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# Call For Help! The Importance of Role Delineation in a Standardized Contrast Media Emergency Response Protocol

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With the use of intravenous contrast in medical imaging, radiologists and radiology personnel will inevitably encounter adverse events at their imaging facilities. At our institution, the stress of these emergency scenarios led to disorderly and unsafe responses by the staff. We present a quality improvement project, where our team addressed these unsafe emergency responses. Through explicit role delineation and standardization, we created an effective and efficient emergency response protocol that was replicable throughout our healthcare organization.



## Description of the Problem

At our institution's outpatient imaging center (OPIC), a patient complained of throat tightness and dyspnea following the intravenous injection of iodinated contrast for a computed tomography (CT) scan. The CT technologist stepped out of the control room to yell for help, and multiple OPIC staff quickly responded. It was immediately evident that staff members were unsure of their role in the emergency response as people stood aimlessly awaiting instructions from the radiologist. The nurse left the scan area to obtain epinephrine, delaying its administration. Once the epinephrine was obtained, its administration was further delayed as the radiologist and nurse double checked the dosing. When the radiologist asked for intravenous fluids and supplemental oxygen, multiple staff left the scan room to search for the location of these supplies. The patient's condition subsequently deteriorated, necessitating transfer to an acute care facility. When the radiologist requested that someone “call 911,” 3 staff members independently called for emergency responders, and one of the callers was unable to relay OPIC's address to the operator. Moreover, when the paramedics arrived, they had difficulty distinguishing OPIC from the surrounding, similar-appearing buildings, delaying the patient's transfer of care. Despite these delays, the patient was eventually transferred to a local emergency department and fully recovered.

With nonionic, low osmolality contrast, the incidence of acute adverse reactions is 0.2%-0.7%, and severe reactions are rarer, estimated at 0.04% in one study.[1,2] Nonetheless, all patients who experience adverse contrast reactions should be promptly assessed and treated to prevent life-threatening clinical deterioration. The American College of Radiology (ACR) regularly updates its Manual on Contrast Media, which includes treatment algorithms for patients experiencing adverse reactions to intravenous contrast.[1] Despite the availability of this resource, the literature suggests that errors still occur, and radiologists are sometimes deficient in their knowledge of emergency treatment regimens.[3,4]

In addition to insufficient knowledge of treatment regimens, as evidenced in our OPIC scenario, another potential problem source in treating contrast reactions is ineffective team dynamics and resultant care delays. Studies of code teams suggest that response times are closely linked to effective teamwork and coordination among responding team members, leading to the inclusion of formal team dynamic training into advanced cardiac life support (ACLS) courses.[5] When team members have clearly defined roles and participate in regular mock code practice sessions, response times and outcomes improve.[6]

Due to the inefficient staff response and resultant confusion during this contrast reaction incident at OPIC, our team initiated a project to improve its emergency response protocols. Using lessons learned from ACLS research, we chose two goals for our study: (1) enhance team dynamics by clearly delineating staff roles in an adverse event and (2) create a visible and standardized algorithm that ensures adherence to the ACR's treatment guidelines during high stress situations.

## Institutional Approach Employed to Address the Problem

We employed the Plan-Do-Study-Act methodology to improve our emergency response protocol. To achieve our two goals, our Plan

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was to: (1) create a poster that listed the response steps for common adverse events at OPIC. Not only would the poster detail specific treatment algorithms, including medication doses and administration routes, but it would also explicitly delineate staff roles and list the facility's address for 911 callers. We also planned to: (2) construct an intercom system that would facilitate communication between the CT/magnetic resonance imaging (MRI) technologists and nursing, thereby expediting staff response. Because we experienced delays in obtaining the epinephrine, supplemental oxygen, and intravenous fluids, we planned to: (3) consolidate an emergency response kit and designate a storage location in OPIC. Finally, to reinforce understanding of this new role-delineated protocol, we planned to: (4) hold regular mock drills.

Success of this project was measured via a 3 question survey with Likert scores of 1-5 (1 = not comfortable/unknown, 5 = very comfortable/well known):

1. How comfortable would you feel if you had to respond to an emergency in the imaging center?
2. Do you know your role during an emergency response?
3. Do you know your resources if you have questions about the emergency response procedure in the imaging center?

We planned to distribute this survey to the OPIC staff at baseline, immediately after introduction of our new emergency response protocol, and after each mock drill. A Likert score of 4 or higher was deemed successful in achieving competence with the protocol.

In the project's Do phase, we: (1) created our emergency response algorithm poster (Fig 1), as adapted from the ACR Manual on Contrast Media.[1] The poster listed response steps for 3 of the most common adverse events experienced at OPIC: contrast media (allergic-like) reactions, contrast extravasation, and vaso-vagal reactions. Importantly, each step was color-coded to explicitly identify the staff member responsible (eg, blue = nursing, orange = CT/MRI technologist). Copies of the poster were placed prominently in the CT room, MRI room, and other key areas, where relevant staff and patients localize.

(2) As the second step of the Do phase, for an intercom system between CT/MRI and nursing, we purchased an alarm unit that was remotely triggered by a single, large button. The button was placed in the CT/MRI control room, and the alarm unit was placed in the patient

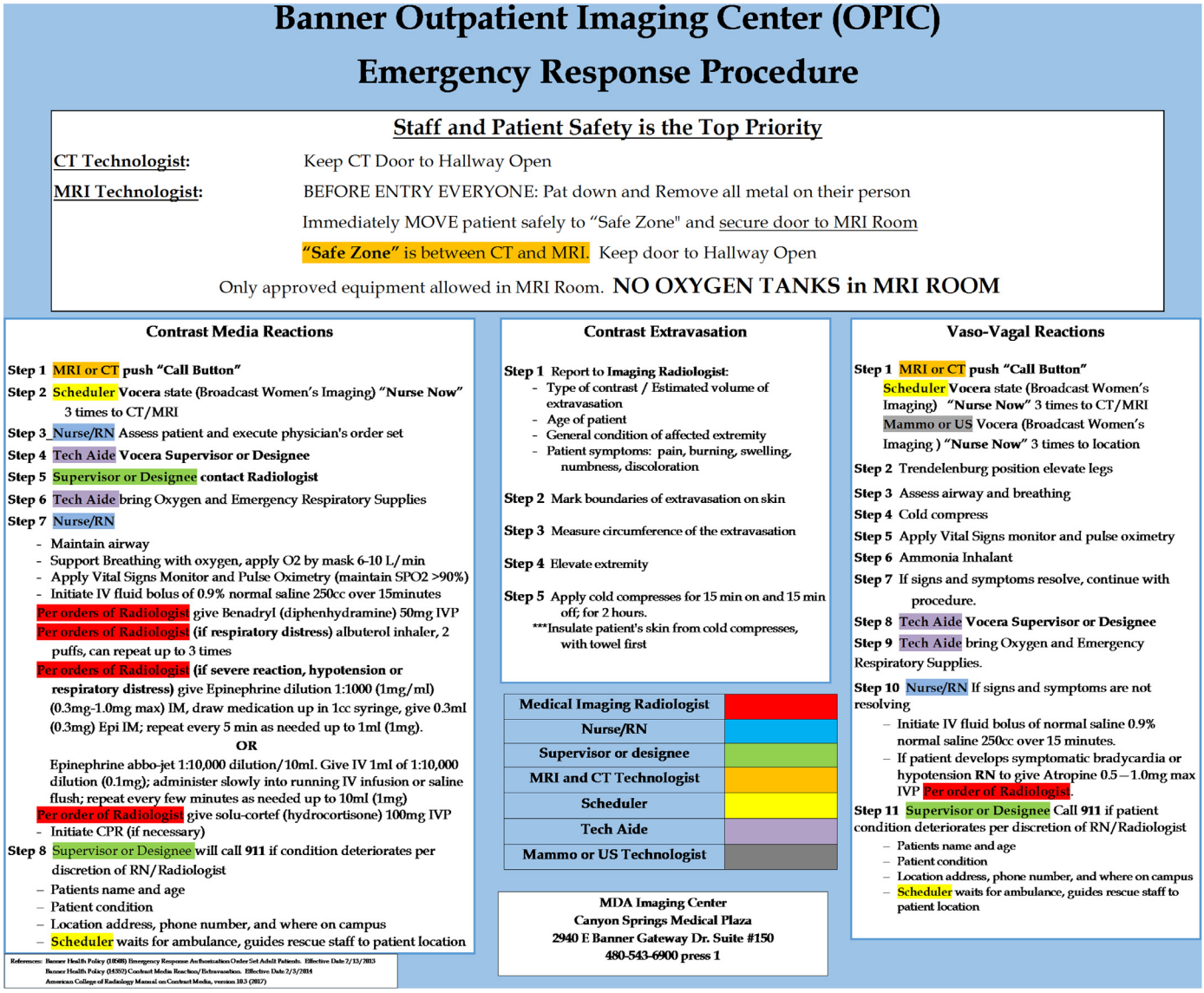


**FIG 1.** Emergency response poster created at our outpatient imaging center. The poster explicitly delineates staff roles via a color-coding system, and it lists treatment algorithms for contrast media (allergic-like) reactions, contrast extravasation, and vaso-vagal reactions, as adapted from the ACR Manual on Contrast Media.[1] (Color version of figure is available online.).

**TABLE 1**
OPIC staff survey responses in regards to comfort level in responding to an intravenous contrast adverse event. Surveys were taken at baseline, immediately after a new protocol implementation meeting, and following a mock drill three months after protocol implementation[a]

| | Preintervention/Baseline (n = 18) | Postintervention/Immediately After First Meeting (n = 18)[b] | After Mock Drill (n = 15)[c] |
|---|---|---|---|
| **Question 1: Comfort level in responding to emergency** | 2.9 ± 1.0 | 4.6 ± 0.5 | 4.8 ± 0.4 |
| **Question 2: Know your role during emergency** | 3.1 ± 1.2 | 4.9 ± 0.2 | 4.9 ± 0.3 |
| **Question 3: Know your resources if questions about emergency response procedure** | 3.7 ± 1.1 | 5.0 ± 0.0 | 4.9 ± 0.3 |

[a]Values in the table are presented as "mean ± standard deviation."
[b]$P < 0.0001$ for each survey question when comparing the preintervention time point to the immediate postintervention time point.
[c]$P = 0.4, 0.49, 0.3$, respectively, for each survey question when comparing the immediate postintervention time point to the mock drill time point.

schedulers' office. The schedulers were chosen for this role because there is a person physically present in this office during all OPIC working hours. When alerted, the schedulers would then broadcast the alarm to the OPIC staff and notify them of the adverse event location. The technologist would remain with the patient at all times. To further decrease the response time, our team: (3) designated the nursing station as the most appropriate location for the newly created emergency response kit, since the nurse was best qualified to perform regular quality control on the equipment and to confirm medication nonexpiration. The technologist aide was tasked with retrieving this kit as necessary per the protocol. Of note, in addition to listing the facility address, the protocol tasked the schedulers with meeting the paramedics outside of OPIC, whenever 911 is called. The schedulers were chosen as they would never be directly involved with the distressed patients' care.

As per our plan, the process improvement team next organized a meeting with all OPIC staff to review the new emergency response poster and protocol. The aforementioned survey was distributed before and immediately after the meeting. Mean Likert scores were calculated and compared using a *t* test. Reported statistics are significant to the level of 0.05.

## Outcomes

The Study phase of our project consisted of reviewing the OPIC staff's survey results at baseline and immediately after the initial protocol implementation meeting. As shown in Table 1, compared to baseline, mean Likert scores increased significantly ($P < 0.0001$ for all three questions) and were all above 4 after our initial meeting, indicating successful understanding of the new protocol. Due to this initial success, we proceeded with a mock drill 3 months after the implementation meeting (step 4 of our Do phase). During the mock drill, a staff member re-enacted a patient experiencing an allergic-like reaction to intravenous contrast in the CT scan room. The CT technologist triggered the alarm button, and the staff responded as if it was a true emergency situation. Staff were encouraged to freely reference the algorithm poster, as would be expected during a true emergency. To fully test the staff's level of competency, the responding radiologist described a fictitious escalating scenario with patient deterioration, necessitating a 911 call, and alternate scenarios such as a vaso-vagal reaction. A survey was administered after the mock drill. As detailed in Table 1, the survey's mean Likert scores remained well above 4 and did not significantly differ relative to the immediate postimplementation meeting, indicating persistent understanding and competence with the protocol. On a subjective level, the staff uniformly stated that the protocol considerably decreased stress and increased their confidence during the scenario since everyone had clear, predefined roles.

In the *Act* phase of the project, the OPIC team deemed the implementation of the emergency response protocol a success. We distributed copies of the poster throughout the remainder of the facility. Additionally, to promote continued competence and training of new hires, OPIC holds semiannual mock drills. After each mock drill and true adverse events, the team holds a debriefing to further improve the emergency response protocol. For example, during a true event, the intercom system was noted to be low in power, and the schedulers barely heard the alarm. As a result, we now designated a technologist to replace the intercom battery quarterly.

## Conclusion and Future Directions

In an emergency situation, emotions and fear may cloud judgment, resulting in inefficient and potentially erroneous treatment responses. We counteracted this effect with an emergency response protocol that successfully achieved two goals: (1) significantly improved team dynamics via clear role delineation and (2) encouraged safe and standardized treatment guideline adherence through a simple poster algorithm. Notably, due to the patient safety promoted by our small scale project, our healthcare organization is widely disseminating similar emergency response protocols into other departments. For example, the inpatient floors and infusion service will be adapting our poster and role delineation model for common emergency scenarios that are specific to their areas. On a national scale, although the ACR continues to educate radiologists regarding the treatment of adverse events from contrast media, it does not include team dynamic training, such as that provided by the American Heart Association's ACLS courses. Our experience suggests that, in addition to a sound knowledge of treatment regimens, radiology practices should also consider implementing explicit emergency response team roles. Role delineation decreases team anxiety and reduces the potential for error.

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