baseline knowledge of medical imaging, their true risk of disease, and their level of clinical stability to ensure a fruitful conversation.

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Appendix: Available at wmjonline.org.

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