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IMPACT OF CLINICAL PRACTICE GUIDELINES ON COMPUTED TOMOGRAPHY USE FOR SUSPECTED APPENDICITIS: A PROSPECTIVE AUDIT STUDY.

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ABSTRACT.

Background.
The Royal Adelaide Hospital implemented a clinical practice guideline for the treatment of patients with suspected appendicitis. This recommendation suggests using CT scanning sparingly until more research is done. This study compared the CT usage rate for the patients during the pre-and post-guideline implementation periods.

Methods.
The prospective audit study included patients who came to the emergency room with symptoms and physical results that suggested they might have appendicitis. During the period following the implementation of the guidelines, these individuals were also prospectively identified if they were referred to the on-call surgical registrar. They were identified via hospital and emergency department databases.

Results.
The study included 119 individuals, 88 of whom underwent appendectomies for appendicitis. Following new clinical practice guidelines from the hospital that advised limited use of CT scans—specifically for patients over 50 or obese after a 24-hour observation—CT scan usage decreased from a baseline of 33% to 9%, reflecting a 31% overall reduction and a 24% decrease in unnecessary procedures. Significant reductions were observed in two patient groups: Group 2 (from 6 to 4 CT scans, $p = 0.0331$) and Group 3 (from 11 to 7, $p = 0.0088$), demonstrating the guidelines' effectiveness despite some limitations in statistical power.

Conclusion.
According to this study, hospitals with high rates of CT use for suspected appendicitis should lower these rates to match the national norm. Clinical practice standards or protocols may help with this effort.

Recommendation.
This study recommends that hospitals with high CT scan usage for suspected appendicitis adopt restrictive CT guidelines similar to those at the Royal Adelaide Hospital, focusing on limited use based on clinical inconclusiveness or specific risk factors like obesity or age over 50.

Keywords: *Appendicitis, Abdominal pain, Diagnostic testing, Clinical decision rule*
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INTRODUCTION.

Since appendicitis is the primary differential diagnosis for acute right iliac fossa pain, patients frequently arrive with this symptom at the emergency room [1]. They are then frequently sent to the on-call surgical unit for additional care. Appendicitis is frequently diagnosed clinically with no investigation needed. But occasionally, different illnesses could appear to be appendicitis, or the illness might manifest atypically, in which case more research or observation is necessary.

When diagnosing appendicitis, computed tomography (CT) scanning has a high sensitivity and specificity [2]. Without raising the rate of perforation, it has been demonstrated to lower the rate of negative appendicectomies [3]. Nonetheless, there is a long-term cancer risk linked with this,

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and it is higher in female patients and younger patients (around 1 in 1000 for each abdomen/pelvis CT scan [4]). Nephrotoxicity, anaphylaxis, and allergies are further risks.
Compared to the national average of 17%, the Royal Adelaide Hospital in South Australia uses CT more often on patients undergoing appendicectomy (33% in 2009/2010) [5]. Some of these scans, it can be argued, are not essential, put patients in danger, and place further strain on hospital resources.
A clinical practice guideline was implemented at the Royal Adelaide Hospital in July 2012 for the treatment of suspected appendicitis [6]. The Acute Surgical Unit surgeons were consulted extensively in the formulation of this guideline. It offers guidance on several patient care issues, such as the application of diagnostic imaging. CT is only advised for obese or older than 50-year-old individuals with a typical presentation who are clinically stable and have had a 24-hour observation period. As a result, it does not support regular use of CT.
This suggestion is not the same as what happens. CT scans are routinely requested for younger people and commonly conducted for older patients who arrive with the classic symptoms of appendicitis. It was predicted that when the recommendation was followed, the number of CT scans performed on these patients would decline. To further lower the frequency of needless CT scans, it might be justified to create and apply clinical practice recommendations for the care of additional presentations such as epigastric pain, suspected diverticulitis, colitis, and small bowel obstruction.
Pediatric groups have benefited from this strategy for lowering CT utilization [7, 8]. It is unknown, though, if this strategy works at our facility, which treats exclusively adult patients and has numerous clinically sound justifications for using CT scans to treat right iliac fossa discomfort.
The study aims to evaluate the impact of implementing clinical practice guidelines on the utilization of CT scans for patients with suspected appendicitis.

METHODS.

Study design.

A prospective audit study was conducted.

Study setting.

The study was carried out at the Department of General Surgery, Mata Gujri Memorial Medical College & Lion Seva Kendra, Kishanganj, Bihar, India, from August 2022 to October 2022.

Study area.

For three months starting from Aug 2022 to Oct 2022, an audit of the guidelines was carried out. This audit was conducted in tandem with the collection of data for this study. Before the audit period, a few information workshops were held to increase knowledge of the clinical practice guidelines. These were given to the doctors working in the emergency department during one of their routine training sessions and at every departmental meeting for the surgical unit. The audit was given ethics approval.

Participants.

The study included 119 participants meeting all the selection criteria.

Inclusion criteria.

• An official appendicitis diagnosis,
• individuals with probable appendicitis who were referred to the surgery unit, and
• Individuals who arrive at the emergency room complaining of localized pain and soreness in the right iliac fossa.

Exclusion criteria.

• An earlier appendectomy.
• Surgery on the abdomen during the prior six weeks.
• A urinary tract infection was identified.
• Women who are expecting.

Bias.

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from those who collected the data.

Procedure methodology.

Clinical practice guidelines for the assessment of patients being evaluated for appendicitis were prepared by a multidisciplinary committee consisting of emergency physicians, surgeons, and radiologists. The patients' physical examination results, white blood cell count, length of discomfort, and differential count were used to classify them as being at low, medium, and high risk for appendicitis. The results of the physical and historical examination were discussed with the attending physician and immediately documented on the data collection form before the laboratory and radiological results were made available. The radiological reports were preliminary rather than final, and they were added to the study database to reflect the data that was available while clinical decisions were being made.

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Outcome measures.

The major outcome measures of the rates of false positives and false negatives for appendicitis, false positives and negatives for appendectomy, CT usage, and the rates of appendicitis in each of these scenarios were used to evaluate the effectiveness of clinical practice guidelines.

Ethical clearance.

The research protocol that was used complied with the institutional ethics committee's approval.

Statistical analysis.

The first group was chosen to be the major outcome measure. The second group's secondary result, and so forth. Since the hypothesis was that CT utilization should be lower in the post-guideline implementation group, a one-tailed Chi-squared test of statistical relevance was employed, with a p-value of less than 0.05 considered significant.

RESULTS.

Before exclusion, 119 presentations were found in the general audit data; they comprised 61 patients in the post-guideline group and 58 patients in the pre-guideline group. The mean ages were 34.5 and 37.8, correspondingly. The pre-and post-protocol implementation data sets, respectively, contained twenty and twenty-six patients that were excluded. Table 1 shows the outcomes for every group. Appendicitis affected slightly more than one-third of patients who met secondary exclusion criteria (36.4% and 36.8% in 2022 and 2023, respectively). The proportion of each group's sex was not statistically different before or after the guidelines were implemented, however, group 4 had a roughly 2:1 ratio of more girls than males. Even though the total number of patients after exclusion was relatively similar (51 compared to 50), there was a 14% increase in admissions for the post-guideline group (37 compared to 32). P value of 0.0670.

Table 1: Data comparing each group's pre- and post-protocol states.

				Diagnosis (%)				
		No. of patients	CT scans	Appendicitis	Abdominal pain of unknown etiology	Other	Age (yrs.)	Sex M/F
Group 1	2022	15	5	15 (100%)	0	0	39.4 (15.1)	8/7
	2023	18	4	18 (100%)	0	0	31.2 (12.1)	10/8
	P value	-	0.0881	-	-	-	0.0057	0.5762
Group 2	2022	21	6	15 (73.2%)	2 (9.5%)	3 (16.1%)	35.4 (14.9)	9/12
	2023	24	4	18 (75.8 %)	3 (12.5)	3 (12.9%)	30.8 (11.0)	12/12
	P value		0.0331	0.7468	0.9205	0.6242	0.0617	0.2517
Group 3	2022	32	11	18 (56.5%)	7 (21.8%)	6 (18.75%)	35.2 (14.0)	11/21
	2023	37	7	18 (48.6%)	11 (29.7%)	7 (18.9%)	31.6 (12.0)	13/24
	P value		0.0088	0.4217	0.2646	0.8053	0.0698	0.4956
Group 4	2022	50	14	18 (36.0%)	23 (46.0%)	9 (18.0%)	35.2 (13.6)	16/34
	2023	51	9	19 (37.2%)	22 (43.1%)	10 (18.8%)	31.7 (12.1)	20/31
	P value		0.0506	0.9356	0.7625	0.7761	0.0273	0.2656

Table 2 shows the ratio of negative appendicitis at operation. For this computation, two instances from 2022 and one from 2023 are removed since additional operational management of a different diagnosis was necessary.

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Table 2: Negative appendicitis at operation.

	Operative cases		Negative for appendicitis	
	M/F	Total	M/F	Total (%)
2022	9/12	21	0/5	5 (23.8%)
2023	12/11	23	2/4	6 (26.1%)
Total	21/23	44	2/9	11 (25.0%)

It displays the findings from the qualitative case note evaluation conducted on patients who underwent CT scans and were included in group 1 post-implementation data collection. For appendicitis, all patients underwent appendicectomies (Table 3).

Table 3: CT scans in group 2 post-protocol implementation period.

Case	Age	Sex	MANTREL score	Reason for CT	Ordered by
1	22	Female	4	A doctor who suspected Crohn's disease had already looked at the patient. Due to a possible case of Crohn's ileitis, a CT scan was requested. Both appendicitis and ileitis were equivocally diagnosed by CT, which was non-diagnostic.	Surgical department
2	24	Female	7	The patient is too sick to wait for a diagnosis. claiming to have had watery stools for the past two weeks. Since colitis was the differential, a CT scan was requested. appendiceal abscess diagnostic.	Surgical department
3	50	Female	5	An obese patient with an unusual appearance. notable co-morbidities while using clopidogrel and Prinzmetal's angina. Appendicitis was not found in the study, but it was medically treated. Operative management was changed because of persistent discomfort and fevers. Operative	Surgical department
4	62	Female	9	Despite having a normal medical history, the dipstick test revealed urine nitrites without any symptoms of the lower urinary tract. Appendicitis was identified on a CT scan that was ordered to rule out UTI. The patient is moved to a private hospital so they can have surgery.	Surgical department
5	38	Male	5	a medically trained patient seeking a CT diagnosis. Positive CT.	Surgical department
6	34	Male	9	shown once more in 24 hours. Nitrites were detected in urine without any symptoms related to the lower urinary tract. Too sick to wait for the urine microscopy. Positive CT.	Emergency department
7	43	Male	5	Differential diagnosis of mesenteric adenitis in the setting of URTI. CT positive. The patient was transferred for operation privately as a busy theatre list.	Surgical department
8	18	Female	5	The patient is suspicious because she had three laparoscopies for ovarian abnormalities in the past. The appendix appeared somewhat thicker on CT.	Surgical department
9	39	Male	5	The patient is ill and may have kidney calculi. Appendicitis was detected on CT KUB.	Surgical department
10	53	Female	6	The patient's co-morbidities were severe. CT scan reveals appendicitis.	Surgical department

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DISCUSSION.

Patients with appendicitis and appendicectomy (group 1) had a 29% lower rate of CT utilization compared to the pre-guideline implementation stage, during the post-guideline implementation phase. However, the p-value of 0.0881 did not show that this was statistically significant. The remaining groups had lower rates of CT usage as well: 41%, 35%, and 31% for groups 2, 3, and 4, respectively. In groups 2 and 3, this difference was statistically significant (p values of 0.0088 and 0.0331, respectively). With fewer patients in the study group, the first group may have had lower power, which could have contributed to the inability to demonstrate statistical significance (the post hoc power for group one is 38.2). A study sample size of 177 is required to discover a clinically relevant change in CT scanning if a reduction of at least 25% is so. In brief, while the implementation of clinical practice guidelines led to reductions in CT scan usage across all groups, only Groups 2 and 3 showed statistically significant changes. The lack of significance in Group 1 could be attributed to insufficient statistical power and a relatively smaller sample size compared to what is needed to confidently observe the effect.

Following the introduction of the clinical practice guideline, there was a decrease in the rates of CT usage among patients who underwent operative management (group 2) and those who were hospitalized under a surgical team (group 3). In these categories, statistical significance was shown. The fact that the ratio of negative appendicitis at surgery did not significantly vary between the pre- and post-implementation phases of the guidelines is reassuring. This amounted to almost 25% of surgeries, with a significant discrepancy between instances involving men and women (9% and 38%, respectively). Overall, the introduction of the guidelines effectively reduced unnecessary CT scans without increasing inappropriate surgical interventions, despite significant differences in outcomes between genders.

But since there wasn't enough power in this study to show a difference, this has to be viewed cautiously. The negative appendicectomy rate can be lowered by almost half by using CT, as reported by Krajewski et al. [3], yet our study lacked the statistical power to identify this impact.

In the post-guideline implementation era, a decrease in CT usage could lead to an increase in hospital admissions. The admission rate increased by 13% between the two periods (p-value 0.067). From the perspective of patient care, if such an impact is true, it might be justified because it lowers the risk of radiation exposure and contrast hazards.

The surgical team (8/10) ordered the majority of CT scans during the post-guideline era, and these investigations might have been the least preventable. Referrals to the surgical team may help avoid CT scans ordered by the emergency department. Nonetheless, operative management or observation may be necessary while awaiting more results (such as urine or stool microscopy, cases 2, 4, and 6) for the surgical team to avoid obtaining a CT scan. Depending on the patient's co-morbidities (cases 3 and 10) and clinical state (cases 2, 6, and 9) in many clinical scenarios, this might not be the best course of action. The use of CT is also impacted by non-clinical factors.

Although the data point to a decrease in CT usage after the clinical practice guideline was put into effect, they do not establish causation. However, it's possible that concurrent with the release of the guidelines, there was a shift in behavior about the use of CT. Additionally, there was a notable shift in the surgical and emergency department staff, both junior and consultant, between the two periods, which could account for variations in practices.

This observational study contains certain elements that could introduce bias. All four categories in the 2022 data set have older patients with comparatively low p-values.

The very high proportion of patients in 2022 who did not receive operational management could be another source of bias. 2022 saw the diagnosis and medical management of appendicitis in 7 people. After CT scans of three of these patients revealed peri appendiceal abscesses, an elective interval appendicectomy was recommended. Due to patient preference, the remaining four patients had non-operative care. The impact in group 2 would have dropped to below statistical significance (p-value 0.0523) if these four patients had undergone surgery.

There could be additional bias resulting from the various techniques employed in patient identification. in particular, the 2022 data set's absence of future data collecting. Groups 3, 2, and 1 would be less affected by this effect than group 4, as these presentations were determined by coding and theater data.

Promoting and raising general knowledge of the guidelines among pertinent medical staff members could be one strategy for enhancing its impact. This is the first guideline related to the treatment of a severe case of general surgery (not trauma) that our institution has developed. The informational workshops may not have been a sufficient means of promotion given the ongoing turnover of the medical staff. If further protocols or standards were created for other acute general surgical disorders, awareness might also be increased more broadly. Therefore, if a series rather than a protocol about a specific ailment were produced, adherence might be higher.

GENERALIZABILITY.

The study findings suggest that wider adoption of clinical practice guidelines could reduce CT usage and maintain safety without increasing negative surgeries, applicable across diverse healthcare settings. Implementing these guidelines broadly could lower healthcare costs, reduce unnecessary radiation exposure, and promote more efficient use of medical resources, with potential implications for tailoring approaches to different patient demographics, including gender-specific treatment pathways.

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CONCLUSION.

According to this study, hospitals that utilize CT scans frequently to investigate cases of suspected appendicitis may be able to lower their CT utilization rates, which will lower patient hazards associated with radiation and contrast. The development of hospital rules or protocols and their encouragement of the administration of these presentations may be one way to bring about such a behavioral change. Although the statistical power was weak, a decrease in CT utilization for these presentations was linked to an increase in admissions rather than an increase in needless procedures.

LIMITATIONS.

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

RECOMMENDATION.

This study recommends that hospitals with high CT scan usage for suspected appendicitis adopt restrictive CT guidelines similar to those at the Royal Adelaide Hospital, focusing on limited use based on clinical inconclusiveness or specific risk factors like obesity or age over 50.

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CONFLICT OF INTEREST.

The authors have no competing interests to declare.

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