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Review Article

An Update on the Role of the Clinical Scoring Systems in the Diagnosis of Acute Appendicitis: Review Article

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Abstract: Clinical scoring systems have been developed to risk-stratify patients who are presented to the emergency department with symptoms of acute appendicitis. They are used to rule out patients with acute appendicitis and those who may require imaging in the form of ultrasound or computerized tomography. The common scoring systems are the Alvarado score, RIPASA score, AIR, and AAS. In this chapter, we will look at the common clinical scoring systems that are used for adults and children. We will also look at the role of these scoring systems in diagnosing acute appendicitis and reducing the negative appendectomy rate.

Keywords: Alvarado Score, AIR Score, AAS, Clinical scoring systems, Imaging, Modified Alvarado Score, and RIPASA score.

INTRODUCTION

Acute appendicitis is one of the most common acute abdominal conditions that is presented to the general surgeon. It is most seen in young adults, especially in the 20 and 30 years of age. It has a slightly higher incidence in males rather than females, with a ratio of 1.4:1. The diagnosis of acute appendicitis involves the history of abdominal pain starting from the periumbilical region radiating to the right iliac fossa, and it is associated with nausea, vomiting, or fever. On clinical examination of the abdomen, there may be guarding and rigidity over the right iliac fossa, with tenderness at McBurney's point. Blood investigations like full blood count to look for leukocytosis and raised C-reactive protein (CRP) are included. Imaging modalities like ultrasound and computerized tomography may be done to establish the diagnosis of acute appendicitis(Krzyzak & Mulrooney, 2020).

These diagnostic approaches are important in the workup of a patient who is present with a suspected diagnosis of acute appendicitis. This includes the clinical scoring systems that employ focused history, clinical examination, and blood investigation, like leukocytosis. These clinical scoring systems can be used in the emergency department to risk stratify into low, intermediate, and high risk of acute appendicitis. Another important function of these scoring systems is to select which patients will require further investigations using imaging modalities like ultrasound and computerized tomography. The most common clinical scoring systems that are used include the Alvarado, Modified Alvarado, RIPASA, Appendicitis Inflammatory Response (AIR), and Adult Appendicitis Score (ASS)(Alvarado, 2018; Bom *et al.*, 2021; Mundada *et al.*, 2020; Teng *et al.*, 2021).

The World Society of Emergency Surgeons (WSES) has recommended that clinical scoring systems be used to exclude acute appendicitis and to identify adult patients who may require further imaging in the form of ultrasound or computerized tomography (CT). They have recommended that these clinical scoring systems be used as clinical predictors for acute appendicitis, and they have recommended that the Appendicitis Inflammatory Response (AIR) and the Adult Appendicitis Score (AAS) are the best at

performing this. For pediatric patients, they have recommended that clinical scores can be used to rule out acute appendicitis, but not to diagnose it alone (Di Saverio *et al.,* 2020).

In this article, we will review the role of the common clinical scoring systems that are used to diagnose acute appendicitis, and which patients would require further investigations in the form of imaging. We conducted a literature review using PUBMED, the Cochrane database of systematic reviews, Google Scholar, and Semantic Scholar, looking for randomized controlled trials, non-randomized trials, observational and cohort studies, clinical reviews, systematic reviews, and meta-analyses from 1990 to 2025. The following keywords were used, "clinical scoring system", "Alvarado score", "Modified Alvarado score", "RIPASA score "," AIR score"," ASS score" and "Imaging". All articles were in English and were assessed by manual cross-referencing of the literature. Commentaries and case reports were excluded from this review. Adult and pediatric patients were included in this study, and pregnant patients were excluded.

DISCUSSION

The Common Clinical Scoring Systems in Adults

Alfredo Alvarado introduced the Alvarado score, the most common clinical scoring system, to aid in the diagnosis of acute appendicitis. This score incorporates three clinical symptoms, migration of abdominal pain, anorexia, and nausea, three clinical signs, tenderness at the right iliac fossa, rebound tenderness, and elevated temperature, and two laboratory investigations, leukocytosis and shift to the left. A score of less than 4 was unlikely to be acute appendicitis, a score of 4 to 7 would require further investigations in the form of imaging, and a score of 8 to 10 was likely to be acute appendicitis(A Practical Score for the Early Diagnosis of Acute Appendicitis,1986).

The Alvarado score is a simple tool that can be used in the emergency department to risk-stratify patients with acute appendicitis who would require admission and further investigations in the form of imaging. This score is also useful in reducing the negative appendectomy rate in patients with suspected acute appendicitis(Bouali *et al.,* 2022; Gebreselassie *et al.,* 2023; Memon *et al.,* 2013).A systematic review was conducted by Ohle *et al.,* on the diagnostic ability of the Alvarado score.42 studies were included in this study, and an Alvarado score of 5 or below was associated with a 99% sensitivity in ruling out acute appendicitis in adults(Ohle *et al.,* 2011).Another systematic review was conducted by Gupta *ET AL.,* using the Alvarado score to predict acute appendicitis. 17 studies with 2239 patients were included in this study, and an Alvarado score of 7 and above was associated with a significant predictor of acute appendicitis(S. Gupta *et al.,* 2023). A systematic review and meta-analysis were conducted by Kinesya *et al.,* on the diagnostic accuracy of the Alvarado score components in patients with appendicitis. 32 studies with 10,862 patients were included in this study. This study showed that a low Alvarado score was sensitive to rule out acute appendicitis, and the components with the highest sensitivity included right lower abdominal pain, nausea and vomiting(Kinesya *et al.,* 2022).

The modified Alvarado score involved the removal of the shift to the left of the neutrophils and reducing the parameters from 10 to 9. This score was able to provide a high degree of sensitivity, specificity, positive predictive and negative predictive value in the diagnosis of acute appendicitis(District General Hospital *et al.,* 1994; Jain *et al.,* 2018; Kanumba *et al.,* 2011).The modified Alvarado score was compared with the Alvarado score for the diagnosis of acute appendicitis by Phophrom *et al.,* The modified Alvarado score was associated with a slightly greater sensitivity and specificity than the Alvarado score in diagnosing acute appendicitis(Phophrom & Trivej, 2005).

The Raja Isteri Pengiran Anak Saleha appendicitis (RIPASA) is a clinical scoring system that was developed to diagnose acute appendicitis in Asian patients. This score includes 18 parameters, of which 4 include patient information,6 symptoms,5 signs,2 investigations, and 1 additional score. A score of 7 or less indicates a low probability of acute appendicitis, and a score of 12 or above is associated with a high probability of acute appendicitis(Chee & Chong, 2010). Using a cut-off value of 7.5 was associated with good sensitivity and specificity for the diagnosis of acute appendicitis. This showed that the RIPASA score is a safe and easy diagnostic tool in the diagnosis of acute appendicitis(Karapolat, 2019; Koroth *et al.,* 2024; Malik *et al.,* 2017; Mumtaz *et al.,* 2022; Singh *et al.,* 2018).

The RIPASA score was found to be superior in detecting acute appendicitis in the Asian population, which was validated by Mumtaz *et al.,* (Mumtaz *et al.,* 2022).The RIPASA score was evaluated in the Irish population by Malik *et al.,* and they used the cut-off score of 7.5 to diagnose acute appendicitis. They were able to demonstrate a similar sensitivity and specificity with the eastern populations(Malik *et al.,* 2017)The RIPASA score was compared with the Alvarado and Modified Alvarado score, and it had better sensitivity, specificity, positive predictive, and negative predictive value for diagnosing acute appendicitis(Ashkan Tabibzadeh Dezfuli *et al.,* 2019; Damburacı *et al.,,* 2020; Heiranizadeh *et al.,* 2023; Inteti *et al.,* 2024; Noor *et al.,* 2020; Shuaib *et al.,* 2017).

A systematic review and meta-analysis comparing the RIPASA and Alvarado score for the risk assessment of acute appendicitis was conducted by Favara *et al.,* 35 studies with 5384 patients were included in this study. The sensitivity and specificity of the RIPASA score were 0.95 and 0.71, and the Alvarado score was 0.72 and 0.77. This study showed that the

RIPASA score was more sensitive in the diagnosis of acute appendicitis, but it had a lower specificity than the Alvarado score(Favara *et al.,* 2022).A meta-analysis of randomized controlled trials comparing the Alvarado and RIPASA score for the diagnosis of acute appendicitis was conducted by Frountzas *et al.*,12 studies with 2161 patients were included in this study, and the sensitivity and specificity of the RIPASA score was 94% and 55%, and the Alvarado score was 69% and 77%.This study also showed that the RIPASA score was more sensitive but lacked specificity in the diagnosis of acute appendicitis(Frountzas *et al.*, 2018).

The Appendicitis Inflammatory Response (AIR) score is another score that includes clinical symptoms and signs, but the blood investigations include total white cell count and C-reactive protein levels. A score of less than 3 is unlikely to be acute appendicitis, a score of 4-8 is a medium probability of acute appendicitis, and a score of 8 and above is highly likely for acute appendicitis(M. Andersson *et al.,* 2021)This score was found to be effective in reducing the waiting time in the emergency department and the complementary examination for suspected acute appendicitis(Deboni *et al.,* 2022; V. Gupta *et al.,* 2022; Von-Mühlen *et al.,* 2015)A systematic review and meta-analysis were conducted by Andersson *et al.,* to look at the diagnostic value of the Appendicitis Inflammatory Response(AIR) score.26 studies with 15,699 patients were included in this study. The sensitivity of the score in diagnosing acute appendicitis was 0.86 to 0.93, and its specificity was 0.98. This study showed that the Appendicitis Inflammatory Response Score (AIR) was effective for risk stratification of patients with acute appendicitis(R. E. Andersson & Stark, 2025).

The Adult Appendicitis Score (AAS) is another scoring system that employs clinical symptoms, signs, and blood investigations that include total white cell count and C-reactive protein (CRP). A score of less than 10 was associated with a low risk of appendicitis, a score of 11-15 was associated with an intermediate risk of appendicitis, and a score of more than 16 was associated with a high risk of acute appendicitis. This scoring system was valuable in the risk stratification of patients who may require imaging(Sammalkorpi *et al.,* 2017).This score was prospectively evaluated, and it was found to be sensitive and specific in the diagnosis of acute appendicitis, and it reduced the number of patients who would require imaging(Sammalkorpi *et al.,* 2014).

Study	Study type	Year	Alvarado score - sensitivity (%)	Alvarado score-specificity (%)	RIPASA score-sensitivity (%)	RIPASA score-specificity (%)	AIR score-sensitivity (%)	AIR score-specificity (%)
Frountzas *et al.,*	Meta-analysis	2018	69	77	94	55		
Andersson *et al.,*	Meta-analysis	2025	79	88			86	93
Favara *et al.,*	Systematic review & meta-analysis	2022	72	77	95	71		

Table comparing the sensitivity and specificity of the Alvarado, RIPASA, and AIR scoring systems

The Common Clinical Scoring Systems in Children

The Alvarado and the Pediatric Appendicitis Score (PAS) are the most common scoring systems that have been employed in the diagnosis of acute appendicitis in children. Both scoring systems employ 8 components with a total score of 10. Both scoring systems can divide patients into low, intermediate, and high risk for acute appendicitis. The sensitivity and specificity of these scores are in the range of 80% to 90% only(Rentea & St. Peter, 2017; van Amstel *et al.,* 2019).Both the Alvarado score and the Pediatric Appendicitis Score (PAS) have been validated in some studies and have been useful to risk-stratify patients who may require further imaging or admission to the hospital(Iftikhar *et al.,* 2021; Maaz Salahuddin *et al.,* n.d.).

A systematic review was conducted by Kulik *et al.,* on the clinical prediction rules for children with acute appendicitis. 12 studies with 4201 patients were included in this study, and the Alvarado and the Pediatric Appendicitis Score (PAS) were the most validated scores. The sensitivity of the Alvarado score was 0.72 – 0.93, and the Pediatric Appendicitis Score (PAS) was 0.82 – 1(Kulik *et al.,* 2013). Another systematic review was conducted by Ebell *et al.,* to look at the cutoff values for the Alvarado score and Pediatric Appendicitis Score (PAS) for acute appendicitis. 26 studies were included in this study, and an Alvarado score of less than 4 rules out acute appendicitis in 60% of the cases, with a score of 8 and above diagnosing acute appendicitis in 60% of cases(Ebell & Shinholser, 2014).

The Appendicitis Inflammatory Response (AIR) is a new clinical scoring system that has been developed to risk-stratify patients with acute appendicitis. This scoring system was compared with the Alvarado score and the Pediatric Appendicitis Score (PAS), and it was found to have a high discriminating power and outperforms the Alvarado and Pediatric

Appendicitis Score(Gudjonsdottir *et al.*, 2021; Macco *et al.*, 2016).

Clinical Scoring Systems with Ultrasonography

Clinical scoring systems with ultrasonography have been used to increase diagnostic accuracy for acute appendicitis and reduce the negative appendectomy rate. Senocak *et al.*, assessed this on the effect on negative appendectomy rate and gender, and they found that the use of clinical scoring systems and ultrasound brought down the negative appendectomy rate in female patients(Şenocak & Kaymak, 2020).A prospective study was conducted by Sirpailli *et al.*, looking at the efficacy of the modified Alvarado score with ultrasound in the diagnosis of acute appendicitis. This study concluded that the combination of the Modified Alvarado score with ultrasound increases the diagnostic ability of this scoring system(Sirpaili *et al.*, 2024). Another study by Al-Wageeh *et al.*, using the Alvarado score with abdominal ultrasonography, also demonstrated the increased diagnostic ability of acute appendicitis(Al-Wageeh *et al.*, 2024).

CONCLUSION

The clinical scoring systems have a role to play in the risk stratification of patients with suspected acute appendicitis who present to the emergency department. They can be used to rule out acute appendicitis and decide which patients will require imaging in the form of ultrasound or computerized tomography. The Alvardo, RIPASA, AIR, and AAS are the most common clinical scoring systems used. Combining these clinical scoring systems with ultrasound may be useful in resource-limited countries to increase the diagnostic ability of acute appendicitis and decrease the negative appendectomy rate.

Conflict of Interest: There is no conflict of interest

REFERENCES

- *A Practical Score for the Early Diagnosis of Acute Appendicitis*. (n.d.). Alvarado A. (1986). A practical score for the early diagnosis of acute appendicitis. *Annals of emergency medicine*, *15*(5), 557–564. https://doi.org/10.1016/s0196-0644(86)80993-3
- Alvarado, A. (2018). Diagnostic Scores in Acute Appendicitis. In *Current Issues in the Diagnostics and Treatment of Acute Appendicitis*. InTech. https://doi.org/10.5772/intechopen.77230
- Al-Wageeh, S., Alyhari, Q. A., Ahmed, F., Altam, A., Alshehari, G., & Badheeb, M. (2024). Evaluating the Diagnostic Accuracy of the Alvarado Score and Abdominal Ultrasound for Acute Appendicitis: A Retrospective Single-Center Study. *Open Access Emergency Medicine*, *16*, 159–166. https://doi.org/10.2147/OAEM.S462013
- Andersson, M., Kolodziej, B., & Andersson, R. E. (2021). Validation of the Appendicitis Inflammatory Response (AIR) Score. *World Journal of Surgery*, *45*(7), 2081–2091. https://doi.org/10.1007/s00268-021-06042-2
- Andersson, R. E., & Stark, J. (2025). Diagnostic value of the appendicitis inflammatory response (AIR) score. A systematic review and meta-analysis. *World Journal of Emergency Surgery : WJES*, *20*(1), 12. https://doi.org/10.1186/s13017-025-00582-x
- Ashkan Tabibzadeh Dezfuli, S., Yazdani, R., Khorasani, M., & Alireza Hosseinikhah, S. (2019). Comparison between the specificity and sensitivity of the RIPASA and Alvarado Scoring systems in the diagnosis of acute appendicitis among patients with complaints of right iliac fossa. *AIMS Public Health*, *7*(1), 1–9. https://doi.org/10.3934/publichealth.2020001
- Bom, W. J., Scheijmans, J. C. G., Salminen, P., & Boermeester, M. A. (2021). Diagnosis of Uncomplicated and Complicated Appendicitis in Adults. In *Scandinavian Journal of Surgery* (Vol. 110, Issue 2, pp. 170–179). SAGE Publications Inc. https://doi.org/10.1177/14574969211008330
- Bouali, M., El Berni, Y., Moufakkir, A., El Bakouri, A., El Hattabi, K., Bensardi, F., & Fadil, A. (2022). Value of Alvarado scoring system in diagnosis of acute appendicitis. *Annals of Medicine and Surgery*, *77*. https://doi.org/10.1016/j.amsu.2022.103642
- Chong, C. F., Adi, M. I., Thien, A., Suyoi, A., Mackie, A. J., Tin, A. S., Tripathi, S., Jaman, N. H., Tan, K. K., Kok, K. Y., Mathew, V. V., Paw, O., Chua, H. B., & Yapp, S. K. (2010). Development of the RIPASA score: a new appendicitis scoring system for the diagnosis of acute appendicitis. *Singapore medical journal*, *51*(3), 220–225.
- Damburacı, N., Sevinç, B., Güner, M., & Karahan, Ö. (2020). Comparison of Raja Isteri Pengiran Anak Saleha Appendicitis and modified Alvarado scoring systems in the diagnosis of acute appendicitis. *ANZ Journal of Surgery*, *90*(4), 521–524. https://doi.org/10.1111/ans.15607
- Deboni, V. S., Rosa, M. I., Lima, A. C., Graciano, A. J., & Garcia, C. E. (2022). THE APPENDICITIS INFLAMMATORY RESPONSE SCORE FOR ACUTE APPENDICITIS: IS IT IMPORTANT FOR EARLY DIAGNOSIS? *Arquivos Brasileiros de Cirurgia Digestiva*, *35*. https://doi.org/10.1590/0102-672020220002e1686
- Di Saverio, S., Podda, M., De Simone, B., Ceresoli, M., Augustin, G., Gori, A., Boermeester, M., Sartelli, M., Coccolini, F., Tarasconi, A., De' Angelis, N., Weber, D. G., Tolonen, M., Birindelli, A., Biffl, W., Moore, E. E., Kelly, M., Soreide, K., Kashuk, J., … Catena, F. (2020). Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. In *World Journal of Emergency Surgery* (Vol. 15, Issue 1). BioMed Central Ltd. https://doi.org/10.1186/s13017-020-00306-3
- Kalan, M., Talbot, D., Cunliffe, W. J., & Rich, A. J. (1994). Evaluation of the modified Alvarado score

in the diagnosis of acute appendicitis: a prospective study. *Annals of the Royal College of Surgeons of England*, *76*(6), 418–419.

- Ebell, M. H., & Shinholser, J. (2014). What are the most clinically useful cutoffs for the alvarado and pediatric appendicitis scores? a systematic review. *Annals of Emergency Medicine*, *64*(4), 365-372.e2. https://doi.org/10.1016/j.annemergmed.2014.02.025
- Favara, G., Maugeri, A., Barchitta, M., Ventura, A., Basile, G., & Agodi, A. (2022). Comparison of RIPASA and ALVARADO scores for risk assessment of acute appendicitis: A systematic review and meta-analysis. In *PLoS ONE* (Vol. 17, Issue 9 September). Public Library of Science. https://doi.org/10.1371/journal.pone.0275427
- Frountzas, M., Stergios, K., Kopsini, D., Schizas, D., Kontzoglou, K., & Toutouzas, K. (2018). Alvarado or RIPASA score for diagnosis of acute appendicitis? A meta-analysis of randomized trials. In *International Journal of Surgery* (Vol. 56, pp. 307–314). Elsevier Ltd. https://doi.org/10.1016/j.ijsu.2018.07.003
- Gebreselassie, H., Zeleke, H., & Ashebir, D. (2023). Diagnosis of Acute Appendicitis: A Cross-sectional Study on Alvarado's Score from a Low Income Country. *Open Access Emergency Medicine*, *15*, 253–258. https://doi.org/10.2147/OAEM.S410119
- Gudjonsdottir, J., Marklund, E., Hagander, L., & Salö, M. (2021). Clinical Prediction Scores for Pediatric Appendicitis. *European Journal of Pediatric Surgery*, *31*(3), 252–260. https://doi.org/10.1055/s-0040-1710534
- Gupta, S., Kolli, V. S., Da Costa, K., Javed, S., Ammar, A., & Rasheed, A. (2023). A systematic review and meta-regression for validation of the Alvarado score as a tool for predicting acute appendicitis. *Annals of Medicine & Surgery*, *85*(2), 111–121. https://doi.org/10.1097/ms9.0000000000000238
- Gupta, V., Gupta, P., Gill, C., & Gupta, M. (2022). Appendicitis inflammatory response score in acute appendicitis: A study at a tertiary care center in North India. *International Journal of Applied and Basic Medical Research*, *12*(4), 234. https://doi.org/10.4103/ijabmr.ijabmr_287_22
- Heiranizadeh, N., Mousavi Beyuki, S. M. H., kargar, S., Abadiyan, A., & Mohammadi, H. R. (2023). Alvarado or RIPASA? Which one do you use to diagnose acute appendicitis?: A cross-sectional study. *Health Science Reports*, *6*(1). https://doi.org/10.1002/hsr2.1078
- Iftikhar, M. A., Dar, S. H., Rahman, U. A., Butt, M. J., Sajjad, M., Hayat, U., & Sultan, N. (2021). Comparison of Alvarado score and pediatric appendicitis score for clinical diagnosis of acute appendicitis in children—a prospective study. *Annals of Pediatric Surgery*, *17*(1). https://doi.org/10.1186/s43159-021-00079-7
- Inteti, K., Shaik, M. R., Ganapa, P., & Gandi, P. S. (2024). A Comparison of the Alvarado Score and the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) Score in the Diagnosis of Acute Appendicitis: A Prospective Cohort Study. *Cureus*. https://doi.org/10.7759/cureus.68041
- Jain, S., Gehlot, A., & Songra, M. C. (2018). Modified alvarado score in diagnosis of acute appendicitis: a clinicopathological study. *International Surgery Journal*, *5*(3), 878. https://doi.org/10.18203/2349-2902.isj20180415
- Kanumba, E. S., Mabula, J. B., Rambau, P., & Chalya, P. L. (2011). Modified Alvarado Scoring System as a diagnostic tool for Acute Appendicitis at Bugando Medical Centre, Mwanza, Tanzania. *BMC Surgery*, *11*. https://doi.org/10.1186/1471-2482-11-4
- Karapolat, B. (2019). Can RIPASA Scoring System Predict the Pathological Stage of Acute Appendicitis? *Emergency Medicine International*, *2019*, 1–5. https://doi.org/10.1155/2019/8140839
- Kinesya, E., Cintya, E. P., Dorothy, M. J., Ennaidi, N. N., Rusti, H. F., Mannagalli, Y., & Pasaribu, E. A. (2022). Diagnostic accuracy of Alvarado score components in patients with appendicitis: Systematic review and meta-analysis approach. *Health Sciences Review*, *2*, 100018. https://doi.org/10.1016/j.hsr.2022.100018
- Koroth, A., Basheer, S., Abdul Rasheed, M. F., Ali Usman, A., & Sadanandan, A. (2024). Association Between Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) Scoring and Pathological Severity of Acute Appendicitis: A Cross-Sectional Study. *Cureus*. https://doi.org/10.7759/cureus.56166
- Krzyzak, M., & Mulrooney, S. M. (2020). Acute Appendicitis Review: Background, Epidemiology, Diagnosis, and Treatment. *Cureus*. https://doi.org/10.7759/cureus.8562
- Kulik, D. M., Uleryk, E. M., & Maguire, J. L. (2013). Does this child have appendicitis? A systematic review of clinical prediction rules for children with acute abdominal pain. *Journal of Clinical Epidemiology*, *66*(1), 95–104. https://doi.org/10.1016/j.jclinepi.2012.09.004
- Salahuddin, S. M., Ayaz, O., Jaffer, M., Naeem, R., Tikmani, S. S., & Mian, A. I. (2022). Pediatric Appendicitis Score for Identifying Acute Appendicitis in Children Presenting With Acute Abdominal Pain to the Emergency Department. *Indian pediatrics*, *59*(10), 774–777.
- Macco, S., Vrouenraets, B. C., & de Castro, S. M. M. (2016). Evaluation of scoring systems in predicting acute appendicitis in children. *Surgery (United States)*, *160*(6), 1599–1604. https://doi.org/10.1016/j.surg.2016.06.023
- Malik, M. U., Connelly, T. M., Awan, F., Pretorius, F., Fiuza-Castineira, C., El Faedy, O., & Balfe, P. (2017). The RIPASA score is sensitive and specific for the diagnosis of acute appendicitis in a western

population. *International Journal of Colorectal Disease*, *32*(4), 491–497. https://doi.org/10.1007/s00384-016-2713-4

- Memon, Z. A., Irfan, S., Fatima, K., Iqbal, M. S., & Sami, W. (2013). Acute appendicitis: Diagnostic accuracy of Alvarado scoring system. *Asian Journal of Surgery*, *36*(4), 144–149. https://doi.org/10.1016/j.asjsur.2013.04.004
- Mumtaz, H., Sree, G. S., Vakkalagadda, N. P., Anne, K. K., Jabeen, S., Mehmood, Q., Mehdi, Z., Sohail, H., Haseeb, A., Zafar, Y., Saghir, S., & Hasan, M. (2022). The RIPASA scoring system: A new Era in appendicitis diagnosis. *Annals of Medicine and Surgery*, *80*. https://doi.org/10.1016/j.amsu.2022.104174
- Mundada, A. V., Lamture, Y., & Yeola, M. (2020). Scoring Systems in Acute Appendicitis - A Review. *Journal of Evolution of Medical and Dental Sciences*, *9*(51), 3881–3886. https://doi.org/10.14260/jemds/2020/850
- Noor, S., Wahab, A., Afridi, G., & Ullah, K. (2020). Comparing Ripasa Score And Alvarado Score In An Accurate Diagnosis Of Acute Appendicitis. *Journal of Ayub Medical College, Abbottabad : JAMC*, *32*(1), 38–41.
- Ohle, R., O'Reilly, F., O'Brien, K. K., Fahey, T., & Dimitrov, B. D. (2011). The Alvarado score for predicting acute appendicitis: A systematic review. *BMC Medicine*, *9*. https://doi.org/10.1186/1741-7015-9-139
- Phophrom, J., & Trivej, T. (2005). The Modified Alvarado Score Versus the Alvarado Score for the Diagnosis of Acute Appendicitis. In *The THAI Journal of SURGERY* (Vol. 26).
- Rentea, R. M., & St. Peter, S. D. (2017). Pediatric Appendicitis. In *Surgical Clinics of North America* (Vol. 97, Issue 1, pp. 93–112). W.B. Saunders. https://doi.org/10.1016/j.suc.2016.08.009
- Sammalkorpi, H. E., Mentula, P., & Leppäniemi, A. (2014). A new adult appendicitis score improves diagnostic accuracy of acute appendicitis - a prospective study. *BMC Gastroenterology*, *14*(1). https://doi.org/10.1186/1471-230X-14-114
- Sammalkorpi, H. E., Mentula, P., Savolainen, H., & Leppäniemi, A. (2017). The Introduction of Adult Appendicitis Score Reduced Negative Appendectomy Rate. *Scandinavian Journal of Surgery*, *106*(3), 196–201. https://doi.org/10.1177/1457496916683099
- Şenocak, R., & Kaymak, Ş. (2020). Diagnostic accuracy of ultrasonography and scoring systems: The effects on the negative appendectomy rate and gender. *Ulusal Travma ve Acil Cerrahi Dergisi*, *26*(2), 306–313. https://doi.org/10.14744/tjtes.2019.86717
- Shuaib, A., Shuaib, A., Fakhra, Z., Marafi, B., Alsharaf, K., & Behbehani, A. (2017). Evaluation of modified Alvarado scoring system and RIPASA scoring system as diagnostic tools of acute appendicitis. *World Journal of Emergency Medicine*, *8*(4), 276. https://doi.org/10.5847/wjem.j.1920-8642.2017.04.005
- Singh, A., Parihar, U. S., Kumawat, G., Samota, R., & Choudhary, R. (2018). To Determine Validation of RIPASA Score in Diagnosis of Suspected Acute Appendicitis and Histopathological Correlation with Applicability to Indian Population: a Single Institute Study. *Indian Journal of Surgery*, *80*(2), 113–117. https://doi.org/10.1007/s12262-018-1731-6
- Sirpaili, S., Rajthala, L., Banmala, S., Gautam, P., Ranabhat, S., Ghatani, S. R., & Shrestha, E. (2024). Efficacy of modified Alvarado score combined with ultrasound in the diagnosis of acute appendicitis: a prospective analytical study. *Annals of Medicine & Surgery*, *86*(5), 2586–2590. https://doi.org/10.1097/ms9.0000000000001932
- Teng, T. Z. J., Thong, X. R., Lau, K. Y., Balasubramaniam, S., & Shelat, V. G. (2021). Acute appendicitis–advances and controversies. *World Journal of Gastrointestinal Surgery*, *13*(11), 1293–1314. https://doi.org/10.4240/wjgs.v13.i11.1293
- van Amstel, P., Gorter, R. R., van der Lee, J. H., Cense, H. A., Bakx, R., & Heij, H. A. (2019). Ruling out Appendicitis in Children: Can We Use Clinical Prediction Rules? *Journal of Gastrointestinal Surgery*, *23*(10), 2027–2048. https://doi.org/10.1007/s11605-018-3997-1
- Von-Mühlen, B., Franzon, O., Beduschi, M. G., Kruel, N., & Lupselo, D. (2015). AIR score assessment for acute appendicitis. *Arquivos Brasileiros de Cirurgia Digestiva : ABCD = Brazilian Archives of Digestive Surgery*, *28*(3), 171–173. https://doi.org/10.1590/S0102-67202015000300006