ACTA RADIOLÓGICA PORTUGUESA
January-April 2026 | Vol 38 nº 1 | e43536 https://doi.org/10.25748/arp.43536

Original Article / Artigo Original

Abdominal Radiography in the Emergency Department – Routine Practice or Real Necessity?

Radiografia Abdominal no Serviço de Urgência – Rotina ou Verdadeira Necessidade?

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Received: 09/10/2025
Accepted: 18/01/2026
Published: 02/02/2026

Abstract

Introduction: Abdominal pain is a common cause of admission in the emergency department, often posing a diagnostic challenge due to its nonspecific nature and wide etiological spectrum. Despite the widespread use of abdominal radiography in the evaluation of acute abdominal pain, its low sensitivity and limited diagnostic value restrict its clinical utility, potentially delaying treatment. This study evaluates the appropriateness of abdominal radiograph in an emergency department, based on the guidelines of the Royal College of Radiologists.
Material and methods: A retrospective analysis was conducted on abdominal radiograph requests made in the emergency department, considering the following variables: patient gender and age, presence or absence of clinical information, establishment of diagnostic hypothesis, exam appropriateness, type of projection performed, projection appropriateness, additional radiological examinations performed, and type of additional examination performed.
Results: Of the 2002 requests, 47,1% included clinical information, while 52,9% did not. Among the 943 requests with clinical information, a diagnostic hypothesis could be identified in 19,4% of the cases. Of the requests that included clinical information, 16,7% were deemed appropriate.
Conclusion: This study revealed an inappropriate use of abdominal radiography, contributing to avoidable patient radiation exposure. The findings reinforce the need for clear guidelines and strategies to encourage a more selective use of this exam, reducing unnecessary radiation exposure and optimizing health resources.

Keywords

Abdominal radiography; Appropriateness criteria; Emergency department; Radiation.

Resumo

Introdução: A dor abdominal é uma causa frequente de recurso ao serviço de urgência, sendo a sua abordagem desafiante por ser um sintoma inespecífico e com extenso espetro etiológico. Apesar da sua ampla utilização neste contexto, a radiografia abdominal tem baixa sensibilidade, limitando a sua utilidade clínica, com potenciais implicações terapêuticas, e reduzido valor diagnóstico. Este estudo avalia a adequação dos exames de radiografia abdominal num serviço de urgência, com base nas diretrizes do *Royal College of Radiologists*.
Materiais e métodos: Foi realizada uma análise retrospetiva aos pedidos de radiografia abdominal realizados no serviço de urgência, considerando as variáveis: género e idade do doente, informação clínica, hipótese diagnóstica, adequação do exame radiológico, incidência realizada, adequação da incidência realizada, realização de exame radiológico adicional e tipo de exame adicional.
Resultados: Foram avaliadas 2002 requisições de radiografia abdominal, de entre as quais 47,1% continha informação clínica, e 52,9% não dispunha desta informação. Entre os 943 pedidos contendo informação clínica, em 19,4% dos casos foi possível estabelecer uma hipótese diagnóstica a partir dos dados fornecidos. Dos exames contendo informação clínica, foram considerados adequados 16,7%.
Conclusão: Este estudo revelou que a utilização inadequada da radiografia abdominal no serviço de urgência, constitui um fator de exposição evitável dos doentes a radiação ionizante. Os resultados reforçam a necessidade de definir diretrizes consistentes e estratégias que orientem o uso criterioso deste exame, equilibrando a proteção contra exposições desnecessárias à radiação com a otimização dos recursos em saúde.

Palavras-chave

Radiografia abdominal; Critérios de adequação; Serviço de urgência; Radiação.

Introduction

Abdominal pain is one of the most frequent complaints in the general population, representing 4% to 10% of admissions to the emergency department (ED).[1,2,3,4] Its management is challenging, as it is a nonspecific symptom with a wide spectrum of aetiologies, ranging from self-limiting to potentially serious and requiring emergency intervention. Clinical evaluation is the first step in the management of abdominal pain, often supported by imaging studies to obtain greater diagnostic accuracy. However, inadequate examinations may be clinically useless and may even add confounding data, delaying treatment, with the inevitable impact on morbidity and mortality rates and length of stay in the ED.[2,5,6,7]

The ideal imaging examination should balance diagnostic value, patient comfort, and cost, following the principle of using the lowest possible radiation dose to obtain the desired diagnostic information – the As Low As Reasonably Achievable principle.[8,9,10] Despite exposing the patient to a significant radiation dose, abdominal radiography continues to be, in many cases, one of the first imaging examinations to be performed, given its wide availability and rapid execution.[11] However, it is known that this technique has diagnostic limitations, namely low sensitivity for detecting certain clinical conditions, such as subtle intestinal obstructions or incipient perforations.[12,13,14,15] Several studies indicate that only 10% of these examinations reveal alterations, while others present normal results or even results unrelated to the initial complaint.[1,14,16] On the other hand, the information provided by abdominal radiography is often insufficient for the decision-making process and clinical management of the patient, requiring the performance of other radiological examinations with greater diagnostic value, such as ultrasound or abdominal computed tomography (CT), resulting in inefficient use of resources.[17,18]

In order to improve the appropriateness of imaging examinations, the Royal College of Radiologists (RCR) has defined specific indications for abdominal radiography. These include suspected bowel obstruction, constipation, and acute exacerbation of inflammatory bowel disease. On the other hand, palpable mass, acute and chronic pancreatitis, foreign body search, and abdominal trauma may be indicated in specific circumstances, however, they are not described in the RCR guidelines.[16,18,19] Less restrictive indications have been defined by the American College of Radiology, defining abdominal radiography as appropriate in a wider range of situations, including, for example, the search for radiopaque urinary calculi.[18,20,21] In turn, the French National Authority for Health states that abdominal radiography should be limited to cases of suspected foreign body and suspected toxic megacolon in the context of chronic inflammatory bowel disease.[18,22]

In addition to respecting established clinical indications, abdominal radiography must meet criteria of technical adequacy. Currently, the recommended practice consists of performing a single anteroposterior view in the supine position, covering the entire abdomen, from the diaphragm to the pubic symphysis. It is stated that the systematic use of the upright view, previously routinely employed, is no longer applied due to cumulative radiation exposure. In cases of suspected perforation of a hollow viscus, chest radiography with the patient standing should be prioritized.[23,24]

This study aims to evaluate abdominal radiography examinations performed in the multipurpose ED of Faro Hospital – Local Health Unit (ULS) of the Algarve, between July and October 2024, according to the appropriateness guidelines of the RCR, selected on the basis of their clarity and applicability in the European context, and according to the technical criteria described by James & Kelly.[23]

Materials and Methods

Study design

A retrospective analysis was conducted of abdominal radiography requests made at the ED of Faro Hospital, ULS Algarve, to the population aged 18 years or older, between July and October 2024. This is a hospital with a multipurpose emergency department, which corresponds to the highest level of specialization in Portugal. This study was approved by the Ethics Committee of ULS Algarve, and the procedures described in the study comply with the principles of the Declaration of Helsinki.

Data collection and variables

The data were obtained from the Radiology Department of Faro Hospital – ULS Algarve, using Synapse® (v 5.7.240) and ByMe bHealth Flow® (v 3.17.1) software.

The variables selected include: patient gender and age, clinical information included in the examination request, diagnostic hypothesis, appropriateness, view obtained, performance of additional radiological examination, and type of additional examination performed.

The variable "clinical information" was classified as present or absent. In situations where only information about the intended view was provided, clinical information was considered absent.

The variable "diagnostic hypothesis" was defined as established or not established. According to the clinical information provided, the diagnostic hypothesis was considered "established" whenever it was explicitly described in the request or when it could be reasonably inferred from the clinical information provided (for example, for the clinical information "constipation", the diagnostic hypothesis of intestinal obstruction was inferred). In cases where the clinical information was insufficient to allow this inference, the diagnostic hypothesis was considered "not established".

The variable "appropriateness" was analysed based on the appropriate criteria of the RCR. This analysis included only requests containing clinical information, considering appropriate those that had an established diagnostic hypothesis covered by these criteria.

The variable "view" was determined taking into account the information included in the abdominal radiograph. In cases where this datum was not identified in the radiograph, the image was analysed and the view inferred. The variable "appropriateness of view" was analysed based on good practices defined in the literature. This analysis included all requests from the study, considering only those with a view in accordance with the standards described by James & Kelly[23] as appropriate.

Statistical analysis

The data were collected using Synapse® (v 5.7.240) and ByMe bHealth Flow® (v 3.17.1) software. Statistical analysis was performed using IBM SPSS Statistics® (v 29.0.2.0) software.

Numerical variables are represented by the mean, while categorical variables are represented by absolute value and percentage.

Results

Demographic data

Between July and October 2024, 2002 abdominal X-rays were performed in the ED of Faro Hospital – ULS Algarve, of which 1021 (51%) were on men and 981 (49%) on women. The average age was 54.0±19.3 years (mean ± standard deviation), with 18 and 99 years being the minimum and maximum values, respectively, in the men's and women's groups.

Clinical information and diagnostic hypothesis

Of the abdominal radiography requests made, 943 (47.1%) contained clinical information, while 1059 (52.9%) did not have that information (Figure 1).

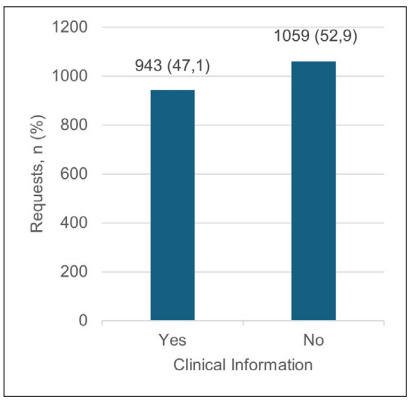

Figure 1 – Frequency distribution of abdominal radiography requests, according to the presence of clinical information.

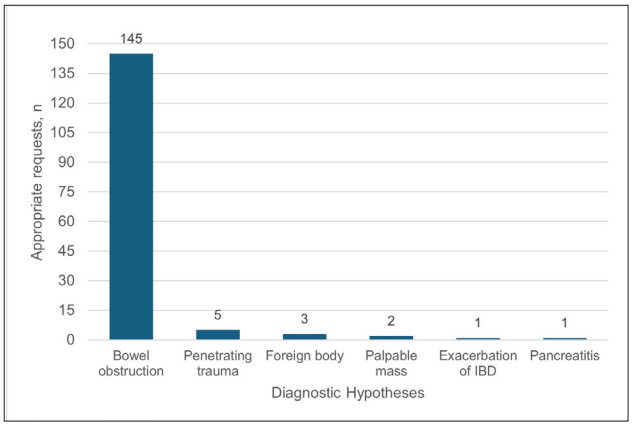

Figure 3 – Frequency distribution of diagnostic hypotheses for examinations considered appropriate (IBD – Inflammatory Bowel Disease).

Of the 943 abdominal radiography requests that included clinical information, 760 (80.6%) did not contain sufficient data to infer a diagnostic hypothesis, often mentioning only a symptom, such as "pain" or "vomiting". Some requests, although not presenting a clear diagnostic hypothesis, contained clinical data that allowed to infer one, and these were considered in the group of established diagnostic hypotheses (for example, in the case of the clinical information "constipation", the diagnostic hypothesis of intestinal obstruction was inferred). In total, it was possible to establish a diagnostic hypothesis in 183 requests (19.4%) (Figure 2).

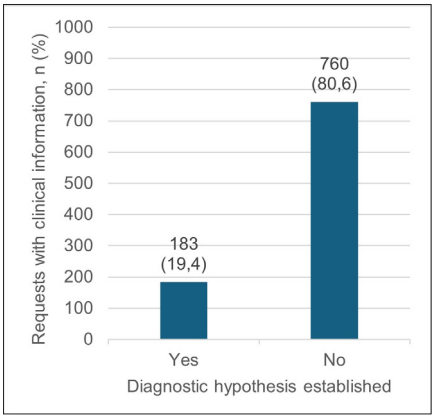

Figure 2 – Frequency distribution of requests for abdominal radiography containing clinical information, according to the presence of a diagnostic hypothesis.

Appropriateness of requests

Of all abdominal radiographs performed during the study period containing clinical information (n=943), only 157 (16.7%) examinations were deemed appropriate. However, these examinations represent an appropriateness rate of 85.8% in the subgroup of examinations with an established diagnostic hypothesis (n=183).

The frequency of examinations considered appropriate, according to the RCR criteria, is distributed as shown in Figure 3, with suspected intestinal obstruction being the most frequent diagnostic hypothesis.

Views performed and its appropriateness

Of the abdominal radiographs studied, 1546 (77.2%) were acquired in standing position, 337 (16.8%) in dorsal decubitus with tangential rays, 116 (5.7%) in dorsal decubitus, 2 (0.2%) with the patient seated and 1 (0.1%) in lateral decubitus (Figure 4).

For the most representative diagnostic hypothesis, suspected intestinal obstruction (n=145), the view of abdominal radiographs performed was evaluated, and it was found that in 93.1% (n=135) of cases, these were not appropriately acquired. Only 6.9% (n=10) of abdominal radiographs were performed in the supine, anteroposterior position.

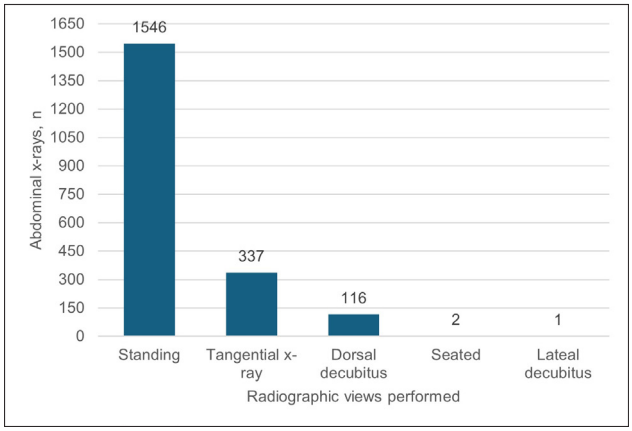

Figure 4 – Frequency distribution of abdominal x-ray views acquired during the study.

Additional radiological examinations

In addition to abdominal radiography, it was found that in 458 (22.9%) cases an additional radiological examination was performed in the same emergency episode. In 107 (5.3%) cases, two additional radiological examinations were performed, while in 17 (0.8%) cases, three examinations were performed. The most frequently requested additional examinations, following the initial abdominal radiography, were abdominal and pelvic CT scan (n=198; 27.4%), abdominal ultrasound (n=175; 24.2%), and a new abdominal radiograph (n=100; 13.8%). In the majority of cases (n=1420; 70.9%), no additional radiological examination was performed.

For the most representative diagnostic hypothesis, intestinal obstruction (n=145), the most frequently requested additional tests were determined (Table 1).

Of all abdominal radiographs considered appropriate (n=157), no additional radiological examination was performed in 61.1% (n=96) of cases.

Table 1 – Frequency of additional radiological examinations following abdominal radiography for suspected intestinal obstruction. (CT AP – computed tomography of the abdomen and pelvis).

	Additional radiological examination					
	CT AP, n (%)	Abdominal ultrasound, n (%)	Abdominal x-ray, n (%)	Other, n (%)	None, n (%)	Total, n (%)
Bowel obstruction, n (%)	18 (12,4)	4 (2,8)	27 (18,6)	7 (4,8)	89 (61,4)	145 (100)

Technical evaluation

Of the abdominal radiographs performed, it was found that 218 (10.9%) did not contain a legend relating to the view performed, while 1784 (89.1%) contained this information.
In situations where the clinician specified the desired view in the examination request (n=377), that view was performed in 342 (90.7%) of the cases, and not in 35 (9.3%) cases.

Discussion

This study aims to evaluate the appropriateness of abdominal radiographs requested in a hospital with a multipurpose ED, providing an insight into current practices.
It is known that the indiscriminate use of abdominal radiography in the evaluation of patients with acute abdominal pain exposes the patient to ionizing radiation and is not indicated in most cases, requiring specific guidelines.[5,24,25,26,27] Although multiple guidelines exist regarding the use of abdominal radiography according to clinical suspicion,[19,20,21] there is some heterogeneity among the recommendations of different societies, which present varying, more or less comprehensive indications. In the context of this study, the RCR criteria were chosen.[19] This choice is based on their greater applicability in the European context, in which Portugal is included, the clarity of the indications, and the existence of other studies in European hospitals that also used these guidelines.[16,28,29,30] Similar to what was described in those studies, the present analysis revealed a high proportion of inappropriate examinations, reinforcing that the overuse of abdominal radiography in urgent contexts is a problem that extends beyond the national level.[16]
When compared with the RCR[19] guidelines, the vast majority of examinations analysed in this study were considered inappropriate. Of the abdominal radiographs evaluated, only 16.7% (n = 157) of the examinations were found to be appropriate. In this context, the impact of ionizing radiation is reinforced, considering that each abdominal radiograph exposes the patient to an average effective radiation dose of 0.7 mSv, a relatively high value compared to the average annual effective dose from natural radiation, of 3 mSv. It is also important to highlight that the radiation dose associated with an abdominal radiograph is approximately 35 times higher than that of a thoracic radiograph (in posteroanterior view).[31]
Similar results have been described in the literature, demonstrating that abdominal radiography is used inappropriately in numerous contexts.[11,18] Bertin, et al.[18] report that abdominal radiography does not provide additional benefit compared to physical examination in the context of evaluating acute abdominal pain, resulting in an appropriateness rate of approximately 15.3%. Even when the RCR indications are followed, a large proportion of abdominal radiographs considered appropriate show normal results.[28,30,32,33]
Despite the evidence, abdominal radiography remains a low-cost, technically simple, widely available examination associated with a lower radiation dose than conventional CT scans.[11] It is thought that these factors may contribute to a false perception of harmlessness by the prescribing clinicians, which reinforces the need for clear guidelines and diagnostic algorithms that promote the appropriate use of resources and avoid unnecessary exposure of patients to radiation.
Analysis of the clinical information from abdominal radiography requests identified a significant proportion of requests with partially or completely missing information (52.9%). Of the requests containing clinical information (n=943), it was only possible to determine a diagnostic hypothesis for a small fraction (19.4%). This limitation is due to the fact that the information provided is often vague and unspecific, mentioning only one symptom, such as "pain" or "vomiting".
The use of structured systems such as the Reason for Exam Imaging Reporting and Data System (RI-RADS)[34] in formulating requests allows, to some extent, for standardization and reduction of the variability of information provided in examination requests, easier assessment of their suitability, and promotion of a more rational use of radiological examinations. In the context of this study, the application of the RI-RADS system to examination requests was limited by the absence of clinical data in a significant proportion of requests, making it impossible to stratify the requests consistently and, therefore, to assess their appropriateness. Thus, the appropriateness analysis was limited to the indication of examinations containing clinical information, according to the RCR criteria.
It is understood that formulating diagnostic hypotheses in the ED can be hampered by time pressure, incomplete clinical records, variability in patient cooperation, and delays in obtaining laboratory results. These factors can often compromise an adequate diagnostic assessment, leading to the request of complementary examinations that may not be the most appropriate.[35] Measures such as the use of forms with mandatory clinical fields that request certain clarifications when making the request could be adopted to promote a more judicious use of this type of examination. Additionally, the implementation of institutional protocols, the holding of periodic awareness meetings aimed at prescribers, the inclusion of the appropriateness of examinations in hospital quality indicators, and a random evaluation of requests could constitute effective strategies to reduce the incorrect use of abdominal radiography.
It is also important to note that, in most Portuguese hospitals, urgent conventional radiology examinations are read by the prescribing physician, meaning that filling out clinical information on abdominal radiography requests can often be considered redundant, leading to a large proportion of attending physicians not completing them properly.

Under these circumstances, it is accepted that requests with incomplete/lacking clinical information do not necessarily determine inappropriate examinations, which is why they were not included in the examination appropriateness analysis. This aspect reduced the number of evaluable examinations in this study, partially limiting the representativeness of the results.

We also found that, after abdominal radiography, additional radiological examinations were performed in the same emergency episode in 22.9% of cases. In this context, the impact of abdominal radiography on the initial diagnostic approach is questionable: either due to the absence of relevant findings, requiring the use of another complementary method to continue the investigation; or due to the presence of alterations requiring further characterization to support the clinical decision. On the other hand, it is important to recognize that, in most of the included episodes, no complementary examinations were requested beyond abdominal radiography, which suggests that, despite its limitations, this examination may play a useful role in the initial assessment of acute abdominal pathology, avoiding the immediate use of other complementary methods. The most frequently requested examination following abdominal radiography was abdominal and pelvic CT scan, implying consecutive exposure to ionizing radiation. Considering the principle "As Low As Reasonably Achievable," some questions arise: if a CT scan is anticipated for diagnostic clarification, is it acceptable to perform an abdominal X-ray? It is important to note that the effective dose of a simple abdominal X-ray is around 0.7 mSv, while that of an abdominal CT scan is approximately 8–10 mSv, that is, about ten times higher than the former.[31] In this context, it becomes pertinent to consider whether the clinical benefit of abdominal X-rays justifies the additional exposure to ionizing radiation, especially considering that the information obtained is, in most cases, limited.

Based on the available evidence, abdominal radiography is an examination with low diagnostic value and, therefore, limited utility in the ED. Several studies have compared the use of CT with plain abdominal radiography in patients with abdominal pain, and consistently support the early use of CT in patients with abdominal pain requiring hospital admission.[3,15,24] Although the radiation dose of abdominal radiography is lower than that of CT, its low diagnostic sensitivity in these cases may delay subsequent patient treatment.[1,3]

It is also noteworthy that the third most frequently performed additional radiological examination in this study was a repeat abdominal X-ray. Although the reasons for repeating the abdominal X-ray are unknown, it cannot be ruled out that factors internal to the radiology department, such as inadequate patient positioning, movement during the examination, or errors in image processing, may have contributed to this practice.[36]

With regard to the technical appropriateness of the abdominal radiographs studied, it is noteworthy that a large proportion did not meet the established recommendations.[23] In particular, for the most representative diagnostic hypothesis, suspected intestinal obstruction (n=145), a lack of appropriateness was observed in 93.1% (n=135) of the cases, with only 6.9% (n=10) of the abdominal radiographs having been acquired in the dorsal decubitus, anteroposterior position, as established as the preferential view.[23]

In the specific case of suspected intestinal perforation, it should be noted that the first-line radiographic study is chest radiography in orthostasis,[4,23,24,37] or alternatively the abdominal radiography in lateral decubitus or dorsal decubitus with tangential rays when orthostasis is not possible.[38] In this study, in cases of suspected intestinal perforation (n=8), the abdominal radiography performed did not meet the considered appropriate view, having most of them been performed with the patient in orthostasis. Although it is not possible to ascertain the real motivation for the low technical appropriateness in this study, it is assumed that the choice of view may be conditioned by factors such as lack of knowledge of current recommendations, limited cooperation from some patients, logistical and operational limitations, pressure for a rapid response and, above all, the absence of a clearly identified clinical suspicion that would allow the selection of the most appropriate view. The absence of standardized protocols may also contribute to the acquisition of radiographs with inappropriate views, directly impacting diagnostic accuracy. In this context, the implementation of institutional protocols, continuous training of the radiology team, and the strengthening of effective communication between clinicians and radiologists are once again relevant.

We acknowledge some limitations in this study, namely the fact that it was carried out in a single hospital, which may reflect local practices. However, this aspect could be seen as an incentive to carry out studies in other Portuguese hospitals. It is recognized that the seasonality of the period under analysis may have some relation to the low rate of completion of clinical information. However, this factor reflects the usual reality of most emergency departments, constituting an intrinsic characteristic of the context studied.

Given the relevance of the topic in the context of clinical management of patients in the ED, it would also be important to conduct a prospective, multicentre study aimed at evaluating the diagnostic contribution of abdominal radiography in this clinical context and comparing different international guidelines.

Using RCR criteria as a basis for evaluating the appropriateness of examinations may constitute a limitation to the study; however, the absence of guidelines applicable to the national context and the existence of some ambiguity among the available international guidelines led us to choose the ones that could best adapt to our reality. In this context, the importance of defining national criteria, with indications and recommendations for requesting and acquiring abdominal radiographs, is highlighted, in order to optimize clinical practice, reduce unnecessary radiation exposure, and ensure greater uniformity in decision-making in the ED.

Conclusion

This study evaluated the appropriateness of abdominal radiographs requested in the ED, providing an overview on current practices and their alignment with the guidelines established by the RCR. Based on the results obtained, it can be concluded that abdominal radiography continues to be used inappropriately in the ED, frequently without a clear clinical basis, incurring unnecessary risks for the patient and generating inefficient use of healthcare resources. The high rate of inappropriateness identified reinforces the need for the implementation of guidelines adapted to the Portuguese clinical reality, as well as the need for clinical decision support mechanisms such as structured requisition forms and training for professionals, aiming to promote a more judicious and safe practice.

Ethical Disclosure / Divulgações Éticas
Conflicts of interest: The authors have no conflicts of interest to declare.
Conflitos de interesse: Os autores declaram não possuir conflitos de interesse.
Financing Support: This work has not received any contribution, grant or scholarship.
Suporte financeiro: O presente trabalho não foi suportado por nenhum subsídio ou bolsa.
Confidentiality of data: The authors declare that they have followed the protocols of their work center on the publication of data from patients.
Confidencialidade dos dados: Os autores declaram ter seguido os protocolos do seu centro de trabalho acerca da publicação dos dados de doentes.
Protection of human and animal subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki). The study was approved by the Ethics Committee of the Algarve Local Health Unit (report no. UAIF 294/2024, dated 12/26/2024). Being a retrospective analysis with fully anonymized data, involving the consultation of a large volume of examinations, the Committee waived the obligation for informed consent.
Protecção de pessoas e animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pelos responsáveis da Comissão de Investigação Clínica e Ética e de acordo com a Declaração de Helsínquia da Associação Médica Mundial. O estudo foi aprovado pelo Comité de Ética da Unidade Local de Saúde do Algarve (relatório n.º UAIF 294/2024, datado de 26/12/2024). Sendo uma análise retrospetiva com dados totalmente anonimizados, envolvendo a consulta de um grande volume de exames, o Comité dispensou a obrigação de consentimento informado.

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