The Effect of AI-Enhanced Breast Imaging on the Caring Radiologist-Patient Relationship

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AI has shown radiologist-level performance at diagnosis and detection of breast cancer from breast imaging such as ultrasound and mammography. Integration of AI-enhanced breast imaging into a radiologist's workflow through the use of computer-aided diagnosis systems, may affect the relationship they maintain with their patient. This raises ethical questions about the maintenance of the radiologist-patient relationship and the achievement of the ethical ideal of shared decision-making (SDM) in breast imaging. In this paper we propose a caring radiologist-patient relationship characterized by adherence to four care-ethical qualities: attentiveness, competency, responsiveness, and responsibility. We examine the effect of AI-enhanced imaging on the caring radiologist-patient relationship, using breast imaging to illustrate potential ethical pitfalls.

Drawing on the work of care ethicists we establish an ethical framework for radiologist-patient contact. Joan Tronto's four-phase model offers corresponding elements that outline a caring relationship. In conjunction with other care ethicists, we propose an ethical framework applicable to the radiologist-patient relationship. Among the elements that support a caring relationship, attentiveness is achieved after AI-integration through emphasizing radiologist interaction with their patient. Patients perceive radiologist competency by effective communication and medical interpretation of CAD results from the radiologist. Radiologists are able to administer competent care when their personal perception of their competency is unaffected by AI-integration and they effectively identify AI errors. Responsive care is reciprocal care wherein the radiologist responds to the reactions of the patient in performing comprehensive ethical framing of AI recommendations. Lastly, responsibility is established when the radiologist demonstrates goodwill and earns patient trust by acting as a mediator between their patient and the AI system.

Keywords: Care ethics; Breast imaging; Computer aided diagnosis

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1. Background

1.1. *Artificial Intelligence in breast imaging*

AI is widely applied to diagnostic and screening breast imaging, across almost all modalities. AI for clinical use can be subdivided into computer-aided detection (CADe), diagnosis (CADx), and exam triage (CADt) systems[1]. The first CADe system for screening mammography, designed to mark mammograms in areas of suspicion before review by a radiologist, was approved by the FDA in 1998[2]. By 2008, CADe was used in 70% of screening and 48% of diagnostic mammography patient visits in hospitals[3]. AI-enabled breast imaging CADe and CADx systems can be classified as *standalone* and *reader aid* systems[4]. Standalone AI-enabled CADs are designed to provide a diagnosis on their own, while reader aid systems are designed to assist a radiologist in establishing a diagnosis.

Recently, there has been a flood of research investigating deep learning-based solutions for breast imaging for cancer risk prediction, diagnosis and prognosis, and in predicting treatment response[1,5-7]. Deep learning has shown performance consistent with radiologists at cancer detection and diagnosis in 2D and 3D mammography[8-10], ultrasound[11,12], and MRI[13] in research settings. Deep learning-based CADe and CADx systems have the potential to both reduce the workload on radiologists by accurately diagnosing simple cases and advance breast imaging as AI can pick up on image characteristics not obvious to human radiologists. However, in reducing the workload on radiologists, a deep learning-based CADe/x system removes the opportunity for the radiologist to exercise fundamental diagnostic skills in their clinical practice.

1.2. *The ethical ideal: shared decision-making*

We identify shared decision-making (SDM) as an ethical ideal for healthcare delivery. SDM has the ultimate aim of cultivating a partnership between patient and radiologist. SDM is promoted by both the Radiological Society of North America's *Radiology Cares* campaign[14] and the American College of Radiology's Imaging 3.0™[15]. SDM literature in breast imaging, specifically mammography, places particular emphasis on the following three components of care delivery[16]:

1. *Information Delivery and Patient Education:* The first step to informed consent and treatment under SDM is patient education through presentation of risks and benefits associated with imaging. A personal breast cancer risk assessment is also recommended to contextualize imaging and treatment options[17,18]. Effective information delivery can involve risk scoring, visual aids, and real-world examples in addition to verbal delivery by the radiologist. In addition, information delivery should involve discussion of CADs.
2. *Interpersonal Radiologist-Patient Communication:* Open, honest communication between radiologist and patient is essential to SDM. Verbal, nonverbal and paraverbal physician communication effect patient trust, comfort, and visit satisfaction[19]. Radiologists can contribute to effective communication through asking questions and attentive, empathetic listening. SDM involves patients and radiologists interacting in a democratic manner, with equal gravity given to radiologist and patient.

3. *Framework of the Decision:* SDM requires that treatment decisions be situated in the patient's values, understanding, and background[16]. The patient must understand that the decision to undergo imaging is their choice to make after communication of risks and benefits. The nature of informed consent regarding AI is an open research area[20-23]. SDM should be adapted to patient cultural background and mindful of possible language barriers between radiologist and patient. Patient trust in their radiologist, patient-perceived radiologist expertise, and patient misunderstanding around the role of AI and CADs can all be barriers to decision framing and interpersonal communication.

We introduce care ethics and its goal to foster caring relationships as an ethical framework that supports SDM.

2. Care Ethics

Care ethics has been developed as an alternative to principle-based theories that have historically dominated biomedical and healthcare ethical thinking. In the past 20 years, care ethics has been increasingly applied to a range of healthcare issues, particularly in nursing ethics[24-26]. Care ethics begins with the assumption that moral responsibility derives from our nature as embodied, interdependent, relational beings. As such, we all experience some level of vulnerability during our lifetimes that puts us in need of care from others. Valorizing relationships and recognizing the work of care is a central tenet. Rather than considering how universal principles enter into ethical decision-making, care ethics takes a contextual point of view, seeing moral dilemmas as arising from concrete situations in the context of particular relationships. This shifts the emphasis of moral questions away from "What principles establish my moral obligations?" to "How can I best meet my caring responsibilities in this context?"

Joan Tronto distinguishes between two senses of care: as an action and as a disposition. To provide a useable framework for navigating the complex terrain of caring processes, she identifies four phases that ideally play out in all caring relationships. These are caring about (becoming aware and attending to a need for care); caring for (assuming responsibility to meet such a need); caregiving (the actual work of care, which requires knowledge and judgment); and care receiving (a complex dynamic involving the shared moral burden between the cared for and caregiver). She also identifies four elements of care—attentiveness, competence, responsibility, and responsiveness—that refer to the disposition of those involved in caring relationships[27].

Tronto observes that almost all medical care is "necessary care." Since it is not care one can provide for oneself, it involves the development of a caring physician-patient relationship: "In such settings [those wherein one cannot care for oneself] there is always a power imbalance between care providers and care receivers"[27]. This inherent power imbalance, wherein a radiologist has substantial societal authority and epistemological advantage over their patient, creates a cautionary situation for the reciprocal nature of an ideal caring relationship. When AI is introduced through a CADe/x/t system, further complications arise in that the epistemological authority of the radiologist may be challenged and opportunities for strengthening of the radiologist-patient relationship are removed. In this context, we take breast radiology as a suitable clinical lens for considering the ethical implications resulting from the use of AI-based CADe/x/t systems in breast imaging, due to care ethics' emphasis on the radiologist-patient relationship.

3. The Caring Radiologist-Patient Relationship

3.1. *Assumptions*

For the purposes of the bioethical analysis in this paper, we identify key assumptions about the roles of both the radiologist and CADe/x/t systems in breast imaging. Firstly, we assume that only healthcare professionals interact directly with the CADe/x/t system. Secondly, we assume that the system being used falls into either the CADx or the CADe classifications (the combination of which is referred to as CAD henceforth). We make this assumption because it is possible that through the use of a CADt system, a radiologist may never see their patient's imaging, which eliminates the opportunity to exercise a crucial part of the competency quality of care, restricting the development of the radiologist-patient relationship. We also assume that all CADs involve the use of AI and that the patient is aware of the use of CAD in their examination. Finally, we assume that the radiologist is involved with image acquisition, image analysis, and communication of results to the patient. This does not entail that the radiologist necessarily acquire the images themselves, nor that the radiologist initially or exclusively communicates results to the patient.

The 21st Century Cures Act requires radiology records be made available to patients as soon as information is in the patient's electronic health record[28]. This is consistent with our assumptions, as long as the radiologist communicates with the patient in a reasonable timeframe. However, immediate release of imaging may expose the patient to CAD results (for example, automated breast density assessment from mammography) before radiologist contact. This may cause the patient to question the competency of the radiologist and damage the radiologist-patient relationship. This is further reason to have the radiologist engaged in caring communication with the patient.

3.2. *Developing the idea of caring relationships*

Virginia Held argues that the central focus of care ethics is "the compelling moral salience of attending to and meeting the needs" of particular others for whom we take responsibility[29]. Complimenting Tronto's position that a care ethic is a relational ethic, Nel Noddings and Vrinda Dalmiya develop care ethics along an "individualistic, dyadic model"[30,31]. This person-to-person model is conducive to discussing radiologist-patient interaction. Thomas Randall identifies attentiveness, mutual concern, responsiveness, and trustworthiness as values integrated in good caring. He finds mutual concerns to be "expressed between related beings when there exists a shared interest to make possible the cooperation required to develop and sustain association for the benefit of all involved"[32]. This focuses attentiveness on the part of both radiologist and patient. It engenders trustworthiness in support of a robust and positive relationship supportive for follow up care. This is particularly important for *responsiveness*, which focuses on how a patient responds and whether their needs are met by the care given. It requires paying close attention, honed listening skills, receptiveness, and understanding[33]. A caring relationship between the radiologist and the patient can thus be characterized by adherence to the four elements identified by Tronto: attentiveness, competence, responsiveness, and responsibility, throughout the stages of caring about, caring for, taking care of, and care receiving. Tronto emphasizes the mediating role of

communication in care ethics, highlighting such facets of caring such as empathy, attentive listening, and expressions of sympathy and concern from the caregiver.

The following sections explore how Tronto's four caring elements play out in a breast imaging workflow adhering to the previously stated assumptions.

3.3. *Attentiveness*

When one is attentive, the need for care is recognized so caring can begin. Attentiveness does not only trigger the beginning of care; empathetic and enthusiastic listening is an act of care itself[34]. Radiologists care attentively when they listen to their patients and examine symptoms and imaging carefully and without bias. In adhering to SDM, a radiologist allows a patient to express their need for care in their own terms. To strengthen reciprocity in the radiologist-patient relationship, patients can cultivate attentive care by communicating their needs and concerns openly, asking questions, listening in turn, and adhering to their treatment plan.

Attentiveness is of particular importance in breast imaging, where patients may identify palpable lumps or other symptoms during self-examination and need to communicate concerns to their care provider. Breast cancer and breast imaging can be an emotional experience for patients; the connections of the breast to motherhood and sexuality can make seeking care for breast-related concerns embarrassing or anxiety-inducing[35]. This adds to the vulnerability of the patient and must be recognized in attentive breast imaging care, as patients may not be comfortable expressing their need for care candidly. An attentive radiologist observes possibly minute indications of patient condition and adjusts caregiving, particularly the communication of results, in kind.

CADs can disrupt attentiveness in the radiologist-patient relationship. Essentially, there are two designs for CADs in clinical practice, 1) the radiologist needs to interact directly with the CAD during a patient encounter (when the radiologist is performing diagnostic imaging themselves, such as an ultrasound follow-up to mammography), and 2) the CAD is used out of sight of the patient. In this first situation, the opportunity to interact with the CAD during the patient appointment is encountered, and the interaction between radiologist and patient is interrupted. When the radiologist is interacting with the CAD, they are not serving as a physician, but as a technician. This fragmentation of roles can lead to disinterestedness in serving as a physician when interacting with the CAD[36]. Aside from role-switching when interacting with CAD, if used in real-time, radiologists may possibly need to input data, trigger analysis, or actively identify lesions in certain CADx systems. This reduces the amount of time spent face-to-face with patients and can damage the patient's perception of the radiologist's attentiveness. Over-interaction with results from non-real-time CAD produces similar damage to the attentive quality of care. Patients can receive attentive care by the caring radiologist choosing to keep CAD interaction to a minimum during patient encounters, or relegating CAD to non-real-time use, such as in exams performed by a radiology technician.

3.4. *Competence*

After identifying that caring needs to occur, for care to be competent, the caregiver needs to be able to administer the needed care well. Requiring ethical care to be competent recognizes that care ethics does not simply involve good intentions but also requires knowledge, judgement, and

skillful execution. Competent caring in breast imaging involves, but is not limited to, maintaining technical competence by staying up to date with new technologies, adhering to reporting standards such as those set forth by the American College of Radiology's Breast Imaging Reporting & Data System[37], and deferring to other physicians or diagnostic tools when necessary. The relational nature of ethical care requires not only that the radiologist administer care well, but that the patient perceives care as competent. Thus, competent caring also involves maintaining patient trust in the radiologist. Medically correct care administered without the perception of competency damages trust and cannot be ethical care. Administering competent care also involves clear, empathetic communication of imaging results at a level appropriate for the patient.

CADs can impact both perception and realization of a radiologist's competency in caring. When a CAD is introduced into the breast imaging workflow, there is a risk of skill erosion, wherein the radiologist loses some or all of their ability to interpret imaging without the use of the CAD. Skill erosion can also occur when new radiologists are not taught the skills which are now being addressed by the CAD. For example, less emphasis may be placed on developing the skills for precise lesion delineation, because this is a common feature of CADe systems. Medical skill erosion, not specific to radiology, has been well-documented as a response to new clinical technology and is an oft-cited professional consequence of incorporating clinical decision support systems into medical practice[38-40].

The ethical question is then whether or not skill erosion challenges the ability of the radiologist to provide competent care. We propose that it does not. The competency requirement of care entails that radiologists evolve with developments in medicine so they provide the best care available to their patient. If we accept that a CADx system diagnoses breast cancer from mammography with higher sensitivity and specificity than the radiologist, then, if the radiologist neglects to defer to the CADx when inspecting imaging, the quality of care suffers. Misdiagnosis can be extremely traumatic for the patient in the case of a false positive, with negative psychological effects lasting up to three years[35], and deadly in the case of a false negative. Thus, it is essential in maintaining a healthy, caring radiologist-patient relationship that a diagnosis be as accurate as possible, and this implies the use of the CADx system.

Accepting that a particular CAD provides a better diagnosis does not necessitate skill erosion. Radiologists may maintain their imaging inspection skills by either examining imaging for a selection of patients without use of the CAD, or ensuring they inspect imaging independently before referring to the CAD. Two concerns present themselves here: The former option may harm a subset of patients and is unethical unless the patients give their informed consent after an SDM-adherent discussion of risks and benefits. The latter slows down the radiologist at best, and at worst subjects patients to over-testing. In the event that the CAD is removed from the medical practice, it is the radiologist who is responsible for "upskilling" to maintain a high quality of care.

The inclusion of a reading aid-style CAD in a breast imaging workflow presents opportunity for disagreement between the radiologist and the CAD. Without the opportunity for follow-up discussion and explanation as one would have with a human collaborator, this can challenge the radiologist's perception of their own competency[41,42]. However, this need not directly affect the caring radiologist-patient relationship, unless the self-perceived skills of the radiologist affect their patient interactions. On the contrary, referring to the CAD adds to the radiologist-patient relationship in much the same way that consulting with another radiologist would. A critical component of providing competent care is knowing when to defer decision-making to others.

The perception of radiologist competency by patients is essential to maintaining a caring relationship. In order to accept care, the more vulnerable care-receiver must trust the caregiver. The inclusion of CAD in the clinical breast imaging environment can damage a patient's trust in the competency of their radiologist. If a CAD is referred to for all imaging results, or if CAD results are presented with minimal explanation of medical significance from the radiologist, there is a risk of seeing the radiologist as just an intermediary between the patient and the computer system[43]. A particular risk to patient perception of radiologist competency arises when CAD results are made available automatically to the patient, before the radiologist can make contact. In this scenario, the patient receives medical information without input from the radiologist, establishing a pseudo computer-patient relationship, in which the computer is presented as competent. When a patient finds a computer to be more competent than the radiologist there is risk to the radiologist-patient relationship (examples from other fields[44-46]). To maintain the perception of competency, radiologists need to be skilled empathetic listeners and communicators, not only with respect to medical knowledge and CAD results[47], but also in person-to-person interactions. If the radiologist and the CAD system agree, radiologists give ethical care when they communicate CAD results effectively. When the patient receives CAD results independently, then the radiologist may maintain the perception of competency by providing adequate medical framing of CAD decisions. If they do not agree, the radiologist may need to compete with a patient's perception of an established epistemic authority in CAD (Note that we are not explicitly referring to explainable AI technologies here, but the skill of the radiologist in communicating diagnostic results in terms appropriate for the patient).

3.5. *Responsiveness*

The responsive element refers to the complex dynamic between caregiver and care-receiver. It implies a shared ethical responsibility, requiring that attention be paid to both the patient and their responses to the care administered. Responsiveness recognizes the vulnerability of the patient and places a particular emphasis on understanding what is being expressed by the patient throughout all stages of care. Both patient and radiologist have a role in responsive care. Medical care can be administered according to best practices, attentively and competently, but as soon as the response of a patient is not considered and care adjusted accordingly, the care can end in moral failure. For example, a patient who is uncomfortable with the breast compression involved in mammography and communicates this discomfort may not continue to be ethically treated. A care-ethical response would involve discussing alternative imaging modalities, and/or adjusting the procedure (or pre-procedural communication) to make the patient more comfortable.

Responsive care encourages dialogue consistent with the ethical ideal of SDM. Patients must feel comfortable expressing their response to care and radiologists must demonstrate that they adjust caregiving to patient response. Responsive caring also necessitates that patient values are incorporated into caregiving. Attitudes around and adoption of mammography have been shown to vary based on patient cultural background[48-50] and a responsive caregiver will adjust their practice and communication to best suit their patient. Radiologist's opportunities to provide responsive care are expanded with the integration of CAD systems, particularly when patients are exposed to CAD results before radiologist communication can occur. Radiologists display responsive care when they modify their communication of CAD results to both the epistemological position and emotional state resulting from previous discovery of CAD results.

However, responsive care can be harmed by CAD usage in clinical breast imaging practice. The application of patient values relating to diagnosis and treatment decisions requires the ethical implications and explanation for these decisions be communicated to the patient. For example, women with different backgrounds may react differently to being told that there is a 2% chance of malignancy in an identified breast lesion, and a recommendation of follow-up imaging or biopsy. CAD decisions are not *a priori* centered around patient value-systems. This risks placing the entire burden of ethical contextualization on the patient.

A patient's capacity to be engaged in responsive care can be further harmed by CAD integration when there is no avenue for the patient to provide feedback on the quality of care they are receiving directly to the CAD. For this reason, the CAD can never assume a role as a moral agent, from a care ethics perspective. We argue that feedback and dialogue with the radiologist is crucial and some may see it as an appropriate substitute for providing feedback to the CAD, especially in the situation where the CAD is serving as a reader aid to the radiologist. We disagree, on the grounds that dialogue about quality of care and accurate diagnosis should be provided to every entity that is making decisions. Patient and radiologist feedback could be incorporated into CADs through closed-loop designs where feedback is used to improve performance. Furthermore, for care to be responsive, the caregiver needs to react to feedback from the care-receiver. The ethical, caring patient cannot receive care from a CAD without substantial radiologist intervention to bridge the ethical gap between CAD output and patient values.

3.6. *Responsibility*

When considering care ethics as a professional ethical framework, we draw attention to the distinction of care ethics as a *responsibility-based* ethical theory, as opposed to more traditional *obligation-based* ethical theories. A care ethics approach to moral decision making involves asking how decisions fulfill our responsibility to maintain caring relationships[51]. By contrast, obligation-based ethical theory asks how decisions influence what we owe to others, thus distancing ourselves from our interpersonal relationships. Defining care ethics as responsibility-based in healthcare assumes practitioners are responsible for the care of their patients as a result of the physician-patient relationship. Radiologists are not care-ethically obligated to administer treatment to their patient; however, they are responsible for how their treatment (and the patient's outcome) will influence not only the radiologist-patient relationship but also the wide network of professional and personal relationships linking the radiologist and patient. Responsible care involves a reciprocal effort on the part of the patient to be open to receiving care.

Radiologists demonstrate responsible care simply by taking it upon themselves to care for their patients. We believe this responsibility need not erode with the use of CAD but can evolve to include more non-medical aspects of care. Radiologists who specialize in breast imaging have unique opportunities to interact with patients in both performing imaging and communicating results. As the medical needs of a patient are met, the radiologist can focus on more humanistic aspects of their practice. The responsibility of radiologists to attend to the emotional and mental wellbeing of their patient through the skills of communication, listening, and empathy is no less a responsibility than diagnosis and treatment. If we take as given that ethical actions are grounded in healthy, caring relationships, it seems obvious that maintaining the radiologist-patient relationship is essential to ethical breast imaging care. It may therefore be necessary for radiologists to shift their focus from medical skills to their less-technical, more caring skills, precisely because CAD

are incapable of forming relationships, and thus cannot function as moral agents from a care ethics perspective[43].

Consideration of CAD errors draws particular attention to the breast radiologist's care-ethical *responsibility* for their patient. CAD may be susceptible to errors due to dataset shift in deployment due to unrepresentative training data and differences in data acquisition methods, among other hard-to-detect reasons[52]. A caring radiologist must be sufficiently *competent* to identify CAD errors and trust their own judgement[53,54]. Furthermore, a responsible radiologist must safeguard their patient from erroneous CAD output to maintain trustworthiness and goodwill towards the patient. Thus, within a care context the radiologist is *responsible* for the effects CAD may have on their patient's diagnosis, and thus must engage in AI/CAD safety and monitoring protocols.

Patients need to trust that their radiologist is administering responsible care. This grounds the radiologist-patient relationship. Trust implies an assumption of goodwill between parties involved. Radiologist-patient trust can be fostered through accurate diagnoses, open communication, and empathetic listening. CAD can harm this trust because the patient cannot trust the CAD, which is serving as an extension of the radiologist in making diagnosis decisions. A distinction can be made between reliability and trustworthiness where consistency in decisions and behavior is a condition of reliability, but does not necessarily imply trustworthiness[55]. Trustworthy AI initiatives that focus on the removal of bias contribute to reliability under this framework.

CAD in itself cannot add to the perception of radiologist trustworthiness, since goodwill and responsibility towards the patient cannot be assumed. The CAD and the radiologist are not the same entity. The radiologist may be trusted while the CAD is not. However, while the CAD is advising the radiologist in image interpretation, it serves as an extension of the radiologist. Trust cannot be established in a radiologist who relies exclusively on CAD to make decisions in their practice. Therefore, the radiologist must be present to compensate for CAD's inability to demonstrate goodwill to patients and safeguard them from CAD unreliability and errors; for example, when identifying and communicating why a CAD recommendation has been dismissed, as with unorthodox breast placement, where CAD is known to be unreliable.

4. Conclusion

CAD can reduce some of the burden on radiologists for diagnostic decision-making in breast imaging but is not wholly consistent with the caring radiologist-patient relationship without considerable adaption of radiologist care patterns. The potential diagnostic accuracy and speed of CAD in breast imaging is impossible for human radiologists to replicate, and the potential for CAD to lessen imaging quality/frequency gaps in low-resource settings is groundbreaking. To deny patients the opportunity to receive timely care and the most correct diagnosis would be blatantly unethical. The perspective of care ethics requires maintenance of responsive relationships in which conflicts can be resolved without damage to the continuing relationship[56]. Radiologist maintenance of the radiologist-patient relationship involves administrating attentive care through disengagement with CAD during patient encounters, demonstrating competency through effective communication of CAD results, providing comprehensive ethical framing of CAD output, and establishing responsibility through caution in applying CAD diagnoses.

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