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Research Article

Current abdominal X-rays practice in accident and emergency

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ABSTRACT

Introduction: Previous literature reviews revealed that abdominal X-rays (AXR) performed for the accident and emergency department (A&E), had low sensitivity, high further imaging and non-alignment rate to the Royal College of Radiologists (RCR) guidelines. A study was performed to investigate the current practice with the aim of making recommendations to improve practice, which can reduce patients' radiation exposures, while can re-routing resources to other priorities.

Methods: A study was performed in one of the UK's largest A&Es, in accordance with the RCR guidelines. All the AXR requests from A&E, regardless of the patient's age, within a 28-day period, were retrospectively assessed. Non-A&E patients and abandoned examinations due to uncooperative patients were excluded.

The total number of AXR requests received by the A&E imaging department was 169, with 28/169 falling into the exclusion criteria.

Results: Of the 141 included requests, five unjustified requests were correctly rejected. The remaining 136 requests were accepted and performed, though only 115/136 (84.6%) of these were justified. The most common justified and unjustified indications were obstruction and renal stones, respectively. Only 4% of reported AXR had pathological abnormalities, while 45/136 patients had further imaging.

Conclusions: The small proportion of significant findings echoed previous studies, suggesting an AXR overuse. Over 80% of non-compliant requests were performed, and awareness of the justification guidelines can be increased by clinical governance, posters, or an algorithm previously presented. The 32.4% further imaging rate recorded in this study, as opposed to the 73.7% reported in previous literature, merits attention.

Implications to practice: Stopping the overuse of AXR can minimise the radiation dose received and relieve the mounting pressure in imaging and reporting, which can serve other patients who would benefit from the services otherwise.

ABSTRACT

Introduction: Des analyses bibliographiques antérieures ont révélé que les radiographies de l'abdomen (RXA) effectuées dans les services d'urgence et d'accident avaient une faible sensibilité, un taux élevé d'imagerie complémentaire et un taux de non-alignement par rapport aux lignes directrices du Royal College of Radiologists (RCR). Une étude a été réalisée pour examiner la pratique actuelle dans le but de formuler des recommandations pour améliorer la pratique, ce qui peut réduire l'exposition des patients aux rayonnements, tout en réorientant les ressources vers d'autres priorités.

Méthodologie: Une étude a été réalisée dans l'un des plus grands services d'urgence du Royaume-Uni, conformément aux lignes directrices du RCR. Toutes les demandes de RXA émanant des services d'urgence, quel que soit l'âge du patient, au cours d'une période de 28 jours, ont fait l'objet d'une évaluation rétrospective. Les patients n'appartenant pas au service des urgences et les examens abandonnés en raison d'un manque de coopération de la part des patients ont été exclus.

Résultats: Le nombre total de demandes de RXA reçues par le service d'imagerie des urgences était de 169, dont 28 répondant aux critères d'exclusion. Sur les 141 demandes incluses, cinq demandes non justifiées ont été rejetées à juste titre. Les 136 demandes restantes ont été acceptées et réalisées, mais seulement 115/136 (84,6 %) d'entre elles étaient justifiées. Les indications justifiées et injustifiées les plus courantes étaient l'obstruction et les calculs rénaux, respectivement. Seulement 4 % des RXA signalées présentaient des anomalies pathologiques, tandis que 45/136 patients ont bénéficié d'une imagerie plus poussée.

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Conclusion: La faible proportion de résultats significatifs fait écho à des études antérieures, suggérant une surutilisation de la RXA. Plus de 80 % des demandes non conformes ont été effectuées, et la sensibilisation aux directives de justification peut être renforcée par la gouvernance clinique, des affiches ou un algorithme présenté précédemment. Le taux d'imagerie supplémentaire de 32,4 % enregistré dans cette étude, par opposition au taux de 73,7 % rapporté dans la littérature antérieure, mérite l'attention.

Implications pour la pratique: L'arrêt du recours excessif à la RXA peut minimiser la dose de rayonnement reçue et soulager la pression croissante en matière d'imagerie et de rapports, ce qui peut servir à d'autres patients qui bénéficieraient autrement de ces services.

Keywords: Abdominal X-ray; Accident & emergency; Overuse; Radiation protection; Abdominal pain

Introduction

One in three patients who went to Accident and Emergency Department (A&E) due to abdominal pain was discharged without a diagnosis [1]. While the number of patients who sought emergency care due to abdominal pain experienced an upward trend, the number of non-specific diagnoses increased during the same period of time [2]. Historically, abdominal X-rays (AXR) have been considered the most appropriate first-line imaging test for assessing non-traumatic abdominal pain [3]. Currently, ultrasound (US) and computed tomography (CT) are among the highly utilised imaging modalities for the evaluation of non-traumatic abdominal pain [3]. However, with the increasing availability of CT and ultrasound (US), the number of AXR performed has not decrease dramatically [4]. The AXR utilisation rate for acute abdominal pain was well above the >10% target [1,5–7]. The position of AXRs in one's treatment pathway was described as a "catch 22" situation [8] - it could potentially avoid unnecessary higher-dose CT imaging [4], while several studies from the 1960s-1980s argued that AXR provides insufficient information for identifying the underlying pathology [4,9–12].

The computational advancement in CT technologies has increased the number of slices for diagnosis, enabled shorter imaging time, allowed 3D reconstruction and lowered the radiation dose levels associated with older CT scanners through the use of low-dose CT techniques. All these updated features have helped to generate more detailed and useful diagnostic information than AXR. In the case of low-dose CT, the radiation dose is similar to AXR, as the average radiation dose of an AXR, a CT abdomen-pelvis, and low-dose CT abdomen is 0.7-1.1 mSv, 10-20 mSv and 2-3 mSv respectively [13–16]. The integration of artificial intelligence software into US has improved its importance in the diagnoses of abdominal pathologies without ionizing radiation [15]. These alternative modalities now challenge the validity of the AXR in the imaging pathway for non-traumatic abdominal pain [4,17]. To echo this change, the Royal College of Radiologists (RCR) updated its AXR guidelines in 2016 by removing a number of indications that warrant AXRs [18] (Table 1). Reducing the use of unnecessary AXRs would reduce the radiation-related risks to patients [19], the pressure imposed onto imaging services, the patient's length of stay (LoS) and its associated issues [20–22], and healthcare cost.

Apart from the AXR effectiveness controversy, a single-centre study revealed that only 32.1% of A&E referrers were aware of RCR guidelines [23]. The lack of awareness reported was backed-up by a number of single- and multi-centre studies, as well as systematic reviews [24–29]. More importantly, this flagged up that referrers and practitioners are not aware of the guidelines, and is potentially the reason behind the large number of unjustified referrals and non-specific reports. Education reinforcing the importance of AXR referral guidelines should be in place. Tools, such as a simple algorithm, in the form of a computer programme, or a flowchart, should also be developed to assist referring patients for abdominal imaging and accepting requests. Its simplicity, accommodating busy A&E and imaging departments, is the key to fruition. However, currently, there is paucity of information on how the RCR guidelines are being followed in A&E. This study was therefore performed to investigate the current practice with the aim to make recommendations to improve practice.

Method

This study was conducted in accordance with the Royal College of Radiologists guidelines [18] between 17/11/2021 to 14/12/2021, in order to understand the current practice at the A&E. The data was collected at the A&E department of the University Hospital Wales (UHW), which is one of the biggest teaching hospitals in the UK. All the abdominal image requests from A&E, in the 28-day period, were recorded and analysed using a purposive sampling method. The number of justified and unjustified requests was counted. Both normal and abnormal studies in the AXRs not justified by RCR guidelines were analysed further. Paediatric patients were not excluded, while follow up imaging concerning outside the abdominal area were omitted. Data were then analysed using descriptive statistics. Patient identifiable data was anonymised and was protected in accordance with the Data Protection Act 2018. Under the NHS Health Research Authority guidelines, this requires no ethical approval [30–32].

Results

A total of 169 abdominal images were performed at A&E X-ray department within the study period, 26/169 non-A&E patients were excluded in this study, and another two were

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Table 1
Differences in Justified Indications of RCR 2007 and 2016 Guidelines

Indication	2016	2007
Clinical suspicion of obstruction	X	X
Acute exacerbation of inflammatory bowel disease	X	X
Palpable mass (specific circumstances)	X	X
Constipation (specific circumstances)	X	X
Acute and chronic pancreatitis (specific circumstances)	X	X
Sharp/poisonous foreign body	X	X
Smooth and small foreign body, e.g., coin, battery (specific circumstances)	X	X
Blunt or stab abdominal injury (specific circumstances)	X	X
Acute abdominal pain warranting hospital admission and surgical consideration		X
Acute abdominal pain: if perforation or obstruction suspected		X
Inflammatory bowel disease of the colon: acute exacerbation		X
Suspected ureteric colic/stones (indicated in specific circumstances)		X
Renal failure		X
Haematuria		X
Foreign body in pharynx/upper oesophagus (indicated in specific circumstances)		X

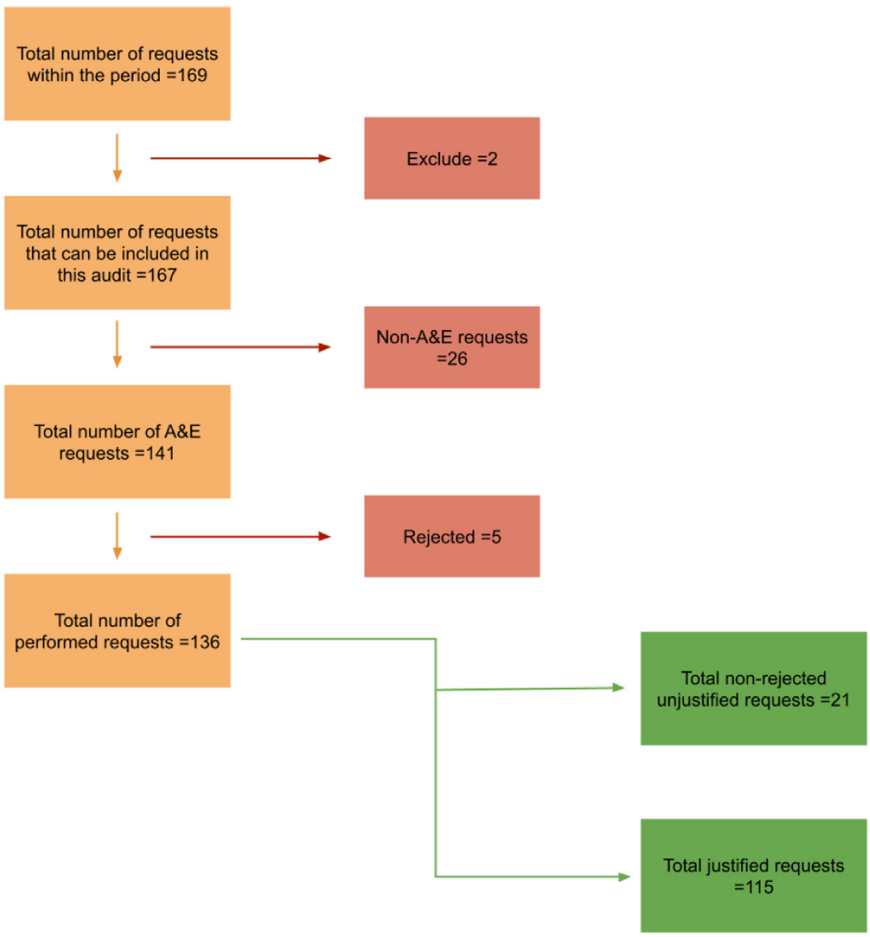

Figure 1. a Flow Chat to show the Patient Inclusion and Exclusion Process

excluded due to poor image quality resulting from uncooperative paediatric patient and lost record. Out of the remaining 141 requests, 4/141 forms were rejected correctly, and 1/141 was rejected incorrectly; 81.6% (115 requests) adhered to RCR guidelines. As the result, 136 requests in total (141 A&E requests – 5 rejected = 136) were accepted and performed. Figure 1 depicts the whole selection process.

Some referrers noted more than one indication on a referral, the number of accumulated indications (both justified and unjustified) is hence, higher than the total number of forms. There were 122 justified indications and 27 unjustified

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Table 2
Breakdown of Report Turnaround time

	Number (n=136)	Percentage in relations to the total number of examinations performed with the named modality (%)
AXRs reported within 24 hours	23	16.9
AXRs reported between 24.1-27.0 hours	1	0.7
AXRs reported between 27.1-30.0 hours	1	0.7
AXRs reported between 30.1-33.0 hours	0	0
AXRs reported between 33.1-36.0 hours	1	0.7
Combined report of AXR and further imaging, within 24 hours	4	2.9
Further imaging reported within 24 hours	42	100

From this, it can be seen that further imaging examinations were always reported on time, but it was not the case for AXRs. Only 27/136, 19.9% (23 AXRs that were reported within 24 hours, and the 4 AXRs that were reported on time with further imaging results) of AXRs were reported within the target set out by the Welsh NHS and the Welsh government.

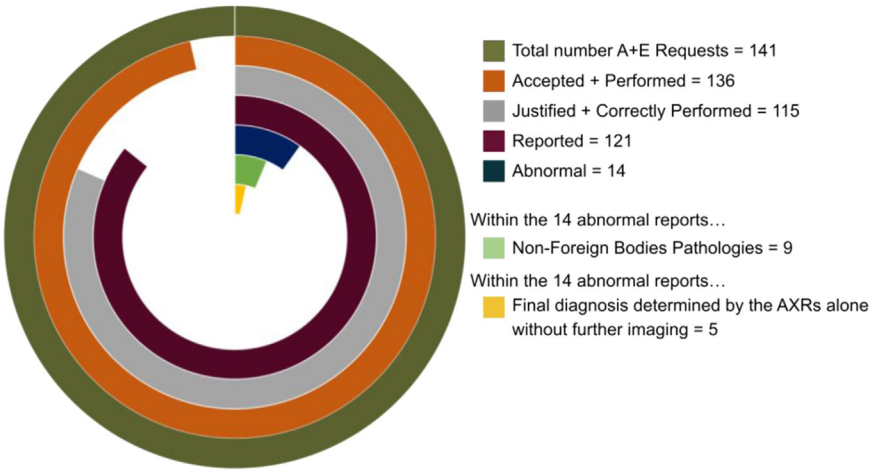

Figure 2. Effectiveness of AXRs in Reaching Final Diagnosis

indications. The most common justified indication was obstruction (100/122, 82.0%), followed by ingested foreign bodies (7/122, 5.7%) and constipation (6/122, 4.9%). On the other hand, the most common unjustified indications were renal stones (11/27, 40.7%), abdominal distension (3/27, 11.1%) and guarding (3/27, 11.1%). Since the compliant rate did not meet the target, further analyses were undertaken, as instructed by the RCR.

A month after the final day included in this study, 15/136 performed abdominal images were not reported (11.0%). Another 15 AXRs were not directly reported, mostly because the initial AXR reports asked the viewer to refer to the subsequent follow-up imaging report. Further analysis has been done to investigate the report turnaround time. The result can be found in Table 2.

Reported AXRs

Of those which were reported (136-15=121), 107/121 (88.4%) were normal AXRs, with the remaining 14/121 images being reported abnormal (11.6%). Out of these 14 abnormal images, 5/14 (35.7%) were for foreign body detections. Of the nine non-foreign body-related abnormal AXRs, only five of them helped reach the final diagnosis (5/14 =35.7% or, 5/136 =3.7%) without the need of further imaging. Figure 2 breaks down the proportion of images in each sub-category.

Post-AXRs *further imaging*

In terms of further imaging, 45/136 patients (32.4%) had further imaging after their AXRs. CT Abdomen-Pelvis (AP) with contrast was the most common further imaging of choice (35/45, 77.8%). Other modalities were utilised as well (ultrasound: 5/45, 11.1%; CT Kidneys-Ureters-Bladder: 2/45; 4.4%; CT Thorax-Abdomen-Pelvis: 1/45, 2.2%). One patient had a CT AP without contrast due to low eGFR (estimated glomerular filtration rate) (Figure 3). Patients who had further imaging for pathologies outside the abdominal cavity were omitted and not counted towards as further imaging in this study. All these further imaging results helped determine the final diagnosis of the patient. Only four abnormal AXRs concurred with the further imaging results, while seven AXRs disagreed with the further imaging results.

Analysing the 37 CTs performed, 28/37 forms were enquired about obstruction or ileus. Obstruction was not seen on both CTs and AXR 42.9% of the time (12/28). Obstruction was seen on 8/28 (28.6%) CTs, and 6/28 depicted no obstruction (21.4%), but the accompanied AXRs were not reported to

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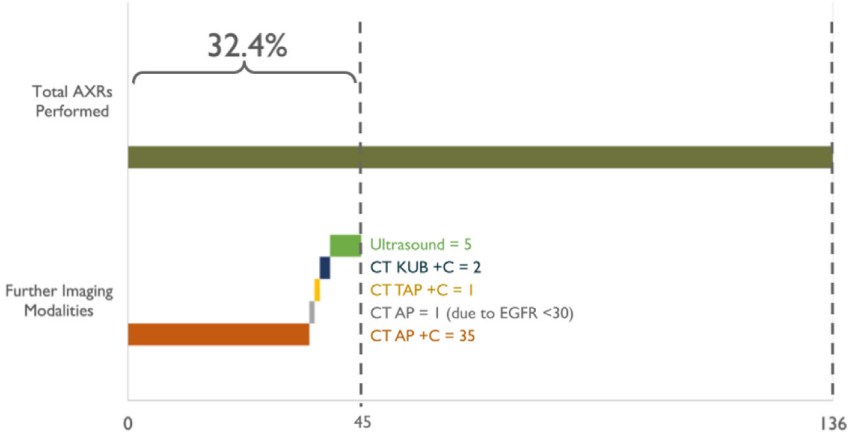

Figure 3. Proportion of Further Imaging done and Distribution of Further Imaging Modalities

Table 3a
Breakdown of Justified Requests by Indications

Justified Indications	Number	Percentage (%)
Post-Gastrografin (as ED patients)	2	1.6
Obstruction	102	82.3
Constipation (When stated as a symptom and inquired an aetiology which was justified)	6	4.8
Foreign Bodies	7	5.6
Position Check (Implants/Devices) (as A&E patients)	3	2.4
Volvulus	1	0.8
Toxic Megacolon	3	2.5
Total Justified	**122**	**89.7**

Table 3b
Breakdown of Unjustified Requests by Indications

Unjustified Indications	Number	Percentage (%)
Guarding	3	11.1
Renal Stones	11	40.7
Hydronephrosis	1	3.7
Abdominal Distension	3	11.1
History of Ulcerative Colitis	1	3.7
Perforation	2	7.4
Diverticulitis	1	3.7
Faecal Loading	2	7.4
Pneumothorax	1	3.7
Abdominal Pain	2	7.4
Total Unjustified	**27**	**19.4**

verify the agreement. Two reported AXRs disagreed with the followed-by CTs (2/28, 7.1%).

All the numerical results of this study can be found in Table 3.

Discussion

Non-compliant requests constitute over 18% of all the AXR requests and, 80.7% of these unjustified requests were performed (21 performed/26 unjustified requests), highlighting that both A&E physicians and radiographers do not fully abide to the RCR iRefer guidelines. There can be a lot of reasons behind the non-compliance. A&E physicians and radiographers may not realise the guidelines update in 2016. This might explain the vast number of renal stones visualisation requests since calculi were one of the justifications in the 2007 guidelines. Another potential explanation could be lack of staff and/or high workload, and it is "easier to do the X-ray than calling the doctors". This should not be, in any way, a plausible excuse for performing non-indicated requests intentionally. Staffing problem is an inherent problem within the department, and can be a catalyst of unintended medical errors, but certainly not a direct cause for intended medical malpractice. Under the professional code of conducts [33], guidelines [34,35], and the IR(ME)R (Section 11) [35,36], practitioners and operators both have the professional and legal obligation to ensure requests with unjustified or incorrect information are rejected. Radiographers are also legally required to keep radiation exposure "as low as reasonably practical", ("ALARP"), by not performing examinations that bring ambiguous benefit to the patient due to insufficient clinical information for exposure justification. If this is the case, this flags up more than just a lack of updated information problem, but bigger concerns in professionalism and ethical practice.

Overuse of AXRs, and high further imaging rate: medium to long term solutions

Overall, the majority of AXRs demonstrate no abnormality (88.4% reported as normal). This agrees with evidence in the literature throughout the years [12,24,37–40]. Furthermore, more than a third of the abnormal images were for foreign body detections. Since the visibility of a foreign body depends on the difference in attenuation ability between the object and its surrounding tissue [41], not the ability of the modality itself; if the

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Table 3c
Breakdown of Rejected Requests by Indications

Correctly Rejected Indications	Number	Percentage in relations to Total AXR requests (%)
Renal calculi	2	1.4
Rectal foreign body	1	0.7
Not clinically indicated	1	0.7
Total Correctly Rejected	**4**	**2.7**
Incorrectly Rejected Indication		
Volvulus	1	0.7
Total Incorrectly Rejected	1	0.7

Table 3d
Proportion of Reported Images and Breakdown of these Reported Images into Normal and Abnormal

	Number of Reports		Percentage (%)
Total Reported	123		88.5
No AXR Report Available	16		11.4
Reported Outcome	**Number of Reports**	**Outcome in relations to all Reported (%)**	**Outcome in relations to all AXR Performed (%)**
Reported Normal	109	88.6	78
Reported Abnormal	14	11.4	10
Reported Abnormal due to Foreign Bodies	5	35.7 (in relations to all Reported Abnormal)	3.5

Table 3e
Further Imaging Performed, by Modality

Further Imaging, by Modality	Number Performed	Further Imaging by Modality in relations to All Further Imaging Performed (%)	Further Imaging by Modality in relations to Total AXR Requests (%)
CT AP with Contrast	35	77.8	24.3
Ultrasound	6	13.3	4.2
Ct KUB	2	4.4	1.4
CT AP without Contrast	1	2.2	0.7
CT TAP with Contrast	1	2.2	0.7
Total Further Imaging Performed	**45**		**32.4**

Table 3f
Number of Final Diagnosis Determined by Abnormal AXRs and Further Imaging

	Number of Final Diagnosis determined by	Proportion of Final diagnosis Determined out of all the exams performed with the named modality (%)
Abnormal AXR	5	36
CT AP with Contrast	35	100
Ultrasound	6	100
CT KUB	2	100
CT TAP with Contrast	1	100
CT AP without Contrast	1	100

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Table 3g
Number of AXRs that Agrees with the Further Imaging Results

	Number of AXR-Further Imaging Result	Percentage (%)
Match	4	36
Mismatch	7	64
Total	**11**	**100**

foreign body images are taken out of the calculation, only 6.6% of the reported AXRs were abnormal. Most of the requests were for obstruction queries, and 94/100 images performed for obstruction ended up being normal. The low yield of significant findings can be an indication of AXR overuse [42]. Multiple different explanations potentially make sense of the overuse: 1) it has been reported that putting patients through AXRs has a physical and psychological effect [43]. 2) A normal, negative AXR result boost referrers' confidence in their diagnoses, as suggested by Mowlem and colleagues [23]. 3) A&E physicians use AXR for triaging patient for further imaging [4]. Nonetheless, the further imaging rate in this study (32.4%) is way lower than the 73.7% reported by Bertin et al. [25], which should also draw attention to. The authors suggested that the higher further imaging rate compared to private hospitals, might be due to the acuity and older demographic served by the university hospitals. These characterises both apply to UHW. The lower further imaging rate of Cardiff might mean that A&E physicians were able to rule out pathology after the AXRs, or physicians skipped the step of AXRs and ordered CT or other deemed to be more appropriate test in the first place. Although the further imaging rate in this study is lower than the Swiss counterpart [25], the 32.4% further imaging rate is still close to the national average of 40% [44]. The national *Getting It Right First Time* campaign is calling for reduction in the number of AXRs performed, especially for those who eventually will receive a further imaging investigation for the sake of radiation dose given to the patients [44].

Furthermore, in the Genevan study, 1997 AXRs were performed across two A&E departments within a year. Bertin and colleagues [25] did not state the exact number of AXRs performed in each hospital, but assuming an equal split, 998.5 AXRs were performed per hospital. Extrapolating from the one-month data collected in this study, 1632 AXRs (136×12 months) would have undertaken in a year, 63.4% more than in Geneva. The population and demographics between Geneva and Cardiff and Vale are exceptionally similar [45,46], which make the comparisons between the two studies appropriate.

In light of the above, as well as the *Getting It Right First Time* campaign which branded AXRs as "limited clinical values investigation", stricter AXR justification guidelines might deem appropriate by adopting or even mirroring the American College of Radiologists, or the French Haute Autorité de Santé guidelines.

Non-reported images constituted 11.0% of the total images taken. The standard report turnaround time for urgent imaging which findings are required for medical or surgical intervention, should be 24 hours according to the nation's Scientific Advisory Committee and the internal guidelines of the hospital trust [47,48]. Note that both guidelines stated that images should be reported within 24 hours, but not one working day; therefore, imaging performed during the weekends should also be reported within the 24 hours timeframe. The National Auditing Office had raised the concern of long report waiting time (over 10 working days) and non-reported examinations [48,49], proving the late- and no-reports problems persist with no improvement, as reflected by this investigation. One could argue that the 24 hours target is impractical amid the Coronavirus pandemic, causing a big reporting backlog. However, neither the National Audit Office, nor the NHS, has published an updated guideline taking Covid-19 crisis into account. Hence, the most current, up-to-date guideline was used as the standard. As well as non-reported/delay reported AXRs, a significant proportion of further imaging were reported in AXRs stead. In the case of non-reported AXRs or reported in conjunction with further imaging, is the AXR necessary if the patients do not get the AXRs reported in the end? Furthermore, is it ethical to put the individual through two examinations, in the expense of other patients getting their imaging quicker and sooner?

Unfortunately, there is no quick fix for any of these challenges. However, the interlinks of these problems mean that medium/medium-long term solutions can have a relieving effect upon the issues that require long-term resolutions. Ultimately, increasing the imaging infrastructures so that CT/US can be done within a reasonable time frame is the key to lower the overuse of AXRs. Understandably, increasing infrastructures can take more than a decade of time. The medium-long term measure can be having a radiologist/reporting radiographer at A&E hot reporting as soon as patients have had their scans, but postgraduate training of radiology registrars takes at least five years in the UK, and one or two years part-time postgraduate certificate training for a plain film reporting radiog-

Table 3h
Agreements between CT APs/TAPs and AXRs

Obstruction Present in CT? (n=28)	Obstruction Present in AXR?	Number (Percentage %)
Yes	Yes	0 (0)
Yes	No	1 (3.6)
Yes	Not Reported	8 (28.6)
No	Yes	1 (3.6)
No	No	12 (42.9)
No	Not Reported	6 (21.4)

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rapher. These medium to long terms solution can be bridged by advocating preliminary clinical evaluation by A&E radiographers [44,50]. Patient education is also important so that AXRs, or other unnecessary imaging examinations, are not ordered for placebo effects.

Perforation, calculi, and other out-of-date justifications: shorter term fixations

There were also a large number of requests for erect chest X-ray (CXR) and AXR, looking for perforation and obstruction. Sometimes, the AXR images were completely forgone on the report and only the CXRs were reported. If perforation was seen on the CXR, patients were sometimes, sent for contrasted CT AP and the abdominal area was not reported in the CT reports. It was also common for A&E doctors to ask for AXRs the same day, sometimes as short as two hours post-CT scans, for stone visualisation. It is worth noting that calculi are no longer a justified indication in the updated 2016 RCR guidelines, because around 20% of renal stones cannot be seen on plain film due to their chemical compositions [51,52]. Two requests were correctly rejected as the patients had the CT scans <3 hours prior to the AXR requests, and the stones could be seen on the CT scouts. Even so, a lot of non-RCR guidelines compliant AXRs for renal calculi performed. In one case, the patient had his/her contrasted CT AP five hours before the AXR, and the stone unseeable because contrast was still in his/her system. There were a few cases where the referrers were looking for hydronephrosis and/or hydroureters after seeing renal calculi on CT scans, performed on the same day; while both of these conditions cannot be diagnosed with AXRs. This study clearly suggested that both A&E physicians and radiographers are not fully complying the iRefer guidelines.

The RCR suggested that educational posters with examples of appropriate and inappropriate indications can be put up around A&E [18]. In addition, training can be given to radiographers to prepare them to have discussions regarding unjustified/ambiguous AXR requests with the referrers. Two different studies had tested the effectiveness of the educational posters, and yielded a 9% and 16% decrease in unjustified requests post-intervention respectively [53,54]. Since information gathered for this study solely came from the request forms and the imaging reports, whether or not laboratory tests were done before the radiological requests cannot be known. Though, laboratory tests should be the first line of investigation for most abdominal pathologies according to the BMJ Best Practice guidelines [55–58]. With this in mind, an algorithm or a flow chart [59], which acts as a prompt for A&E physicians, in addition to the RCR posters, can be put up around A&E to remind them that laboratory tests should be done before requesting an AXR.

Continue to monitor

Moving forward, the potential of an algorithm should be discussed and created with the gastrointestinal team, to lower the number of unjustified and unnecessary AXRs done in A&E. It would be a good idea to involve A&E physicians, the users of the algorithm, in creation process to ensure the efficacy of the algorithm in such a fast-paced working environment.

The algorithms and the RCR educational posters can be put up around A&E areas and a repeat study can be conducted three months after the intervention, and regularly thereafter.

In terms of the reporting time frame and making sure that the images are reported in a timely manner, the reduction of unnecessary AXR should help reducing the report turn-around time. However, to tackle the root of the report delay, employing more radiologists and training more reporting radiographers are the long-term solutions, in which neither solution provides a quick fix. Further iterating the importance of regular repeat studies to ensure the reporting delay is consistently improving.

Conclusion

This study, agreed with other previous literature that there are issues of AXRs overuse, high number of further imaging, non-reported, delay/combine reports. This study flagged up and reiterated these problems and provided medium to long term solutions to tackle these interconnected problems. Monitoring studies should be conducted regularly to track the improvement process brought by educational and awareness-raising interventions, while planning to increase the imaging capacity and reporting workforce. The effectiveness of these interventions will benefit the patients themselves, for not exposing to unnecessary radiations and reducing their LoS. The correct use of AXRs reduces the workload of A&E and radiology and improve the cost-effectiveness of the service. In turn, appropriate care can be re-directed to those who need the most.

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