



Evidence-based Process for Improving Resident CT Protocol Competency

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Abstract

The purpose of this project was to improve resident competency in protocolling CT studies using a web-based electronic protocol system and teaching module. Henry Ford Hospital recently implemented an electronic protocol process, allowing for quick and easy review of patient data, the original imaging request, and the appropriate available imaging protocols. An additional benefit of this electronic system is the ease of documentation and review of protocol mistakes. When a protocol mistake is identified, an override is initiated and the appropriate change is made. We reviewed protocol overrides over a 3-month period and examined the patterns of errors. A web-based PowerPoint module instructing residents how to correct those errors was instituted. The module specifically addressed protocol processing, careful request review, appropriate contrast use and volume, and those clinical scenarios where accurate protocolling may require staff involvement. All residents were assigned the module and override patterns were then re-evaluated.

Purpose and Background

Managing and understanding CT protocols are an integral part of a radiology resident education. However, differences between institutions, imaging equipment, and imaging objectives make the protocol process tedious and error prone. When protocol errors do occur, the resident who made the error is often different than the one making corrections, and thus unable to learn from the mistake. Furthermore, the intricacies of the protocol process are often difficult to teach in a didactic environment, making the learning process a “learn-as-you-go” model.

Recently, Henry Ford Hospital implemented an electronic protocol system. Beyond the numerous advantages this provides to workflow and patient throughput, the ability to easily identify errors provides a unique opportunity to improve resident competency in protocolling CT studies. Utilizing this information, our project’s intent was to design and institute an evidence-based protocol teaching module for Henry Ford radiology residents.

Methods

Using the electronic override system, we reviewed protocol overrides over a 3-month period and examined the patterns of errors. A web-based PowerPoint module instructing residents how to correct those errors was then created.

The teaching module (example cases shown below) included sets of protocol situations that the resident may encounter. The goal of the teaching module was to include cases which specifically addressed those issues most commonly requiring protocol overrides. The cases included situations that arise frequently and therefore must be understood in order for a resident to function on a day-to-day basis. Cases requiring a more advanced level of understanding were also included.

Residents were then assigned to complete the online module. Following completion of the module by all residents, the number of protocol overrides were again analyzed over a 5 week period.

The Protocol System – How it Works

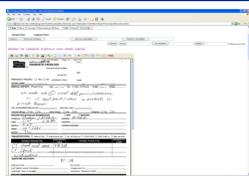


Fig. 1

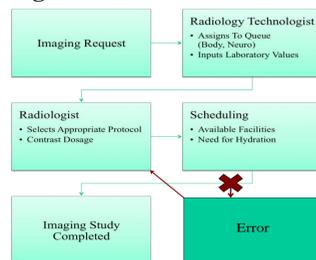


Fig. 4

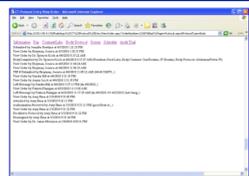


Fig. 2

Fig. 1 – Web-based protocol site. Here the resident can review the request, recent labs, and select the appropriate protocol.

Fig. 2 – Audit trail. Here actions taken by the technologists and radiologists are documented (including overrides).

Fig. 3 – Protocols. All applicable protocols are available for the radiologist to select. In addition, special instructions can be input at this time.

Fig. 4 – Flow chart of the protocol process.

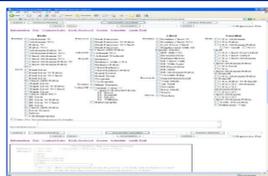


Fig. 3

Results

Over the initial three month period, over 6600 imaging studies were protocollated with 224 (3.4%) overrides reported. Common errors included issues with patient contrast allergy (10%), contrast use or contrast volume reduction (26%), and inappropriate protocol being selected (52%). This information allowed for the successful implementation of an evidence-based online teaching module.

During the 5 week period following implementation of the teaching module, the rate of overrides fell to 2.8% (107 overrides of 3800 studies completed), an 18% reduction.

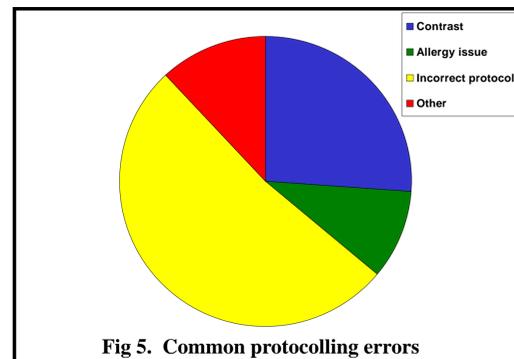


Fig 5. Common protocolling errors

Conclusion

Improving resident competency in protocolling imaging studies is an important part of radiology resident education. Yet as the protocol process becomes more complex, the “learn-as-you-go” model no longer suffices as a teaching method.

By utilizing the electronic protocol system, we were able to readily identify resident weaknesses in protocolling and create an evidence-based teaching module addressing those areas. After implementing this module in our residency program we observed a significant reduction in protocol errors as evidenced by the decreased number of protocol overrides.

Given our success in reducing protocolling errors, we plan to continue using the protocol system to identify additional errors and further enhance our teaching module. We hope to permanently integrate this module into our radiology resident curriculum. Evidence-based modules such as this, which emphasize case-based learning, may one day become a standard part of the radiology resident education.

Teaching Module – Example Cases

CT Protocol Teaching Module	Teaching Module Goals	Case 1	Case 1 - Explanation	Case 2	Case 2 - Explanation
Henry Ford Hospital Brent Griffith, Jim Morrison, Eric Spickler	<ul style="list-style-type: none"> Increase resident competency regarding the selection of CT protocols, including: <ul style="list-style-type: none"> Protocol choice for common indications. Use of specialized protocols. Develop an understanding of the Henry Ford Health System (HFHS) policy regarding: <ul style="list-style-type: none"> Prevention of contrast-induced nephropathy. Management of contrast allergies. Increase resident proficiency in navigating the electronic protocol system. 	67-year-old male with 6 mm pulmonary nodule seen on prior CT. What protocol should be used for the follow-up CT? <ul style="list-style-type: none"> CT Chest with contrast CT Chest without contrast CT Chest – low dose with contrast CT Chest – low dose 	CT Chest – low dose (nodule protocol) <ul style="list-style-type: none"> A non-contrast, low mA technique should be used when follow-up of a lung nodule is the only indication for the CT examination. The benefit of the low-dose (nodule) protocol is reduced radiation dose and no need for IV contrast. If it is not clear if a prior CT was obtained, this information should be obtained prior to protocolling the study. 	56-year-old female hospitalized with acute renal failure requiring hemodialysis now with abdominal pain. GFR 26 ml/min. Physician requests CT Abdomen/Pelvis without contrast. What is the correct protocol? <ul style="list-style-type: none"> CT Abdomen/Pelvis with routine IV contrast CT Abdomen/Pelvis with reduced IV contrast CT Abdomen/Pelvis with reduced IV contrast and hydration CT Abdomen/Pelvis without IV contrast 	CT Abdomen/Pelvis without contrast <ul style="list-style-type: none"> Although it is HFHS policy that contrast can be given to patients on dialysis, this does not apply in the setting of acute renal failure. In the setting of acute renal failure, IV contrast should be withheld as it will be detrimental to the patient’s recovery of renal function.
Case 3	Case 3	Case 3 - Explanation	Case 3 - Explanation	Case 4	Case 4 - Explanation
58-year-old female with history of breast cancer presents with shortness of breath. Clinician requests PE CT to rule out pulmonary embolism. GFR is 44 ml/min. What is the correct protocol?	PE protocol CT with standard IV contrast and hydration	<ul style="list-style-type: none"> Per HFHS guidelines, contrast should not be reduced for Pulmonary Embolism CT as this may significantly diminish the quality of the exam. 	HFH guidelines for prevention of contrast-induced nephropathy <ul style="list-style-type: none"> GFR > 60 - Proceed with the exam in normal fashion. GFR 46 - 59 - Contrast reduction (per HFH guidelines) <ul style="list-style-type: none"> Hydration should be utilized in this range for studies that require full contrast volume (Dual/Triples Phase Liver CT and Pulmonary Embolism CT). Hydration is not necessary when reduced IV contrast volume is utilized. GFR 30 - 45 - If protocollated in advance, use hydration protocol and contrast volume reduction. <ul style="list-style-type: none"> If protocollated immediately before scanning, must be done as non-contrast exam or rescheduled with hydration and IV contrast. GFR < 30 - The use of IV contrast is contraindicated in these patients. <ul style="list-style-type: none"> IV contrast should only be used under specific circumstances where it is a necessity and a risk-benefit discussion has occurred with informed consent. 	52-year-old male status post radiofrequency ablation of a hepatocellular carcinoma. The radiology request form states CT liver. What is the correct protocol? <ul style="list-style-type: none"> IR Liver IR Liver with pelvis Dual Phase Liver Triple Phase Liver 	IR Liver <ul style="list-style-type: none"> Interventional radiology has requested that cases of liver neoplasm in which IR was involved have non-contrast images through the entire liver before the dual phase exam. This would include follow up exams with history of: <ul style="list-style-type: none"> Radiofrequency ablation Cryoblation Drug dosing bead embolization Blind embolization Therapies The IR liver protocol includes noncontrast images of the entire liver followed by a standard dual phase exam with delayed kidneys. The main utility of the IR liver protocol is to determine if the lesions are truly enhancing as they may have high attenuation blood product or coagulative necrosis from prior intervention.
Post-Module Self Assessment	2. Which of the following does not require a dual phase liver CT for evaluation of possible liver involvement? <ol style="list-style-type: none"> Breast cancer Melanoma Carcinoid Renal Cell Carcinoma Thyroid Carcinoma 				