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The evaluation of compliance with iRefer guidelines for abdominal imaging and the impact of the normal abdominal radiograph on the clinical confidence and decision making of emergency clinicians

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ABSTRACT

Introduction: Attendance of adult patients to the Emergency Department (ED) with acute abdominal pain is a frequent event. Abdominal X-ray imaging (AXR) is commonly the first line of investigation but previous studies have suggested that the AXR has no place in assessing acute abdominal pain because of its low diagnostic yield and limited contribution to direct clinical decision making. However, no evaluation of the impact of a negative AXR on the clinical confidence and decision making of emergency clinicians has been undertaken. This study aims to fill this gap.

Method: A self-designed paper questionnaire was distributed to medical clinicians on ED placement at a single NHS trust in the South of England. The survey sought to explore the impact of the negative AXR on clinical confidence and decision making and compliance with iRefer guidelines for referring to alternative imaging modalities (ultrasound and computed tomography) should the option to refer for AXR be restricted.

Results: A total of 28 (n = 28/41; 68.3%) completed questionnaires were returned. Most clinicians (n = 18/28; 64.3%) indicated that negative AXR had little impact on their clinical decision making although a small majority (n = 10/18; 55.6%) acknowledged it provided greater clinical confidence in their decision making. Variable compliance with iRefer guidelines for referral to ultrasound and computed tomography was noted.

Conclusion: Whilst the negative AXR did not impact on the clinical decision making of most ED clinicians, it did increase clinical confidence. Consequently, the AXR should remain a referral option in the workup for adult patients presenting with acute abdominal pain to the emergency department.

Background

Acute abdominal pain is the presenting complaint for approximately 4–10% of patients attending the emergency department (ED).[1–4] X-ray imaging of the abdomen (AXR) has traditionally been the first line of investigation for acute abdominal pain[3–6] despite its low diagnostic yield and limited contribution to directing clinical decision making.[3,4] While there is some evidence that the AXR may be a beneficial diagnostic tool for limited clinical indications such as suspected bowel obstruction[3,4,6] or ingested radio-opaque foreign body,[4,6] indiscriminate referral for AXR should be discouraged[6] and the AXR undertaken only where the outcome will aid diagnosis, influence clinical management and increase diagnostic certainty.[2]

The iRefer guidelines,[7] published by the Royal College of Radiologists provides graded evidence-based guidance intended to assist referring clinicians to determine the most appropriate imaging investigation(s) for their patients and ensure the benefits of imaging outweigh the risks of radiation exposure. The AXR has a relatively high radiation exposure (approximately 0.7 mSv)[8] when compared to other single projection X-ray image examinations and therefore referral should only be made where the image and its findings are necessary to inform the patient treatment pathway. However, studies have suggested that clinician compliance with iRefer guidelines is low[9,10] with evidence suggesting that, with respect to the AXR, poor compliance reduces the diagnostic impact of the examination[10] resulting in delay to patient treatment[4,5,10,11] and poor clinical outcomes.[11,12]

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Importantly, despite the AXR being a regular ED referral, the examination may be considered to have minimal clinical value as a consequence of poor clinician interpretation,[3] a reported high level of false negative interpretations[11] and the 'normal' status of many radiological reports.[5] Shreedharan et al.[5] (2014) considered the impact of the AXR radiological report on clinical decision making within the ED setting and suggested that, as most AXR examinations are reported as 'normal', the AXR did not reassure the clinician that no pathology was present. Indeed, in this study[5], 41% of patients with a 'normal' AXR (n = 34/82) were referred for additional imaging with 18 of these (n = 18/34; 53.0%) having abnormal findings. The sub-optimal referral pattern for both initial and follow-up imaging was considered by Shreedharan et al.[5] to be a result of poor clinician understanding of referral guidelines with only 16% (n = 3/19) of ED clinicians having awareness of the iRefer guidelines. Shreedharan et al.[5] concluded that poor clinician understanding of the referral guidelines leads to unjustified imaging requests and an inefficient service to patients. Two further studies have also demonstrated low compliance with iRefer guidelines for AXR referral (approximately 30% compliance)[9,10] suggesting that these issues are widespread. As a result, it has been suggested that the AXR should have no role in the workup for acute abdominal pain.[1,3,4,11]

In response to the published evidence, the large volume of AXR referrals from our local ED, and high proportion of these reported as 'normal', we decided to evaluate the impact of restricting the option for AXR referral for patients attending the ED with acute abdominal pain. However, as uncertainty existed over the value of the 'normal' AXR to clinical decision making and patient treatment pathways locally, we needed to ascertain the clinical value of the 'normal' AXR in supporting ED clinical decision making. This single site study reports the results of a survey undertaken to consider this, in addition to referral patterns across ED clinical grades and knowledge of iRefer guidelines, to determine whether restricting the option to refer for AXR is an appropriate action.

Method

The research was performed at a single NHS Trust hospital in the South of England. Between September 2016 and August 2017 inclusive, approximately 67,000 adult patients attended the hospital ED. Of these, abdominal pain was the presenting complaint in 2900 cases (n = 2900/67,000; 4.3%), an incidence figure lower than has been previously reported.[1–4]

This study was an extension of an existing service evaluation registered with the Trust Research and Development department and following consultation they deemed that external ethical approval was not required. The over-arching intention was to reduce the number of AXR examinations undertaken from ED referrers and improve the service provided to patients by increasing compliance with iRefer guidelines.

A survey approach was adopted using a self-designed paper-based questionnaire to understand the imaging referral practice of clinicians for adult patients presenting with acute abdominal pain. The questionnaire considered the role, experience and knowledge of referrers as well as incorporating a series of behaviour/belief questions with likelihood measured using a five-point Likert scale.[13] In addition, respondents were asked to consider a series of clinical signs and symptoms and determine whether referral to computed tomography (CT) or ultrasound was appropriate. These questions were based upon the iRefer guidance and were included to establish the level of clinician knowledge regarding appropriate referral to alternate imaging modalities should the option for AXR referral be restricted.

The questionnaire was piloted prior to distribution by two consultant radiologists and a senior radiographer who considered the questions for parity and pertinence. Some minor amendments to question phrasing and formatting were made following feedback. All ED clinicians (n = 41) on rotation in the hospital Trust at the time of the study were invited to take part in the survey and there were no exclusions.

Paper copies of the questionnaire were chosen over online distribution as we felt that access to a paper version would increase the response rate from ED clinicians. The study was introduced, and questionnaire distributed, to ED clinicians in mid-July 2017 following discussion with the lead consultant and staff briefing with a return date of 2 weeks later. To capture the wide range of AXR referral experience, the study was also introduced, and questionnaire distributed, to new clinicians (F2 and SpR) as part of their induction during the 1st week of August 2017 with a return date of one week later. The researchers regularly promoted the study to the clinicians throughout the data collection period to encourage completion and ensure a good response rate.

Participants were assured that data collected was confidential and completed questionnaires were collected in a sealed post-box placed within a locked office accessible only to ED staff. This was to ensure security of the completed forms. Data from the questionnaires was entered into a Microsoft Excel (version 16.0)[14] database. The research team individually inputted batches of data from the questionnaires and each double checked their entries to ensure accuracy of transcription. In addition, the lead researcher checked all data entry values for six questionnaires (n = 6/28; 21.4%), selected at random throughout the database, to determine accuracy of database entries. A data item error rate of 2% was considered the threshold value below which database accuracy was assumed. Data were analysed using descriptive statistics to summarise proportional variations between referrer groups. Further analysis using Chi Squared test[15] was undertaken to evaluate any relationship between referrer group and outcome of interest.

Results

Of the six questionnaires checked for data quality, four data cells (n = 4/256) were completed incorrectly giving an error rate of 1.6%. This was within the data item error rate tolerance and therefore accuracy of database was assumed.

A total of 28 clinicians completed and returned the questionnaire within the allocated timeframe (n = 28/41; 68.3%). They consisted of 10 consultants, five specialist registrars (SpR) and 13 foundation year 2 (F2) doctors. Most respondents were less than 40 years of age (n = 24/28; 85.7%), male (n = 17/28; 60.7%) and had less than 6 years clinical experience (n = 15/28; 53.6%). Only four respondents (n = 4/28; 14.3%) had undertaken a surgical rotation prior to their placement in the ED and one clinician had trained outside of the United Kingdom (n = 1/28; 3.6%).

All consultant clinicians (n = 10/10; 100%) completed the questionnaire. No statistical significance in response rate between the F2 (n = 13/19; 68.4%) and SpR (n = 5/12; 41.7%) grade doctors was noted (Chi square $\chi^2 = 2.162$; p = 0.142). Clinicians were asked if a negative (normal) abdominal X-ray image would influence their clinical decision-making confidence in relation to managing an adult patient presenting to the ED with acute abdominal pain for the first time using a 5-point Likert scale. Response options were "greatly increases clinical confidence, increases clinical confidence, no change in clinical confidence, reduced clinical confidence and greatly reduced clinical confidence". The majority (n = 18/28; 64.3%) indicated that a negative (normal) abdominal X-ray image increased their clinical confidence (see Table 1) with the greatest increase in confidence being reported by F2 (76.9%; n = 10/13) and consultant grade doctors (60.0%; n = 6/10). No statistical significance was noted in the reported impact of a negative AXR on

Table 1
The impact of negative AXR on clinical confidence.

Clinician grade	Impact on clinical confidence		
	Increased n (%)	No change n (%)	Total
F2	10 (76.9)	3 (23.1)	13
SpR	2 (40.0)	3 (60.0)	5
Consultant	6 (60.0)	4 (40.0)	10
Total	**18 (64.3)**	**10 (35.7)**	**28**

n = number of respondents.

clinical confidence between the three clinician grades (Chi square $\chi^2 = 2.269$; $p = 0.322$). No clinician suggested negative AXR reduced their clinical confidence.

Only 32.1% of respondents (n = 9/28) had awareness of the iRefer guidelines[7] for appropriate imaging referrals (see Table 2) with the F2 grade clinicians being least likely to be aware of referral guidelines.

There was borderline statistical significance in the awareness of the iRefer guidelines between the three grade doctors (Chi square $\chi^2 = 5.570$; $p = 0.062$) with consultant clinicians being more likely to be aware of imaging referral guidelines.

Awareness of the iRefer guidelines does not in itself indicate the appropriateness of the imaging referral pathway. CT and ultrasound may also have a diagnostic role to play in the assessment of acute abdominal pain depending on presenting symptoms and clinical indications.[7] To determine knowledge of appropriate alternative imaging examinations, the 7th edition of the iRefer guidelines was used. While we are aware of the publication of the 8th edition of these guidelines,[16] at the time of data collection the hospital Trust had not purchased a license to access these online and therefore the 7th edition was the most recent version accessible to clinicians.

To assess the impact of restricting the option to refer for AXR on appropriate referral to alternative imaging modalities, we asked respondents to identify which indications would lead them to refer to CT or ultrasound rather than AXR. Abdominal clinical indications were selected from the iRefer guidance[7] and identified as appropriate for ultrasound, CT or both modalities. For clarity, clinician responses have been separated by imaging modality (see Tables 3 and 4). Responses were separated by clinician grade.

For justified ultrasound indications, a high level of compliance was seen for cholecystitis, gallstones and jaundice across all medical grades. Good compliance was also seen for appendicitis. Interestingly, despite apparent lack of awareness of iRefer guidelines, a greater proportion of F2 clinicians recognised suspected acute pancreatitis as being a justified indication for ultrasound referral. Considering non-justified indications, F2 doctors were more likely to refer inappropriately for renal colic. Most clinicians (n = 27/28; 96.4%) correctly identified that bowel obstruction was not an indication for ultrasound and no clinician indicated they would refer a patient for ultrasound with a suspected acute gastrointestinal (GI) bleed.

For justified CT indications, a greater variation in degree of compliance was noted with greatest referral compliance being for suspected perforation. No clinician correctly identified a suspected GI bleed as an appropriate indication for CT referral. Considering non-justified indications, most clinicians would inappropriately refer for CT for cholecystitis but generally there was good compliance with iRefer guidelines for appendicitis, jaundice and gallstones.

An overview of the data showed a similar level of referral compliance for both ultrasound and CT across all clinical grades. Importantly, no clinician attained 100% compliance with iRefer guidelines and the best individual performance was achieved by a F2 grade doctor with 1–5yrs clinical experience.

Finally, we assessed clinician perceived impact of a negative abdominal X-ray image on their clinical decision making (see Table 5).

Interestingly, while many clinicians of all grades indicated that a negative (normal) AXR would never or rarely impact on their clinical decision making (n = 18/28; 64.3%), 10 of these clinicians (n = 10/18; 55.6%) reported that a negative AXR increased their clinical confidence. This suggests that while clinicians may consider their clinical decision-making to be unaffected by a negative AXR, their confidence and certainty in that clinical decision may be affected potentially influencing referral for further diagnostic tests.

Table 2
Respondent awareness of iRefer guidelines.

	Awareness of iRefer guidelines		Total
	Yes	No	
Clinician grade			
F2	2	11	(n = 2/13; 15.4%)
Specialist Registrar	1	4	(n = 1/5; 20.0%)
Consultant	6	4	(n = 6/10; 60.0%)
Total n (%)	9 (32.1%)	19 (67.9%)	100%

Table 3
Appropriateness of ultrasound referral based on iRefer recommendations.[7]

Ultrasound	Clinician Grade		
	F2 (%)	SpR (%)	Consultant (%)
Justified Indications			
Acute abdominal pain	5 (38.5)	1 (20.0)	0 (0)
Abdominal sepsis	2 (15.4)	0 (0)	0 (0)
Appendicitis	8 (61.5)	5 (100)	6 (60.0)
Cholecystitis	12 (92.3)	5 (100)	8 (80.0)
Gallstones	13 (100)	5 (100)	8 (80.0)
Jaundice	13 (100)	4 (80.0)	6 (60.0)
Suspected acute pancreatitis	9 (69.2)	1 (20.0)	1 (10.0)
Non-justified Indications			
Acute GI bleed	0 (0)	0 (0)	0 (0)
Perforation	1 (7.7)	0 (0)	0 (0)
Renal colic	7 (53.8)	0 (0)	3 (30.0)
Small bowel obstruction	0 (0)	0 (0)	1 (10.0)
Large bowel obstruction	0 (0)	0 (0)	1 (10.0)

Table 4
Appropriateness of CT referral based on iRefer recommendations.[7]

CT	Clinician Grade		
	F2 (%)	SpR (%)	Consultant (%)
Justified Indications			
Acute abdominal pain	11 (84.6)	3 (60.0)	2 (20.0)
Abdominal sepsis	9 (69.2)	4 (80.0)	4 (40.0)
Acute GI bleed	0 (0)	0 (0)	0 (0)
Perforation	12 (92.3)	5 (100)	5 (50.0)
Renal colic	8 (61.5)	4 (80.0)	5 (50.0)
Suspected acute pancreatitis	4 (30.8)	3 (60.0)	4 (40.0)
Small bowel obstruction	10 (76.9)	2 (40.0)	5 (50.0)
Large bowel obstruction	10 (76.9)	2 (40.0)	5 (50.0)
Non-justified Indications			
Appendicitis	3 (23.1)	0 (0)	2 (20.0)
Cholecystitis	12 (92.3)	5 (100)	8 (80.0)
Gallstones	1 (7.7)	0 (0)	0 (0)
Jaundice	5 (38.5)	1 (20.0)	0 (0)

Discussion

While this paper reports the findings of a small, single site study, this is the first paper to consider the impact of a normal or negative AXR on clinical decision making and patient pathway beyond radiology. Importantly, while 18 clinicians indicated that a negative

Table 5
Clinician perceived impact of negative AXR on clinical decision making.

Clinician Grade	Clinician perceived impact of negative AXR on clinical decision making				
	Never n (%)	Rarely n (%)	Sometimes n (%)	Often n (%)	Total
F2	0	7 (53.8)	3 (23.1)	3 (23.1)	13
SpR	0	4 (80.0)	1 (20.0)	0	5
Consultant	1 (10.0)	6 (60.0)	3 (30.0)	0	10
Total	**1 (3.6)**	**17 (60.7)**	**7 (25.0)**	**3 (10.7)**	**28**

n = number of respondents.

AXR would not impact on their clinical decision making, the majority of these (n = 10/18; 55.6%) indicated that it provided greater confidence in the appropriateness of their decision making resulting, one could argue, in improved patient care. This increase in confidence appeared to be related to clinical experience and grade with F2 clinicians reporting greater clinical confidence as a consequence of a reviewing a negative AXR although no statistical difference was noted between grade of referrer (Chi square $\chi^2 = 2.269$; $p = 0.322$). This finding may be a key factor dictating the volume of AXR referrals by junior clinicians. Further, the increased clinician confidence in their clinical decision making following an AXR may reduce unnecessary referrals for additional tests[17] and also impact on the perception of patients on the appropriateness of their care, particularly where uncertainty is perceived in the explanation of a test and its value to patient diagnosis. Importantly, it has been observed that clinicians are generally not well trained or effective in this explanatory role.[18]

Hughes et al. (2015)[19] suggest that appropriate referral to advanced imaging techniques enhances the quality of patient care[19,20] and increases diagnostic confidence permitting better clinical decision making, greater confidence in the treatment choices and shortening of time to definitive diagnosis. The iRefer guidelines[7] support clinicians to make an informed choice of the most appropriate imaging examination for their patients based upon the latest published graded evidence, but it is not an absolute referral criteria tool. It relies on the clinical judgement of the referrer to decide whether imaging will beneficial to patient diagnosis and treatment. Disappointingly, the majority of clinicians (n = 19/28; 67.9%) within this study reported a lack of awareness of the iRefer guidelines, although this is consistent with other published literature.[9,10] This suggests that referral practices may not be optimised, possibly explaining the inconsistent referral compliance to CT and ultrasound observed. This lack of awareness of imaging referral guidance is a concern, particularly as imaging demand volume nationally continues to increase, and it is postulated that a potential reason for this is the careful scrutiny and vetting of imaging referrals by radiology departments to prevent inappropriate imaging examinations. This routine scrutiny of referrals perhaps removes responsibility of referral appropriateness from the referrer although this needs further exploration. Regardless, this finding suggests that radiology departments need to engage more with different referral groups to promote appropriate imaging referral pathways.

Limitations

This study was limited to a single site with a small sample of 28 clinicians which reduces the generalisability of the results. However, many of the findings reflect those of previous published studies in relation to referral knowledge and therefore the findings reported are unlikely to be local phenomena and could reflect national practice. As such, a wider multi-centre study would be beneficial to accurately determine the size of the problem and develop successful solutions. Survey research relies on the participant interpreting the question in the way the researcher intended and responding truthfully. Neither of these can be assured and therefore both are sources of potential response bias. The survey identified that a negative AXR increased clinical confidence however the potential for this to be false confidence (i.e. inappropriate confidence) was not explored.

Conclusion

The impetus for this study was to consider whether restricting the option to refer for AXR to reduce referral volume was an appropriate action but this required exploration of the potential benefits of a normal AXR on clinical decision-making and onward referral for other imaging first. The findings of this study suggested that the negative AXR impacts on clinician confidence in their decision making, potentially promoting better patient outcomes. As such, this study has identified an important non-radiological outcome of negative X-ray image examinations which has not been considered in previous studies and which could be an essential component of patient care in the wider hospital setting. While radiology departments may wish to reduce unnecessary referrals and increase compliance with the iRefer guidelines through education of staff and referral audit,[9,10] this should be undertaken with cognisance of the wider clinical picture and awareness of the impact of negative imaging on clinical confidence and ED decision making, promoting multidisciplinary collaboration and professional understanding.[7,10] Further, the impact of strict referral vetting on responsibility for referral appropriateness should not be overlooked as it could inadvertently promote poor practice although this requires further exploration.

Despite its poor negative predictive value[5,10] the findings of this small single site study suggest that the option to refer for AXR should not be restricted from the clinical workup for acute abdominal pain in adults presenting to the ED as has been suggested by other studies.[1,3,4,11] The rationale for this conclusion is the perceived increase in clinical confidence of clinicians following negative AXR examination, the lack of a locally agreed pathway for referral to alternative imaging modalities for acute abdominal pain should referral to AXR be restricted, and the reported poor referrer awareness of the iRefer guidelines.

Conflicts of interest statement

None.

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