EUROPEAN SOCIETY OF RADIOLOGY
European Radiology

SPECIAL REPORT

Patient-centered radiology: a roadmap for outpatient imaging

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Abstract Creating a patient-centered experience is becoming increasingly important for radiology departments around the world. The goal of patient-centered radiology is to ensure that radiology services are sensitive to patients' needs and desires. This article provides a framework for addressing the patient's experience by dividing their imaging journey into three distinct time periods: pre-exam, day of exam, and post-exam. Each time period has aspects that can contribute to patient anxiety. Although there are components of the patient journey that are common in all regions of the world, there are also unique features that vary by location. This paper highlights innovative solutions from different parts of the world that have been introduced in each of these time periods to create a more patient-centered experience.

Clinical relevance statement Adopting innovative solutions that help patients understand their imaging journey and decrease their anxiety about undergoing an imaging examination are important steps in creating a patient centered imaging experience.

Key points

- *Patients often experience anxiety during their imaging journey and decreasing this anxiety is an important component of patient centered imaging.*
- *The patient imaging journey can be divided into three distinct time periods: pre-exam, day of exam, and post-exam.*
- *Although components of the imaging journey are common, there are local differences in different regions of the world that need to be considered when constructing a patient centered experience.*

Keywords Patient-centered care, Anxiety, Cloud storage

Introduction

Patient experience is a growing priority in health care. Patients are actively engaged in choosing their health care facilities, and have increasing expectations related to timeliness, service, and experience [1, 2]. In response to these expectations, patient-centered experiences are becoming increasingly important to health care providers including radiology departments. The goal of patient-centered radiology is to ensure that radiology services are sensitive to patients' needs and desires.

Although there are many factors that are important to creating a patient-centered experience, one important factor is addressing patient's anxiety due to the anticipation of the imaging exam and uncertainty of the outcome and results. The term "scanxiety" has been coined to describe scan-associated distress or anxiety [3]. In one study performed in patients with a diagnosis of cancer, 55% of patients demonstrated "scanxiety" [4]. In another

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study, waiting for imaging results resulted in an emotional change in 45% of individuals, with the majority (85%) experiencing anxiety [5]. Improved communication between radiologists and patients can help alleviate patient concerns and "scanxiety" and is an important component of patient-centered care.

For outpatient imaging, we can divide the patient's journey with imaging into three distinct time periods: pre-exam, day of exam, and post-exam. This paper highlights innovative solutions from different parts of the world that have been introduced in each of these time periods by radiology departments to create a more patient-centered experience. The solutions discussed are based both on the literature and the authors' personal experiences. The role of the referring physician as well family members for pediatric and elderly patients is also important in reducing patient anxiety but is not the subject of this paper.

Pre-exam

Imaging encounters are unique in healthcare, particularly in the outpatient environment as patients may not meet a physician as would typically occur in an office visit [6]. To better understand and address patients' expectations and make the imaging experience more comfortable for the patient, one of the author's departments used human-centered design to map the outpatient imaging journey for patients and identify the critical problem areas in the imaging journey.

Design thinking is an innovative, human-centered approach to problem-solving. Although widely used within the business sector, design thinking has not been extensively applied in the healthcare field outside of medical education [7, 8].

The University of Cincinnati Medical Center Department of Radiology established a multidisciplinary partnership with the University of Cincinnati College of Design, Architecture and Planning, Live Well Collaborative (a nonprofit academic-industry design organization), and GE Healthcare Global Division to leverage the tenets of design thinking in the area of clinical imaging care, with the goal of improving the patient experience in the radiology department. Design thinking emphasizes empathy and user-centered insights to approach complex problems.

Members of the team included students from the design school, a design faculty advisor, and several faculty and staff from the radiology department and hospital including patient experience officers, CT and MR technologists, a quality coordinator, radiologists, a radiology business manager, and the radiology chair. The team conducted in-depth interviews, observations, questionnaires, feedback sessions, and benchmarking with a total of 60 internal and external users including patients, patient families, patient advocacy groups, the hospital patient experience committee, hospital administrators, referring physicians, technologists, nurses, schedulers, radiologists, and trainees. The team also spent 14 hours observing activities in the radiology department including the registration process, activity in waiting rooms, scan preparation, and the imaging examination itself. Patients chosen for interviews included patients with variable degrees of literacy, and number of prior imaging examinations.

Examples of frequent pain points uncovered were wayfinding and navigating the complex medical campus and lack of pre-appointment communication about specific patient needs (such as contrast allergy) for the CT or MR study. Substantial differences were identified in patient education, health literacy, and comprehension of the imaging process, leading to a lack of clarity for some patients as to what to expect during the imaging process. Finally, radiologists were often invisible to patients, leading to a lack of understanding of radiologists' role and impact on patient outcomes.

Using these insights as a starting point, design thinking was used to improve the experience of patients visiting CT and MR outpatient imaging facilities. Specifically, informational videos and pamphlets to describe the radiology patient experience clearly and concisely, from the perspective of a layperson, and to educate patients about their imaging journey, were found to be important in improving the patient experience.

At the time of the initial appointment, each patient received a toolkit with an imaging video and a pamphlet (Fig. 1). An imaging journey map, explaining the many steps from scheduling, to scanning, to obtaining results, was included in the toolkit. Also included were numerous resources for wayfinding and navigation. Directions, phone numbers, and three-dimensional (3D) renderings of the multiple inpatient and outpatient imaging sites and parking facilities were provided, as well as actual pictures of the building entrances. Both the videos and pamphlets were integrated into the electronic medical record and were delivered through the patient portal at the time of scheduling an imaging appointment. Pamphlet versions were also widely disseminated through referring physicians' offices.

The desired outcome was to improve the patient experience through these educational appointment tools by better preparing patients for their imaging journey. Metrics evaluated included Press Ganey survey responses and examination lengths (check-in to discharge) for CT and MRI. While no substantial changes occurred in length of the examinations, there were improvements noted in patient response scores to Press-Ganey survey questions regarding "overall rating of care" and the

Fig. 1 Four pages (**A**, **B**, **C**, **D**) of a pamphlet designed for patients scheduled for a CT or MRI scan. Adapted with permission from Humanizing Radiology Appointment Education to Improve Patient Experience, Journal of the American College of Radiology, Volume 19, Issue 5, May 2022, Pages 647-651

"staff's explanation of the test" for both the CT and MRI departments. The Press Ganey surveys use a Likert-type scale of 5 responses: very poor, poor, fair, good, and very good. The percentage of responses answered "very good" is called the Top Box score. The Top Box scores for "overall rate of care" improved in the first 6 months of utilizing the education materials for both CT (90.32%→92%) and MRI (78.13%→85.29%). Similarly, the Top Box scores for the "staff's explanation of the test" also improved in the CT department (87.1%→90%), and even more so in the MRI department (71.88%→85.29%).

Although the effect of the educational materials on anxiety in the pre-scan phase related to delays in scheduling imaging studies was not specifically evaluated, it is not unreasonable to conjecture that by better understanding the imaging process, the steps involved, and the

Fig. 1 continued

timeline once imaging occurs, that patients would feel better prepared, the process would seem less confusing, and there would be less building of anxiety while awaiting an upcoming imaging appointment.

Day of exam

Despite providing information about the exam prior to the patient's arrival, many patients may have incomplete or limited understanding of what to expect on the day of the exam. Therefore, on the day of the exam, everyone who encounters the patient, from front desk staff to the technologists to radiologists, should be mindful of the patient's possible "scanxiety," and should communicate details about the exam in a compassionate and caring manner, including what to expect during the exam, and when to expect the results of the exam.

Front desk staff are the first point of contact with patients as they greet and welcome patients to the department on the day of their exam. Technologists guide the patient and perform the exam and are likely to spend the largest amount of time with the patient, thus largely shaping their experience in the department. Educating the front desk staff and technologists in appropriate communication skills is essential. One such communication approach that has been recommend to engage patients empathetically is described by the acronym "AIDET," **A**cknowledge: greet and welcome the patient; **I**ntroduce: introduce yourself using your name and explain your role in the patient's care; **D**uration: describe the amount of time the patient can expect to wait for a test or procedure to begin; **E**xplanation: describe what is going to happen to the patient and what he or she can expect; and **T**hank you: thank the patient for his or her cooperation and participation [9].

Unexpected delays or wait times are a major source of frustration and annoyance for patients [10]. Accurate and timely communication of any delays can alleviate patients' anxiety and frustration, improving their experience on the day of the exam. In an innovative approach called "waiting-room rounding," the staff at one major hospital was trained to check on the patients in the waiting room to assess their comfort, (https://healthmanagement.org/c/imaging/news/improving-patient-experience-in-radiology-waiting-rooms). It is also possible

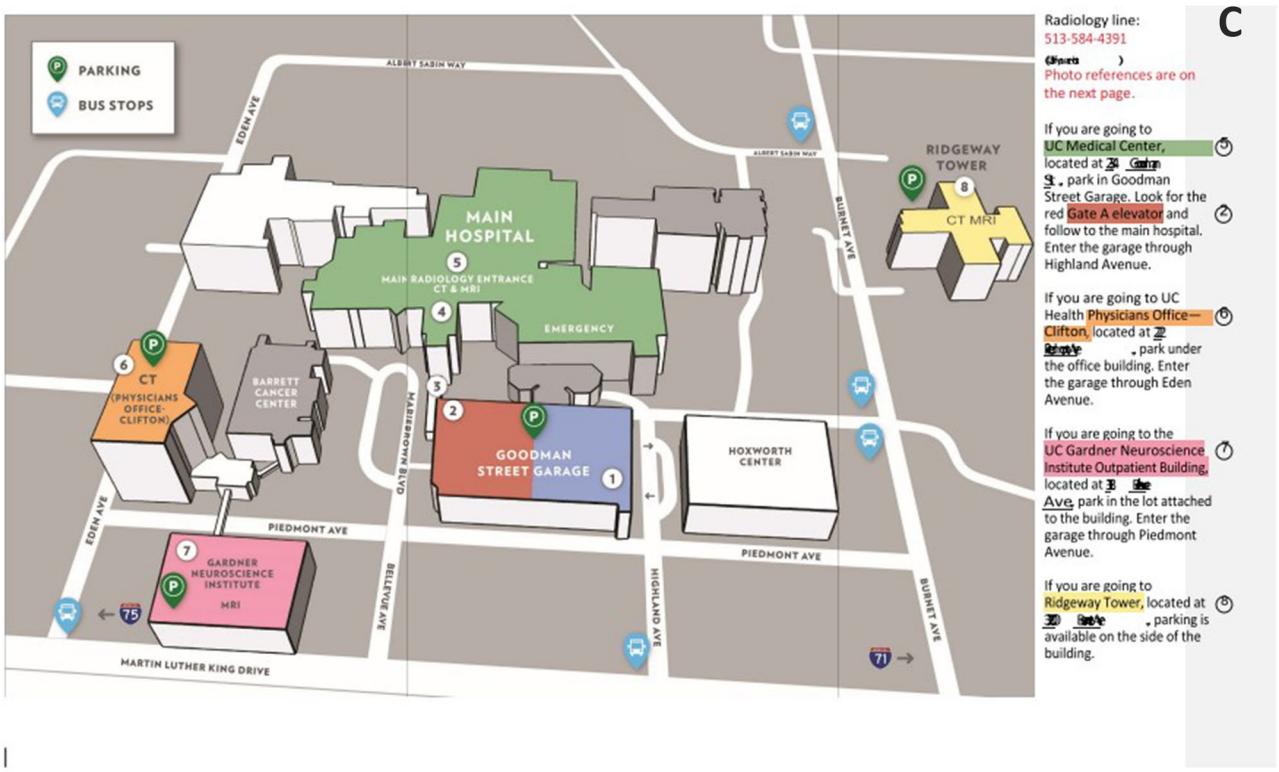

Fig. 1 continued

to leverage technological solutions to further improve and aid in patient-centered communication. Advances in predictive analytics may help to foresee delays in the start of the exam [11], and this can be communicated via text messaging or through the electronic patient portal to let the patient know if there will be longer than expected wait-times or a delay [12]. Another approach for improved communication is to use the time in the waiting room to educate patients about the exam through pre-prepared videos in the patient's primary language. For example, in a pilot study performed at one of the author's institutions [13], 29 patients undergoing abdominal MRI whose primary language was either Spanish or Mandarin Chinese were shown a pre-recorded video of breathing instructions by the technologist in their primary language. The group of patients who saw the video had higher image quality scores when compared to those patients who had the procedure explained through a phone translation service. Furthermore, the image quality scores were similar to English-speaking patients who received instructions in English.

In many parts of the world, radiologists perform ultrasound examinations and various procedures. This gives them the opportunity to connect with patients and relieve their anxiety. Furthermore, in many instances, patients may desire to speak with the radiologist following their diagnostic examination. This is an opportunity for radiologists to provide patient-centered communication about their imaging results. However, to make the most of these opportunities, radiologists need to be prepared to communicate effectively with the patient. A communication model, known by the acronym RADPED, was developed by Goske et al following review of various published work and guidelines in the field of physician–patient communication [14]. RADPED consists of following components: **R**apport (creating an affinity with the patient); **A**sk (obtaining information from the patient about the illness and the reason for the examination); **D**iscuss (informing the patient of the steps of the procedure); **P**erform (performing the procedure); **E**xamination (using techniques of distraction, such as movies, music, and toys, during the examination); and (again) **D**iscuss (informing the patient of the outcome of the examination). Although this was initially described for pediatric studies, this approach is easily generalizable and applicable when communicating with all patients.

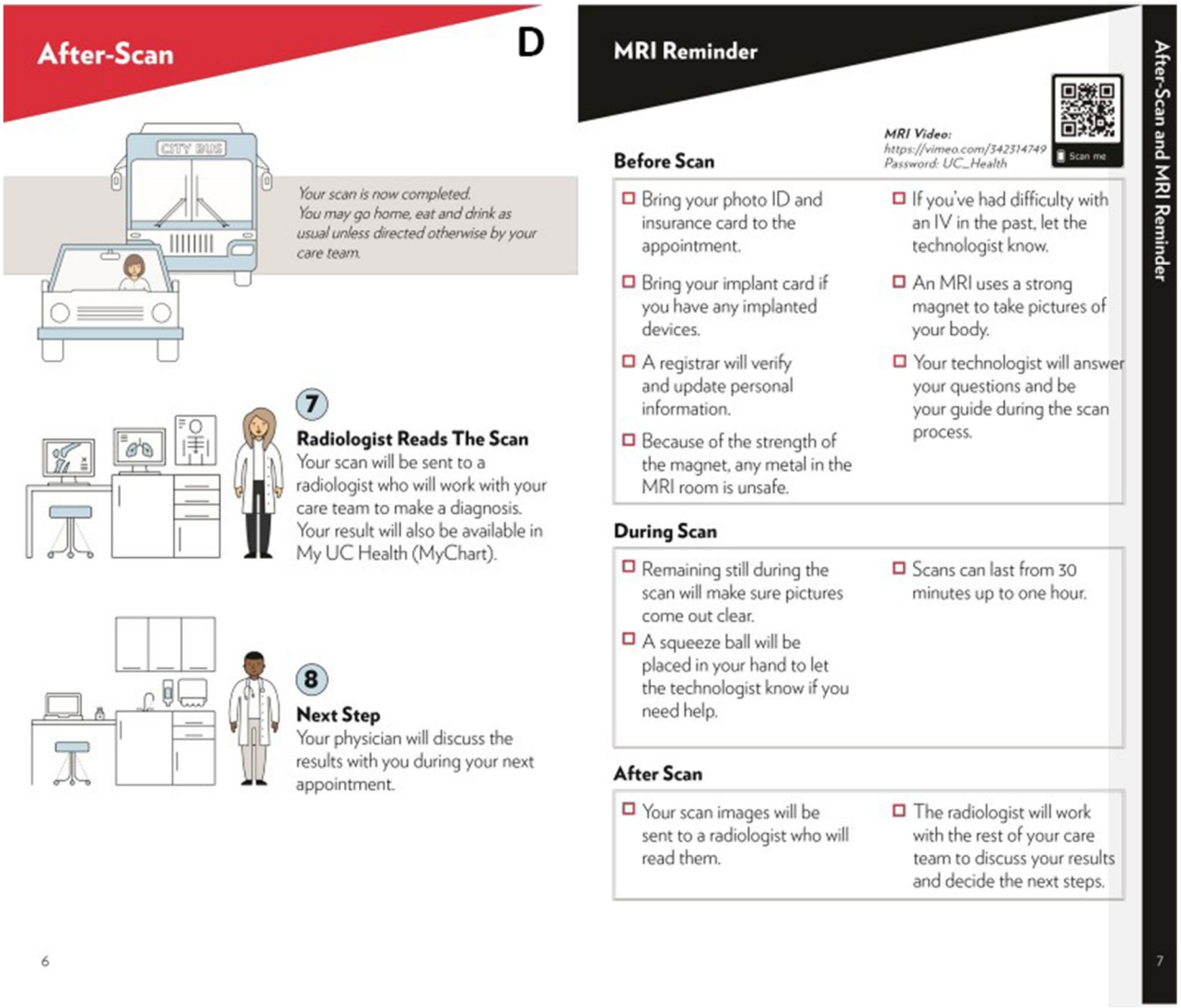

Fig. 1 continued

Table 1 lists several "Day of Exam Challenges" and suggestions on how to best meet each challenge.

Post-exam

Radiology report

The radiologist's main means of communication is through the radiology report. The primary audience of the radiology report has traditionally been the referring physician. Not surprisingly, the typical radiology report is highly technical using medical jargon that presupposes considerable medical knowledge. The recent introduction and popularity of digital patient portals has created a second important audience for radiology reports, the patient. Although initially not all radiology reports were released and those that were released were only available after a delay, the twenty-first Century Cures Act [15] in the USA mandated that essentially all reports be released immediately. Not surprisingly, studies have shown that patients have significant difficulty understanding their imaging reports [16]. Two major reasons for this difficulty are unclear or technical language and the length of the radiology report [17, 18]. This difficulty in understanding combined with the immediate release of report can also be a cause of increased stress for patients.

Several solutions have been proposed to modify and improve the traditional written radiology report and improve radiologist-patient communication. Direct in-person communication between the radiologist and patients has been proposed [18, 19]. Although this is feasible with limited studies as discussed above, this is

Table 1 "Day of Exam Challenges" and potential solutions

Challenges	Proposed solutions
Incomplete understanding of the exam resulting in "scanxiety"	1. Front desk staff and technologists communicate details about the exam in a compassionate and caring manner, including what to expect during the exam, and when to expect the results of the exam. 2. Leverage solutions such as videos to educate patient about the exam in their primary language.
Unexpected delays or wait time for the exam	1. Leverage technologic solutions to predict potential delays and communicate these prior to patient's arrival. 2. Accurate and timely communication of any delays when patient is on the site.
Suboptimal or limited communication by the staff and radiologists	1. Train the front desk staff and technologists in appropriate communication skills. 2. Educate radiologists to provide patient-centered communication.

impractical for many imaging studies such as radiography, CT, and MRI. Direct in-person communication would significantly increase the time required for interpretation and could require patients to wait a substantial amount of time following their imaging examination. The incorporation of images, tables, and graphs into the radiology report have been found to be valuable by referring physicians [20], but does not address the major reasons for patients' difficulties in understanding their imaging reports.

More recently, two solutions have been proposed that have potential advantages in making the radiology report more useful for patients and not limiting the value of the report for referring physicians. The first is the use of automated lay-language translation of the medical terminology used in radiology reports [21]. The annotations include patient-oriented definitions, anatomic illustrations, and hyperlinks to additional information. A small pilot study reported that 77% of patients felt that the definitions helped them understand the report, and 91% stated that the illustrations were helpful. One major advantage of this method is that radiologists do not have to change the way they produce the report or use a different lexicon to simplify the radiology report.

A recent study at one of the author's departments also demonstrated the value of short video reports that are patient-centered [22]. In this study, short, approximately 1-min video reports were created highlighting one or two important findings in the examination. The reports used non-medical lay language and included relevant images, including novel 3D cinematic rendered images, to improve patients' ability to understand their imaging findings. The video reports were a complement to, and not a substitution for, the traditional written report. A subsequent survey of patients revealed that 91% preferred receiving both the video and written report, with only 2% preferring the written report alone. The video report was found to decrease patients' anxiety. Patients found the following aspects of the video report to be most helpful: simple-to-understand language, having the radiologist demonstrating the findings on their images, the use of comparison images to demonstrate abnormalities, and the use of the 3D images. Potential drawbacks to the video report are the need for the radiologist to produce two separate reports (the traditional written report and the video report) and the increased time required to produce the video report, which was just under 4 min. Further modifications of the technique used to create the video report, including the use of macros, have now decreased the time required to create a video report to less than 40 s (M. Recht, personal communication, April 2, 2023).

Patient follow-up

Follow-up communication can be best understood in the context of guidelines such as those associated with BIRADS or LungRADS, where follow-ups are an integral part of management and where communication plays an important role in ensuring compliance from patients.

In the USA, the Mammography Quality Standards Act requires that written communication of screening mammography studies be sent to every patient within 30 days of the study [23]. This letter should be written using simple language and terms that lay people would understand, with as little jargon as possible. In the UK, abnormal results suggesting cancer are ideally delivered in-person [24], though there are hospitals that telephone the patient for follow-up. In Australia, reaching out to non-English-speaking immigrants via telephone has been shown to be superior to sending letters, whether translated or not [25]. All follow-up communication techniques need to account for patient and people factors, prevailing methods of communication within the socio-cultural milieu, and the local laws and expectations [26].

One significant problem is the lack of adherence to follow-up guidelines, which may affect as many as two thirds of patients who are recommended to undergo imaging follow-up [27]. There are many reasons for this, including the clarity of the follow-up request, the role of the referring physician in reinforcing the request and the

clarity of the recommendation. A precise, unambiguous follow-up recommendation should be used in all reports to increase compliance with the recommendation. Implementing a closed-loop system has been found to improve adherence to recommendations [28] and prevent patients from falling through the cracks.

Many hospital information systems across the world use automated text messaging for communicating about appointments and for follow-ups. A 2015 systematic review of automated alerts and reminders showed that using text messages or reminders tethered between a patient health record (PHR) and the hospital's electronic health record (EHR) improved patient adherence and compliance across a wide range of clinical problems [29]. It is safe to assume that such systems would work well for radiology follow-up reminders.

In many parts of the world, messaging apps such as WhatsApp and WeChat have become the dominant mode of communication. In this context, perhaps the use of WhatsApp could allow better communication than letters, telephone calls, emails, or even text messaging. A recent meta-analysis showed improved psychosocial and physical outcomes among cancer patients followed-up using WhatsApp/WeChat as compared to other traditional methods [30]. It is possible that adherence to follow-up recommendations may also be better with such apps. However, there are still issues with privacy [31] and implementation that need to be solved before a WhatsApp- or WeChat-based solution can be used universally for such purposes.

Image storage and access

In 2018, a World Health Assembly resolution recognized the enormous potential of digital health to contribute to advancing the objectives of the Sustainable Development Goals and universal health coverage [32]. Subsequently, in 2019, the World Health Organization (WHO) released the first formal guidelines recommending the use of digital health for health system strengthening [33]. Several of the recommended applications are relevant with the direct impact for the patient-centered radiology: targeted client communication via mobile phone; client-to-provider and provider-to-provider telemedicine; training and education; decision support tools; and tracking for treatment initiation and monitoring [34].

Although recent years have brought an extensive adoption of electronic methods for image storing and sharing, compact discs (CDs) remain the prime means of sharing medical images with patients. A recent study noted that the use of CDs as a main medical image delivery method was "an immediate issue" that required attention [35]. Using cloud systems for healthcare offers several potential advantages [36, 37]. Cloud computing not only allows its users to access the information remotely, as it includes automation of backups and disaster recovery options, but in the case of a breach, healthcare providers do not lose any data. The cloud can carry an extensive quantity of information at a very negligible cost and cloud-based tools can update and upgrade their features with minimal intervention. Cloud technology facilitates patients' access to subspecialists and quality medical care without substantial travel. A radiologist can treat a patient in a different geographical area without needing access to complicated infrastructure. Use of the cloud provides access to medical images and other medical data to healthcare facilities in rural areas and developing markets around the world. With cloud technology, data can be safely shared, in real time, among all healthcare stakeholders potentially improving patients' outcomes. Finally, health systems frequently struggle to keep up with advances in computing power and using the cloud can help them do so more effectively and economically.

Online access may be short term or permanent, accessible by everyone with whom the patient shares the link or limited to those within the provider's healthcare system. Some countries, like Turkey, have developed a mandatory personal health record system (e-nabiz), which allows patients' access to health data collected from health institutions all over the country, via Internet and mobile devices. Since 2020, all hospitals and imaging centers in Turkey are obligated to upload their radiology images to the system in order to be reimbursed [38].

Summary

Patient-centered radiology demands that radiology departments be aware of and sensitive to patients' concerns and needs regarding their imaging experiences. There are multiple methods and processes that radiologists and radiology departments can adopt to improve the patient experience. This paper presents innovative solutions that have been developed and trialed for each of the three periods of the patients' imaging journey: pre-exam, day of exam, and post-exam. We have highlighted a design-thinking approach to improve the patient experience prior to their arrival for imaging exam. Providing information explaining what the encounter in radiology will entail decreases anxiety and improves the patients' sense of being cared for. Similarly, once the patient arrives for the examination, compassionate and caring front desk-staff, technologists, and radiologists who are well versed in empathetic communication will decrease patient's "scanxiety." Appropriate and timely communication about wait-time and delays as well as addressing any patient's concerns about their exam in the patient's primary language will also improve their experience. It is important for radiology departments to leverage tools like video reporting or automated lay-language

translation to improve patient's understanding of their imaging findings, harness digital tools to increase compliance with follow-up exams, and develop tools to allow convenient image sharing.

Abbreviations

3D	Three dimensional
BIRADS	Breast Imaging Reporting & Data System
CD	Compact disc
CT	Computed tomography
EHR	Electronic Health Record
LundRADS	Lung Imaging Reporting and Data System
MR	Magnetic resonance
MRI	Magnetic resonance imaging
PHR	Personal health record
UK	United Kingdom
US	United States
WHO	World Health Organization

Acknowledgements
The authors would like to thank the Journal of the American College of Radiology for allowing us to adapt Figure 1 from "Humanizing Radiology Appointment Education to Improve Patient Experience, Journal of the American College of Radiology, Volume 19, Issue 5, May 2022, Pages 647-651".

Funding
The authors state that this work has not received any funding.

Declarations

Guarantor
The scientific guarantor of this publication is Michael Recht.

Conflict of interest
MPR has a collaboration with Amazon Web Services Public Dataset Program.

Statistics and biometry
No complex statistical methods were necessary for this paper.

Informed consent
Written informed consent was not required for this study because it is a special report.

Ethical approval
Institutional Review Board approval was not required because it is a special report.

Study subjects or cohorts overlap
Not applicable.

Methodology

- Special report

Received: 17 April 2023 Revised: 16 August 2023 Accepted: 31 August 2023
Published online: 04 December 2023

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