Journal of Surgery
Kabir SMU, et al. J Surg 7: 1467
www.doi.org/10.29011/2575-9760.001467
www.gavinpublishers.com
Research Article

A Systematic Review of Evidence-Based Right Iliac Fossa Appendicitis Care Pathways

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Citation: Kabir SMU, Fitzgerald J, Huan H, Stephens I, Broderick M, et al. (2022) A Systematic Review of Evidence-Based Right Iliac Fossa Appendicitis Care Pathways. J Surg 7: 1467 DOI: 10.29011/2575-9760.001467

This project was supported by the European Union's INTERREG VA Programme, managed by the Special EU Programmes Body (SEUPB) and Donegal Clinical and Research Academy

Received Date: 24 January, 2022; **Accepted Date:** 08 February, 2022; **Published Date:** 14 February, 2022

Abstract

Introduction: Improving delivery of care through evidence based pathways may reduce unacceptable variation in outcomes in patients with Right Iliac Fossa (RIF) pain. This study reviewed current guidelines to develop a RIF/ appendicular pathway and delineate Key Outcome Indicators (KOIs). **Methods:** Two systematic reviews of literature using Pubmed, Embase and Cochrane databases from January 2011 to December 2021, were undertaken. PRISMA guidelines were used to select guidelines for both RIF pain/appendicitis management and KOIs for appraisal by two independent authors using an AGREE II score of >70 and recommendations tabulated. Evidence based recommendations were used to develop a RIF pain/appendicular clinical pathway. KOIs were streamed into 3 areas; care process, surgical outcomes, and adverse events. **Results:** Six studies met inclusion criteria. Guidelines from these were used to design a pathway stratifying clinical risk of appendicitis into 5 categories based on clinical presentation, appendicitis scoring systems, and imaging features. These categories are; Possible, Probable, Definite appendicitis, Appendicular mass or diffuse peritonitis. KOIs were established across three domains; Care process, Surgical outcomes and Adverse events. These KOIs allow for meaningful cyclical audit of outcomes, evaluation of care, and can guide pathway redesign. **Conclusion:** This pathway for RIF pain management promotes evidence-based strategies to optimise care and, combined with KOIs, may help reduce variation in outcomes.

Keywords: Appendicitis; Clinical pathway; Patient outcomes; Surgical diagnosis; Right iliac fossa pain

Introduction

Appendicitis remains the most commonly occurring acute abdominal emergency in both children and adults globally occurring in 5.7-50/100,000 [1]. Although first described by Fitz in 1886, and despite its frequency and perceived simplicity, clinicians are not achieving acceptable diagnostic accuracy with almost 20% of patients undergoing unnecessary surgery [2,3]. Appendicitis presents across a diverse, heterogenous spectrum of acute severity from mild appendicitis to generalised peritonitis. There are further confounders such as age, where perforation risk is greater in younger children (30-75%) and older patients (50-70%) [2,3]. Apart from patient co-morbidities, delay in presentation and variable surgical management contributes to variable outcomes including re-admission rates which can approach 15% at 30 days [4-6].

To improve diagnostic and patient outcomes, pathway-driven surgical care, using combined clinical, laboratory, imaging and scoring systems should be incorporated into clinical care [7-9]. Clinical pathways, initially proposed by Vanhaecht and colleagues in 2007, lead to the development of the European Pathway Association (EPA) in 2008, which defines them to be a "complex intervention for the mutual decision making and organisation of care processes for a well-defined group of patients during a well-defined period" [10]. The Royal College of England has recommended formal pathways for delivery of standardised emergency surgical care and quality improvement [11]. Multiple studies have validated the utilisation of such pathways in improving clinical outcomes in all emergency surgical patients including both adult and paediatric patients presenting with appendicitis [12-16]. Key performance or outcome indicators including negative appendectomy rates and re-admission rates have been used as quality benchmarks in appendicitis. This allows comparison of patient care to set standards, which can, in turn, guide interventions with the aim of improving outcomes [9,16-19].

The aim of this study was to review current evidence base for RIF pain / appendicitis guidelines to develop a decision and management pathway with benchmarking Key Outcome Indicators (KOIs).

Methods

Two systematic reviews of literature were undertaken from January 2011 to December 2021 utilising the PRISMA guidelines to retrieve consensus statements and peer reviewed guidelines for the diagnosis and management of patients presenting with appendicular right iliac fossa pain [20]. Pubmed, EMBASE and Cochrane databases were searched using the key words "appendicitis", "guidelines", "consensus", "adult", "paediatric". Web searches and review of citations from relevant articles were also preformed.

The inclusion criteria of the study delineated that the studies should be in English, include guidelines that utilised critical appraisal of literature for development of recommendations, and be available as peer reviewed articles. In cases whereby there were multiple iterations of a guideline, only the most contemporaneous was used. (Figures 1,2). The included guidelines were assessed by using the Appraisal of Guidelines for Research and Evaluation (AGREE II) tool which is a framework designed to evaluate the quality of guidelines which can be reported and utilised to develop clinical practice recommendations and policies [21]. Its design comprises of 6 domains - scope and purpose, stakeholder involvement, rigor of development, clarity of presentation, applicability, and editorial independence, which take into account 23 outcomes on a Likert scale ranging from 1 to 7 representing strongly disagree to strongly agree respectively. Though no specific criteria are defined to determine each specific point, a guidance document provides instructions on assessing the different domains to delineate key aspects to score the guidelines appropriately. Each domain is then separately scored, and a guideline is deemed "High Quality" if the assessment of at least domain three accomplishes a score greater than 70. Two independent authors scored the guidelines (UK, JF), and a combined score was calculated for each domain. The guidelines deemed as high quality were used to extract statements and recommendations to develop an evidence based clinical pathway.

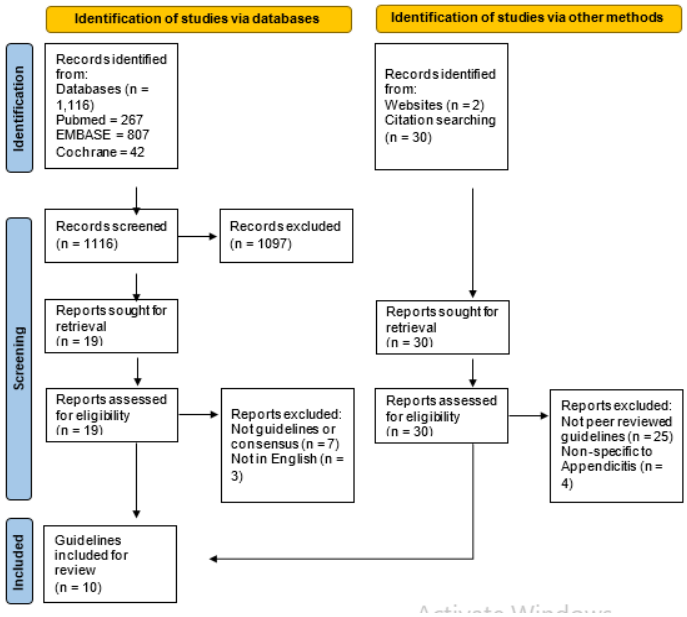

Figure 1: PRISMA flow diagram for the Literature Search Strategy for the Guidelines.

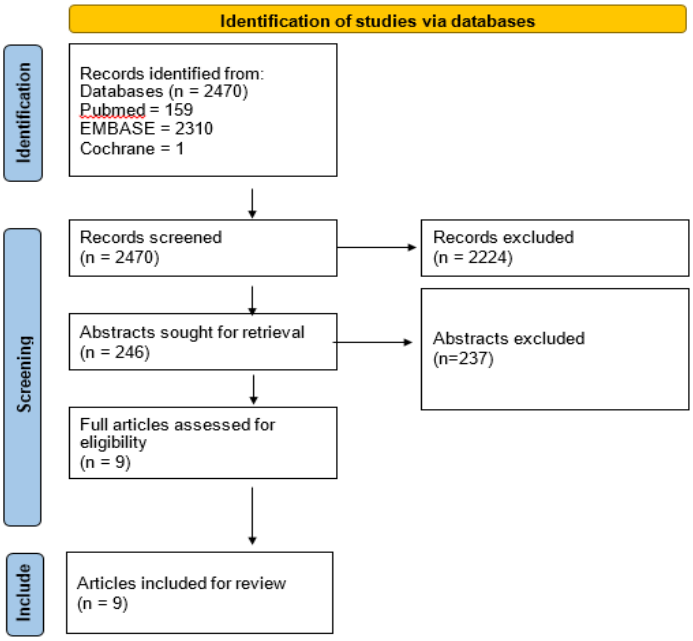

Figure 2: PRISMA flow diagram for the Literature Search Strategy for the Key Outcome Indicators.

Development of the Paper-Based Pathway

The development of a paper-based clinical pathway for patients presenting with right iliac fossa pain involved a Multidisciplinary Team (MDT) of surgical consultants, senior surgical trainees and registrars, and surgical nursing staff. Emergency physicians, radiology consultants and the eSOAP team including nurses, research fellows and an information and technology (IT) expert (MB) also formed an integral part of the MDT. Weekly meetings and clinical consensus focussing on evidence-based guidelines, utilisation of robust and cost effective scoring systems, and availability of hospital resources, including operating theatre access, Magnetic Resonance Imaging (MRI) and out of hours CT scanning were all taken into consideration during the design process. A process mapping approach helped formulate a decision tree model for a paper-based guidance tool to stratify patients presenting with right iliac fossa pain and also outline the KOIs (Table 1) that would help in defining quality of care for this cohort [1,19,22,23].

	Care Process	Targets
1	Enrolment of Patient to pathway before leaving Emergency	>90%
2	Patients with Grade 5 appendicitis should have surgery in <12 hours of initial surgical review in ED	>90%
3	RIF pain patients should have a appendicitis risk score documented on the admissions proforma	>90%
	Surgical Outcomes	**Targets**
4	Laparoscopic surgical approach	>90%
5	Laparoscopic conversion rates	<3%
6	Negative appendectomy rates	<10%
	Adverse Events	**Targets**
7	30-day Re-admission following appendectomy	<5%

Table 1: Key Outcome Indicators for patients presenting with right iliac fossa pain after consensus meeting.

Operators

The pathway was intended to serve as a clinical aid for emergency department physicians and surgeons by guiding assessment, diagnosis, and management of patients with RIF pain with a focus on prompt recognition and diagnosis of appendicitis, with severity stratification. It was designed for use by all levels of seniority with the goal of achieving low variance in care, and achievement of KOIs (Table 1). This paper based pathway was to be labelled and filed in the patients' medical records and the stage of the pathway clearly marked or encircled.

Implementation

The pathway was implemented on the 1st of January 2021 and the team continued to meet twice a week to discuss user feedback and modify the pathway accordingly until consensus was reached and a final approved pathway design re implemented on the 1st of March 2021.

Systematic Review to Determine Key Performance Indicators

Results

The search strategy yielded 1116 articles, and after review of abstracts, and application of inclusion criteria, 10 guidelines were identified for further evaluation (Table 2). The individual domain scores for each guideline are presented in Table 3. Rigour of development domain for six of the guidelines yielded a result greater than 70 and hence they were deemed as high-quality guidelines used to formulate statements and recommendations for the development of a clinical pathway. Four guidelines achieved a score below 70 and were not used in pathway designed. The lowest average scores were seen in the domains of stakeholder involvement and applicability with scores averaging to 46.95 and 48.5 respectively.

Number	Institution	Guideline	Publication	Abbreviation	Year
1	The European Association of Endoscopic Surgery (EAES)	EAES rapid guideline: appendicitis in the elderly	Surgical Endoscopy	EAES	2021
2	French Society of Digestive Surgery (SFCD) Society of Abdominal and Digestive Imaging (SIAD)	Adult appendicitis: Clinical practice guidelines from the French Society of Digestive Surgery and the Society of Abdominal and Digestive Imaging [24]	Journal of Visceral Surgery	SFCD SIAD	2021
3	Italian Polispecialistic Society of Young Surgeons (SPIGC)	Consensus Statement of the Italian Polispecialistic Society of Young Surgeons (SPIGC): Diagnosis and Treatment of Acute Appendicitis [25]	Journal of Investigative Surgery	SPIGC	2020
4	World Society of Emergency Surgery (WSES)	Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines [1].	World Journal of Emergency Surgery	WSES	2020
5	Eastern Association for the Surgery of Trauma (EAST) American College of Surgeons (ACS) American Association for the Surgery of Trauma (AAST)	Management of acute appendicitis in adults: A practice management guideline from the Eastern Association for the Surgery of Trauma [26]	Journal of Trauma and Acute Care Surgery	EAST	2019
6	XXIX National Congress of the Italian Society of Surgical Pathophysiology (SIFIPAC) Italian Society of Geriatric Surgery (SICG) World Society of Emergency Surgery (WSES) Italian Society of Emergency Medicine (SIMEU)	The SIFIPAC/WSES/SICG/SIMEU guidelines for diagnosis and treatment of acute appendicitis in the elderly (2019 edition) Open Access [27]	World Journal of Emergency Surgery	SIFIPAC	2019
7	American College of Radiology (ACR)	ACR Appropriateness Criteri® Suspected Appendicitis-Child [28]	Journal of the American College of Radiology	ACR	2019

8	American College of Radiology (ACR)	ACR Appropriateness Criteri® Right Lower Quadrant Pain-Suspected Appendicitis [29]	Journal of the American College of Radiology	ACR	2018
9	The European Association of Endoscopic Surgery (EAES)	Diagnosis and management of acute appendicitis. EAES consensus development conference 2015 [30]	Surgical Endoscopy	EAES	2016
10	Association of Italian Hospital Surgeons (ACOI)	Consensus conference on laparoscopic appendectomy: development of guidelines [31]	The Association of oloproctology of Great Britain and Ireland	ACOI	2011

Table 2: Guidelines assessed with AGREE II tool.

Guideline	Scope and Purpose	Stakeholder Involvement	Rigour of Development	Clarity of Presentation	Applic ability	Editorial Independence	Overall Assessment	Recommend for use
EAES (ELDERLY)	83.3	75	63.5	80.6	50	95.8	66.7	YM*
SFCD SIAD	52.8	33.3	70.8	80.6	39.6	100	58.3	Yes
SPIGC	50	36.1	62.5	94.4	47.9	83.3	75	Yes
WSES	88.9	52.8	82.3	94.4	58.3	100	83.3	Yes
EAST	97.2	58.3	83	75	77	100	58.3	YM*
SIFIPAC	97.2	38.9	80.2	94.4	52.1	100	83.3	YES
ACR HILD	83.3	36.1	48.9	69.4	33.3	37.5	66.7	YM*
ACR	80.5	30.6	48.9	69.4	35.4	33.33	66.7	YM*
EAES	80.6	52.8	75	75	39.6	75	58.3	YM*
ACOI	69.4	55.6	81.3	88.9	52.1	79.2	66.7	YM*
*Yes with modification								

Table 3: AGREE II score results based on domain scores.

Development of the Right Iliac Fossa Decision Tree Model

The statements from the guidelines were tabulated utilising the levels of evidence and grades of recommendations (Appendix 1). The WSES and most other articles [1,26,27,30]. utilised the GRADE scoring methodology and the SFCD/SIAD French guidelines [24] developed a grading system for evidence based on the type of evidence where high quality evidence from meta-analysis was deemed grade A, retrospective studies were grade B, case studies were grade C and finally expert opinion was deemed the lowest type of recommendation where the evidence was weak. Based on these recommendations, the team developed the final decision tree process as follows:

Initial Presentation

The beginning of the pathway was outlined by the patient of acute right iliac fossa pain presenting to the primary care physician or the emergency department triage. The focus of the clinicians during this initial presentation would be to carry out a robust history and clinical examination followed by relevant laboratory tests to finally deem the patient either suitable for discharge back into the community, or referral onto a specialist service such as surgery, gynaecology or paediatrics (Figure 3).

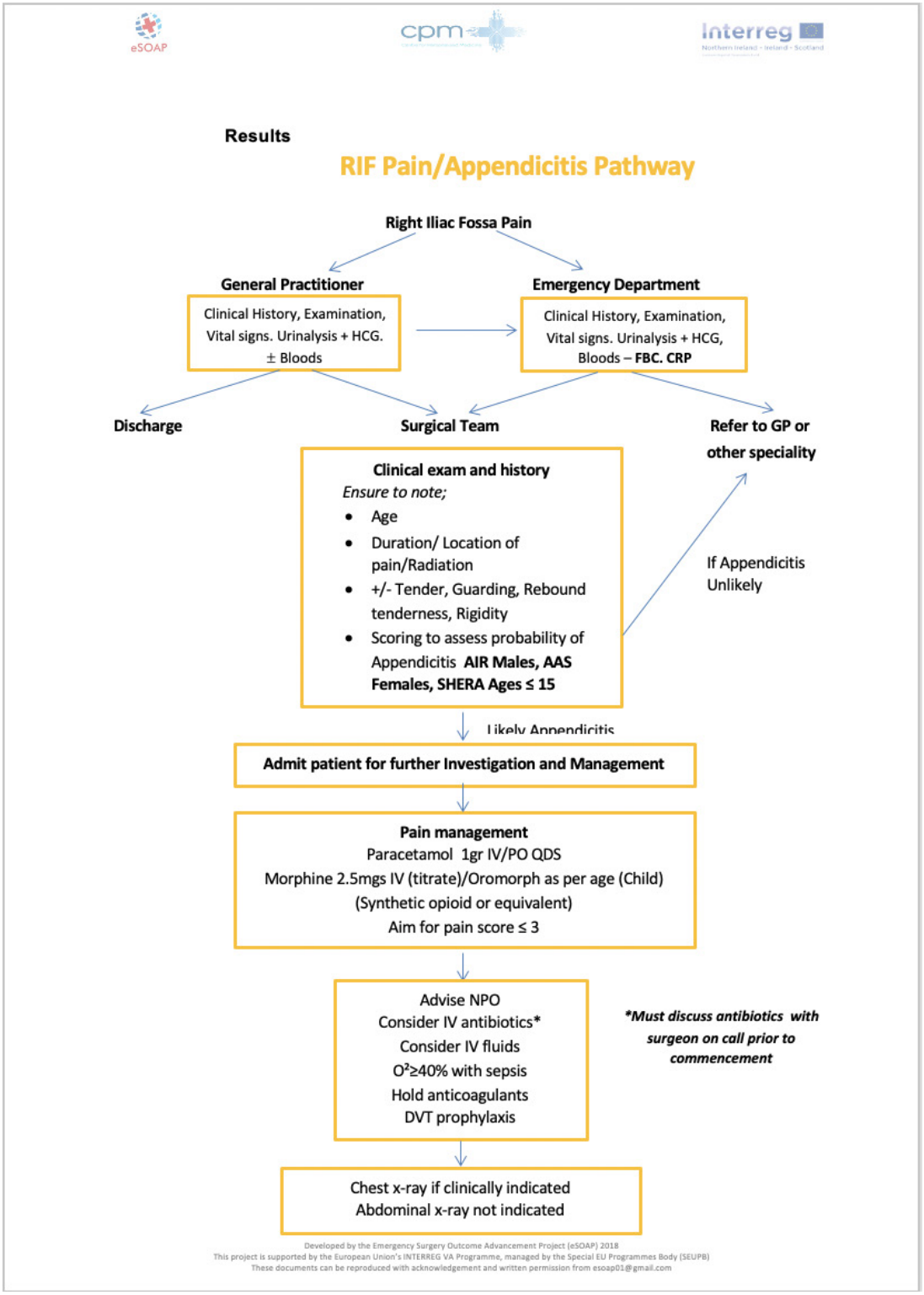

Figure 3: Pathway and Initial management of patients presenting with right iliac fossa pain.

Surgical Review

Appendicitis risk scoring systems are used as clinical adjuncts to aid in diagnosis; Appendicitis Inflammatory Response (AIR) score for males, Adult Appendicitis Score (AAS) for females and Shera score for paediatrics [32]. Following this, patients are assigned one of five distinct triaging categories (Figure 4).

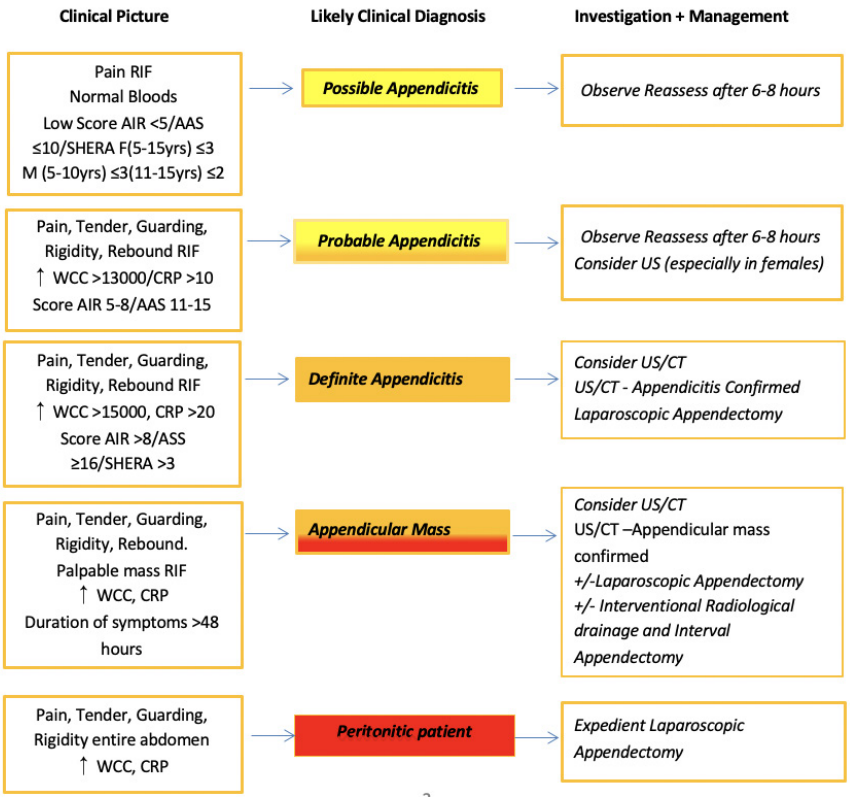

Figure 4: Five triage categories of patients presenting with right iliac fossa pain, based on the clinical, and laboratory findings along with utilisation of scoring systems.

Five Triaging Categories Defined

1. **Possible appendicitis:** The patient may have right iliac fossa pain but no guarding or rebound tenderness along with normal laboratory results. The male patient may have a low AIR score of less than 5 and a female may have an AAS score less than 10. The female paediatric patient aged 5-15 years may have a Shera score of less than or equal to 3. The male paediatric patient between the age of 5-10 years may have a Shera score of less than or equal to 3, and the age group between 11-15 may have a Shera score of less than or equal to 2
2. **Probable appendicitis:** These patients may have Right iliac fossa pain with rebound tenderness, guarding, or rigidity. The inflammatory markers would be raised, where the White Cell Count (WCC) is above 13000 and C- Reactive Protein (CRP) is above 10. The male patients may have an AIR score between 5-8 and the females may have an AAS score between 11-15
3. **Definite appendicitis:** Patients who have signs of rebound tenderness and guarding in the right iliac fossa with a raised WCC above 15000 and a CRP above 20 along with an AIR score above 8 for males, AAS score greater than or equal to 16 and children with a Shera score above 3 may be triaged to this category.
4. **Appendicular mass:** If the patient has similar features as the previous category along with fullness in the right iliac fossa on clinical examination and a history of duration of symptoms greater than 48 hours, this diagnosis may be considered.
5. **Peritonitic patient:** These patients may have signs of generalised peritonism on clinical exam along with the features of appendicitis.

Management

Management is guided by triaging category. All patients with likely appendicitis are admitted to hospital. These patients are kept fasting to facilitate possible surgery. Antibiotics may be considered in patients with a definitive appendicitis or after discussion with the senior surgeon on call. Fluid resuscitation and oxygen should follow the local sepsis protocol, followed by a chest x-ray if clinically indicated. Abdominal x-rays should not be done routinely (Figure 3). Once the patients have been triaged based on the proposed five categories, the management of the first two categories would be to reassess in six to eight hours with the consideration of a pelvic ultrasound especially for female patients. The diagnosis of definitive appendicitis in patients below the age of 35, may proceed to laparoscopic appendectomy, and patients above 35 may be considered for a CT scan. Patients with appendicular mass may have a step up approach of imaging with ultrasound followed by CT, and accordingly a laparoscopic appendectomy as an index operation or initial radiological drainage followed by interval appendectomy. Peritonitic patients should be managed by prompt surgical intervention (Figure 4).

Key Outcome Indicators

The systematic review yielded a total of 2470 results, out of which 246 were selected for review after application of the inclusion criteria. From these 246 abstracts, 9 articles were deemed eligible for our review as they contained generic information on key performance indicators for appendicitis [9,17,18-38]. From these articles, the KOIs were tabulated (Appendix 2) and a consensus meeting determined the KOIs for the audit and measurement of the performance of the pathway once implemented. These included 3 domains; 1. Care Process, that dealt with pathway enrolment and use of scoring systems, 2. Surgical Outcomes, which suggested laparoscopic approach with conversion to open rates below 3% and negative appendectomy rates below 10%, and finally, 3. Adverse events, which included 30-day re-admission rates following appendectomy to be less than 5% (Table 3).

Discussion

We identified six high quality guidelines using the AGREE II tool where the guidelines displayed a high standard in the rigour of development domain, and utilised their recommendations to develop a clinical pathway to facilitate clinicians in providing standardised patient care with optimal outcomes [12,16]. A rigorous process of systematic review was used to screen for guidelines to use in pathway design. These were then appraised and quality assessed using the readily available and user friendly AGREE II tool [21]. This tool has many benefits, as it helps delineates guidelines into defined, easily assessable domains which can be scored to provide an evaluation of quality, but the tool itself lacks clear thresholds or cutoffs to define guidelines as high, moderate, or low quality. Therefore, the more appraisers that a guideline may have, the better its scoring and quality assurance may be. Also, the experience of the appraisers and their clinical knowledge and practice also influences their scoring, and hence these biases still exist when the guidelines are appraised, and hence further research with increased number of appraisers may improve the guideline appraisal process.

Clinical pathways for appendicitis are not universal and multiple recommendations exist in different guidelines, and therefore, our study tailored a pathway based on expertise and resources from our institution [1,8,10,16]. The pathway is designed as a streamline for the patient journey from presentation to definitive treatment for those presenting RIF pain. Swift review of the low-risk group and discharge as appropriate leads to an increase in patient turnaround times. The high risk group would be recognised promptly with usage of a robust care pathway, with early antibiotics and theatre for standardised treatment and reduced complications. These important measures like patient demographics, time from triage to surgery, type of surgical approach, length of hospital stay, negative appendectomy rates and re admission rates along with complications, would be recorded onto a registry for further review on a digitalised platform which would generate annual reports and correlate these findings with the local morbidity and mortality meetings data to further audit the acute surgical care provided to patients presenting with appendicitis and over all improve outcomes related to patients, clinicians, and nursing staff. Key outcome indicators are a measurement metric that allows outcomes to govern patient care and helps shift focus of research to relevant measurable parameters that are well established and reproducible [39,40]. We utilised the previous literature and local expertise to determine KOIs for our study and hence have a system in place to audit our pathway. This is a limitation in our study, as the key to developing KOIs is through specific methodology like the Delphi or the modified Delphi method, where panels of experts determine the KOIs through multiple survey processes, and hence future research in determining KOIs could be undertaken after the audit of our pathways [41,42].

Conclusion

Appraisal of guidelines to establish an evidence base for the development and implementation of a robust pathway incorporating clinical, laboratory and radiological findings, which will be measurable against established key performance indicators, should set a template to improve quality care in appendicitis.

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Appendix 1: Summary of guidance statements and recommendations.

Statement	Supporting Guideline	Grade of Evidence
Clinical Diagnosis		
Right Iliac fossa pain and normal laboratory results (normal WCC and CRP) not sufficient to out rule appendicitis. A tailored individualized approach is recommended, depending on disease probability, gender, and age of the patient	SFCD/SIAD WSES	LoE low, GoR weak LoE: Moderate; GoR: Strong
Scoring Systems		
Clinical scoring systems recommended to exclude acute appendicitis and stratify intermediate- risk patients for further imaging. AIR scores and AAS scores are the best performing scoring systems and are recommended to be used in the diagnostic pathway	WSES	LoE High, GoR Strong
Imaging		
Ultrasound may be considered as a first line for children and female patients. CT scan is preferred for high-risk patients younger than 40 years old (with AIR score 9-12 and Alvarado score 9-10 and AAS $\geq$ 16). All elderly patients should have adequate diagnostic imaging and clinical scores and examination may not be sufficient to diagnose appendicitis accurately	WSES SFCD/SIAD SIFIPAC	LoE low, GoR weak
Management		
Laparoscopic approach is recommended for all patients over open approach if expertise and equipment is available and no other contraindications exist. In case of complicated appendicitis, non-operative management t may be considered it has risk of long term failure. Patients with complicated appendicitis should have surgery within 8 hours Recommendations are against post-operative abdominal drains	WSES SFCD/SIAD	LoE High GoR Strong LoE low GoR weak
Special Circumstances		
Pregnant women and children may benefit from ultrasound as a primary imaging investigation followed by MRI (subject to availability) to avoid unnecessary exposure to radiation	WSES SFCD/SIAD	LoE moderate, GoR weak
* LoE: Level of **evidence**, GoR: Grade of Recommendation		

Appendix 2: Summary of Key Performance indicators from the literature

Year	Author	Article	Key Performance Indicators (KOI)	Appendicitis Specific KOIs
2021	Jukic et al.	Incidence and causes of 30-day readmission rate from discharge as an indicator of quality care in paediatric surgery	30 day Re-admission rate	30 day Re-admission rate
2020	Sherratt et al	Core outcome set for uncomplicated acute appendicitis in children and young people	1. Adverse events	1. Adverse events
			a. Bowel obstruction	a. Bowel obstruction
			b. Wound infection	b. Wound infection
			c. Wound complication	c. Wound complication
			2. Pathophysiological manifestations	2. Pathophysiological manifestations
			a. Negative appendicectomy	a. Negative appendicectomy
			b. Recurrent appendicitis	b. Recurrent appendicitis
			c. Intra-abdominal abscess	c. Intra-abdominal abscess
			d. Antibiotic failure for non-operative management	d. Antibiotic failure for non-operative management
			3. Life impact	3. Life impact
			a. Child's quality of life	a. Child's quality of life
			b. Patient stress/psychological distress	b. Patient stress/psychological distress
			c. Time away from full activity	c. Time away from full activity
			4. Resource use	4. Resource use
			a. Length of hospital stay	a. Length of hospital stay
			b. Readmission to hospital	b. Readmission to hospital
			c. Reoperation (including interventional radiology procedure)	c. Reoperation (including interventional radiology procedure)
			5. Mortality	5. Mortality

2019	Hardy et al	The Impact of an Acute Care Surgical Service on the Quality and Efficiency of Care Outcome Indicators for Patients with General Surgical Emergencies	Efficiency of care variables:	1. 30-day Re-admission
			1. Time variables:	2. Pathology
			a. Transfer to hospital(from original hospital)	3. Type pf operation:
			b. Triage time	a. Laparoscopic
			c. Time to Emergency room physician (ERP) assessment	b. Open
			d. Time to imaging	c. Conversion rates
			e. Time to surgical consult	
			f. Surgical response time	
			g. Admission time	
			h. Time to Operating Room (OR) after surgical assessment	
			i. Duration of OR	
			j. Time of operation:	
			i.Day	
			ii.Evening	
			iii.Night	
			k. Time from OR to discharge	
			l. Length of stay (LOS)	
			2. Complications:	
			a. Intra-operative	
			b. Intervention-related	
			c. Postoperative (Clavien-Dindo Classification System on a scale of I through V)	
			d. 30-day hospital readmission rate	
			e. 30-day emergency room (ER) visits,	
			3. Risk of perforated appendicitis,	
			4. Pathology for appendectomy and cholecystectomy specimens.	
			5. Co Morbidities	
			6. Age	
			7. Gender	
			8. Type of Operation	
			a. Laparoscopic	
			b. Open	
			c. Conversion rates	

2019	Mears et al	Readmission within 30 days of discharge (ReAd): a quality-of-care indicator in paediatric surgery	30 day Re-admission rate	30 day Re-admission rate
2018	Mathur et al	Emergency general surgery and trauma: Outcomes from the first consultant-led service in Singapore	1. Case time (min) from booking to OT	1. Case time (min) from booking to OT
			2. Priority 1 (P1)	2. Priority 1 (P1)
			3. Priority 1 (P2)	3. Priority 1 (P2)
			4. Priority 3 (P3)	4. Priority 3 (P3)
			5. Time from ED referral to Surgical review (min)	5. Time from ED referral to Surgical review (min)
			6. Consultant in OT for major cases (%)	6. Consultant in OT for major cases (%)
			7. Cases performed at day/night time (%)	7. Cases performed at day/night time (%)
			a. Day (07:30-16:00)	a. Day (07:30-16:00)
			b. After hours (16:00-07:30)	b. After hours (16:00-07:30)
			8. Hospital Cost	8. Hospital Cost
			9. ICU length of stay (d)	9. ICU length of stay (d)
			10. Overall length of stay (d)	10. Overall length of stay (d)
			11. Re-admission rate (%)	11. Re-admission rate (%)
			12. Mortality	12. Mortality
2018	Balasubramanian et al	Impact of an acute surgical unit in appendicectomy outcomes: A systematic review and meta-analysis	1. Time to theatre	1. Time to theatre
			2. Negative appendectomy rate	2. Negative appendectomy rate
			3. Length of hospital stay	3. Length of hospital stay
			4. Postoperative complications	4. Postoperative complications
			5. Night time operating	5. Night time operating
			6. conversion to open surgery	6. conversion to open surgery

2016	Shilton et al	Is the acute surgical unit model feasible for Australian regional centres?	1. Gender	7. Gender
			2. Mean age	8. Mean age
			3. Time to theatre (mins)	9. Time to theatre (mins)
			4. Operating time (mins)	10. Operating time (mins)
			5. Day of operation	11. Day of operation
			a. Day 0	a. Day 0
			b. Day1	b. Day1
			c. Day 2	c. Day 2
			d. Day 3	d. Day 3
			e. >Day 3	e. >Day 3
			6. Time of operation	12. Time of operation
			a. 08.00-18.00 hours	a. 08.00-18.00 hours
			b. 18.00-24.00 hours	b. 18.00-24.00 hours
			c. 00.00-08.00 hours	c. 00.00-08.00 hours
			d. Total after-hours 18.00-08.00	Total after-hours 18.00-08.00
2014	Lancashire et al	Introduction of an Acute Surgical Unit: Comparison of Performance Indicators and Outcomes for Operative Management of Acute Appendicitis	1. Age (years)	1. Age (years)
			2. Female sex (%)	2. Female sex (%)
			a. Females aged 15-45 years	a. Females aged 15-45 years
			3. ED LOS (h)	3. ED LOS (h)
			a. Time from ED arrival to admission (h)	a. Time from ED arrival to admission (h)
			b. Time from admission to ED departure (h)	b. Time from admission to ED departure (h)
			c. Time from admission to operation start (h)	c. Time from admission to operation start (h)
			d. Time from ED arrival to operation start (h)	d. Time from ED arrival to operation start (h)
			4. Total admission LOS (days)	4. Total admission LOS (days)
			5. Postoperative LOS (days)	5. Postoperative LOS (days)
			6. Patients with preoperative imaging	6. Patients with preoperative imaging
			7. Patients without preoperative imaging	7. Patients without preoperative imaging
			8. Total admission costs	

2013	Pillai et al	Comparison of appendicectomy outcomes: acute surgical versus traditional pathway	1. Length of stay	1. Median age in years (range)
			2. Surgical complications	2. Gender (M : F)
			3. Return to theatre	3. ASA ≥ 2
			4. Re-admission	4. Perforated appendicitis
			5. Time to theatre	5. Median time to theatre (h)
			6. Weekend discharge rate	6. Duration of operation (min)
			7. Proportion of operations during daylight hours	7. Proportion daytime operations
			8. Duration of operation	8. Mean admission to consultation time (h)
			9. Time from referral to review	9. Trainee as primary surgeon
			10. Mortality	10. Total length of stay (days)
				11. Return to theatre
				12. 30-day readmission rate
				13. Surgical complications
				14. Wound complications
				15. Intra-abdominal collection
				16. Death