Original Article

A quality improvement project: Reducing the number of unnecessary plain abdominal radiographs performed in the emergency department of a London district general hospital

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Abstract

Background: Inappropriate completion of abdominal radiographs results in unnecessary exposure to ionizing radiation. This quality improvement project aimed to reduce the number of inappropriate abdominal radiographs performed in the emergency department. **Materials and methods:** Abdominal radiograph request forms were analyzed with reference to the Royal College of Radiologists (RCR) iRefer guidance. A teaching session was then delivered to ED clinicians and posters were disseminated within the department. Post-intervention data collection followed. **Results:** Following the intervention, there was an increase in the proportion of abdominal radiographs meeting iRefer guidance, which was accompanied by an increased diagnostic yield of these investigations. There was a reduction in the number of requests post-intervention. **Conclusions:** Our interventions helped increase awareness of both the guidelines and radiation dose associated with each study. Routine education of the iRefer guidelines will help reduce inappropriate requests. This in turn will reduce unnecessary radiation exposure, whilst also reducing the financial burden.

Keywords: Abdominal radiographs, audit, emergency department, ionizing radiation, iRefer guidelines, quality improvement

Introduction

Plain abdominal radiographs are commonly performed in the emergency department (ED). Historically, abdominal radiographs were the investigation of choice for all cases of abdominal pain.[1] However, Eisenberg *et al.*[2] reported that only 10% of a cohort of 1,780 patients with acute abdominal pain had a positive radiological finding on the abdominal radiograph. Similarly, other studies from the 1980s revealed the vast proportion of abdominal radiographs performed to investigate non-specific abdominal pain, nausea, and vomiting, were either normal or showed unrelated positive findings.[3,4] Guidelines were published by the Royal College of Radiologists (RCR) in 1,988 to promote the effective use of radiological investigations.[5]

RCR guidelines (iRefer guidelines) for the appropriate use of abdominal radiographs in the hospital setting have been further refined and updated over recent years, most recently in 2017 [Table 1].[6] Interestingly, the American College of Radiology (ACR) guidelines for the use of abdominal radiographs are more restrictive. In particular, ACR guidelines state that

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Received: 17-06-2021 **Revised:** 20-09-2021
Accepted: 27-09-2021 **Published:** 31-01-2022

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_1193_21

How to cite this article: Kyriakides J, Khamar R, Khani A, Khatkar H. A quality improvement project: Reducing the number of unnecessary plain abdominal radiographs performed in the emergency department of a London district general hospital. J Family Med Prim Care 2022;11:190-3.

Table 1: Royal College of Radiologists (RCR) iRefer guidelines

RCR guidelines for the use of pain abdominal radiography:
Clinical suspicion of obstruction
Acute exacerbation of inflammatory bowel disease
Palpable mass (specific circumstances)
Constipation (specific circumstances)
Acute and chronic pancreatitis (specific circumstances)
Sharp/poisonous foreign body
Smooth and small foreign body, e.g., coin, battery (specific circumstances)
Blunt or stab abdominal injury (specific circumstances)

computed tomography (CT) is more appropriate than plain abdominal films in suspected bowel obstruction.[7]

Morris-Stiff *et al*.[8] reported that 76.7% of abdominal radiographs had a positive finding when RCR guidelines were adhered to, compared to 8.9% when guidelines were not followed. As such, RCR guidelines improve the diagnostic yield of this radiological investigation.[8] It is important to note that this study was based on RCR guidelines from 2003.[8]

There are a number of reasons supporting the appropriate use of abdominal radiographs in the ED. Each film is associated with a radiation dose of 0.5–0.7 mSv, which is equivalent to approximately 35 chest radiographs.[9] As well as unnecessary exposure to ionizing radiation, inappropriate abdominal radiographs result in inefficient use of resources. Finally, inappropriate completion of abdominal radiographs may delay the completion of more appropriate imaging such as CT or ultrasound.

This quality improvement project aimed to first evaluate the proportion of inappropriate plain abdominal radiograph requests in the ED of a London district general hospital. Following the intervention, the aim was to reduce the number of inappropriate abdominal radiographs performed.

Materials and Methods

An initial audit involved retrospective analysis of plain abdominal radiographs performed in the ED of a London district general hospital in a one-month period. Radiographs performed in patients under the age of 18 were not included in this audit. Furthermore, follow-up images were not included in this audit. Ethical permission not required for completion of quality improvement project (http://www.hra-decisiontools.org.uk/research/docs/DefiningResearchTable_Oct2017-1.pdf

Electronic request forms for completed abdominal radiographs were analyzed, and the documented indication was compared to RCR iRefer Guidelines. The number of images taken per study was noted, and their reports (reported by either a reporting radiographer or radiologist) were analyzed. The patient's notes were explored to understand the final diagnosis, and hence decide whether the abdominal radiograph was diagnostic in itself or whether the radiograph aided clinical management in some way.

On completion of the first cycle of this audit, a teaching session was delivered to ED clinicians. This teaching session focussed on the iRefer guidelines, but also highlighted the findings of the results of the first cycle of the audit. Further, this teaching session highlighted the importance of adherence to iRefer guidelines, particularly with regards to the risks of unnecessary ionizing radiation. In addition, posters were disseminated within the ED and uploaded to the departmental shared computer drive (of which all clinicians have access) for future reference.

Post-intervention data collection followed over a one-month period. The same exclusion criteria were used. Abdominal radiograph requests, images, reports, as well as patient notes, were analyzed with regards to the same set of criteria as the first cycle.

Institutional permission for the completion of this quality improvement project was granted.

Results

There were 71 abdominal radiographs performed in the one-month period prior to intervention, and 60 abdominal radiographs performed in the one-month period following the intervention, representing a 15% reduction post-intervention. The proportion of abdominal radiograph studies including more than one image were 52% and 55% in the two cycles respectively.

In both cycles, the majority of abdominal radiographs requests had more than one indication documented. Before the intervention, 72% of abdominal radiograph requests forms listed two indications. 70% of abdominal radiographs request forms listed two indications post-intervention. Following intervention, there was an increase in the proportion of plain abdominal radiograph requests with at least one indication meeting RCR iRefer guidelines, from 79% to 87% [Figure 1].

The patient's notes were analyzed to evaluate whether the abdominal radiographs were diagnostic in themselves, or whether they aided clinical management in some way. Prior to intervention, 27% of abdominal radiographs were diagnostic, increasing to 47% following intervention [Figure 2]. Prior to intervention, 50% of abdominal radiographs aided clinical management in some way, through either confirming a differential diagnosis with the presence of positive radiological findings or ruling out a differential diagnosis with the absence of radiological findings [Figure 2]. This increased to 70% post-intervention [Figure 2].

Discussion

The RCR iRefer guidelines specify appropriate indications for the completion of abdominal radiographs. This quality improvement project aimed to reduce the number of inappropriate radiographs performed in the ED of a London district general hospital, subsequently improving the diagnostic yield of this investigation. We have shown that our intervention, consisting of a teaching

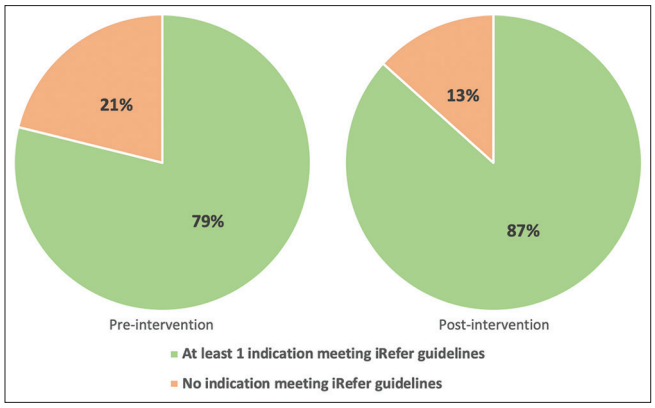

Figure 1: The proportion of abdominal radiographs meeting iRefer guidelines

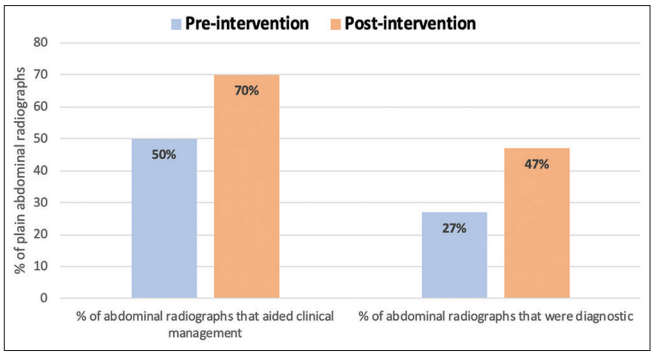

Figure 2: The proportion of abdominal radiographs aiding clinical management and diagnosis

session and dissemination of physical and electronic posters, resulted in a reduction in the total number of abdominal radiographs performed in the ED by 15%. This was accompanied by an increase in the proportion of electronic request forms meeting RCR iRefer guidance. Furthermore, there was a 20% increase in the proportion of these films aiding clinical management, as well as a 20% increase in the proportion of these films being diagnostic themselves.

Inappropriate completion of abdominal radiographs in the ED exposes patients to unnecessary ionizing radiation. The radiation dose of the average abdominal radiograph study is equivalent to 35 chest radiographs, which corresponds to a quarter of the normal background radiation dose per year.[9] Although difficult to accurately calculate, the risk of inducing fatal malignancy from an abdominal radiograph is estimated to be 1:30,000, in comparison to a risk of 1:1,000,000 for a chest radiograph and 1:2,000 for a CT scan of the abdomen and pelvis.[10] Although this risk is relatively low, it is important to consider when contemplating the huge number of abdominal radiographs being performed. Furthermore, over half of the abdominal radiographs performed in our study included more than one image to gain adequate exposure of the abdomen, which has further implications when considering unnecessary radiation exposure.

Unnecessary completion of abdominal radiographs results in the inefficient use of resources in a healthcare system. In the first cycle of the audit, only half of the abdominal radiographs aided clinical management. A large volume of radiographs performed therefore did not provide any clinical benefit. Completion of abdominal films may delay the time to a more suitable investigation that could provide diagnostic certainties, such as ultrasound scan or CT. With ultra-low-dose CT abdomen studies being a suitable alternative to abdominal radiographs in some pathologies, their preferential use over abdominal radiographs makes a compelling argument.[11]

A large proportion of abdominal radiograph request forms in this study listed constipation as an indication. Although an accepted indication as per RCR iRefer guidance, it should be recognized that the presence of stool in the colon of an abdominal radiograph does not provide a diagnosis of constipation.[6] A retrospective study by Driver *et al*.[12] revealed that the majority of patients who attended the ED and were subsequently diagnosed and treated for constipation had a normal radiograph with no or minimal stool burden. As such, abdominal radiographs performed in these patients did not play a beneficial role in their management.[12] A diagnosis of constipation should instead be made following a thorough clinical assessment involving a description of the type of stools as well as the effect on the quality of life.[13]

The intervention in this quality improvement project involved providing ED clinicians with further education. A teaching session was held, focussing on iRefer guidelines and the consequences of inappropriate radiological investigations. Posters were disseminated within the department and uploaded onto the departmental computer shared folder for future reference. This intervention resulted in a reduction in the total number of abdominal radiographs performed, which was accompanied by an increase in the proportion of requests meeting iRefer guidance. These results support previous studies, including a systematic review showing that despite abdominal radiographs being a beneficial imaging modality in the ED, their use could be substantially reduced for some presenting complaints.[14] Furthermore, our results support studies that have reported a higher diagnostic yield of abdominal radiographs when RCR guidelines are followed.[8]

This quality improvement project did have some possible limitations. The teaching session given to ED clinicians was given on one occasion, and hence not all ED clinicians were able to attend this session due to ED shift patterns. The dissemination of physical and electronic posters aimed to target this cohort of clinicians. Furthermore, poor completion of radiology request forms is known to exist, especially in busy departments.[15] Thus, the lack of an indication on the request form may not have correlated with the true absence of clinical indication.

Conclusion

This quality improvement project helped facilitate the better use of abdominal radiographs within the ED through increasing awareness of guidelines and radiation exposure. We propose that routine education of the iRefer guidelines amongst primary care clinicians will help reduce inappropriate requests. This is turn will reduce unnecessary exposure, whilst also reducing the financial burden. Future developments should utilize the move towards electronic note keeping within a number of different primary care settings; the use of electronic proformas to incorporate into patient's notes can aid both documentation and clinical decision making.

Ethical statement

There were no ethical concerns in the undertaking of this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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