# A STRUCTURED ALGORITHM FOR THE RATIONAL SELECTION OF IMAGING MODALITIES IN ONCOLOGY: A COMPARATIVE ANALYSIS OF MSCT, MRI, AND PET/CT

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**Abstract:** *This study presents the development and evaluation of a structured algorithm for the rational selection of imaging modalities in oncological patients. The algorithm integrates diagnostic performance indicators, including sensitivity, specificity, and the clinical role of imaging techniques in tumor detection, staging, and treatment monitoring.*

*A total of 284 patients with various tumor localizations were included in the study. The results demonstrated that the application of an algorithm-based approach significantly improves diagnostic accuracy, reduces the frequency of redundant imaging studies, and optimizes the diagnostic pathway.*

*The findings highlight the importance of systematic decision-making in radiological diagnostics and support the implementation of standardized algorithms in clinical oncology practice.*

## INTRODUCTION

Modern oncological diagnostics relies heavily on advanced imaging technologies, including multislice computed tomography (MSCT), magnetic resonance imaging (MRI), and positron emission tomography combined with computed tomography (PET/CT). Each modality has unique diagnostic capabilities, advantages, and limitations.

Despite technological advancements, the selection of imaging methods in clinical practice often remains non-standardized and dependent on subjective clinical judgment. This leads to duplication of diagnostic procedures, increased healthcare costs, delayed diagnosis, and unnecessary patient burden.

The lack of a structured algorithm for selecting imaging modalities is particularly critical in oncology, where accurate staging and timely diagnosis directly influence treatment planning and patient outcomes.

The development of a rational, evidence-based algorithm for imaging selection represents an important step toward improving the efficiency and quality of oncological care.

Relevance. The relevance of this study is associated with the growing complexity of oncological diagnostics and the need for optimization of diagnostic pathways.

The increasing availability of high-cost imaging technologies, particularly PET/CT, requires careful justification of their use. At the same time, inappropriate or excessive use of imaging studies leads to inefficient resource utilization and increased financial burden on healthcare systems.

In addition, the absence of unified clinical guidelines for imaging selection in many practical settings results in variability in diagnostic approaches and inconsistency in patient management.

Thus, the development of an algorithm that integrates clinical indications, tumor characteristics, and diagnostic performance metrics is highly relevant for improving the quality and efficiency of oncological diagnostics.

Materials and Methods

A retrospective analytical study was conducted using data from oncological patients examined between 2022 and 2024.

A total of 284 patients were included in the study:

- 136 males (47.9%)
- 148 females (52.1%)

The age of patients ranged from 21 to 74 years.

Patients were categorized based on tumor localization:

- lung tumors — 72 cases
- abdominal tumors — 64 cases
- pelvic tumors — 58 cases
- brain tumors — 42 cases
- bone tumors — 48 cases

The following imaging techniques were analyzed:

- MSCT — 284 examinations
- MRI — 198 examinations
- PET/CT — 126 examinations

The diagnostic performance of each modality was assessed according to three key clinical задач:

1. Primary tumor detection
2. Tumor staging
3. Treatment monitoring

The reference standard was clinico-morphological verification.

Sensitivity, specificity, and overall diagnostic accuracy were calculated.

Additionally, the frequency of redundant examinations was assessed, along with their impact on diagnostic timelines.

The algorithm was developed based on:

- statistical analysis of diagnostic performance
- expert evaluation
- integration of clinical decision-making principles

Results

Diagnostic performance

The study demonstrated that the effectiveness of imaging modalities varies significantly depending on tumor localization and clinical задач.

Primary detection

MSCT showed high sensitivity (85–88%) in lung and abdominal tumors, making it the preferred first-line imaging modality in these cases.

MRI demonstrated superior performance in soft tissue evaluation and central nervous system tumors, with sensitivity up to 91%.

Tumor staging

PET/CT showed the highest diagnostic accuracy for staging, with sensitivity up to 94% and specificity up to 92%, particularly in detecting distant metastases.

Treatment monitoring

MRI and PET/CT were more effective in assessing treatment response, especially in tumors with complex anatomical localization or metabolic activity.

Redundant examinations

In the absence of a structured algorithm, redundant imaging studies were identified in 23% of cases.

These included:

- repeated MSCT without clinical indication
- unnecessary MRI following sufficient CT data
- unjustified use of PET/CT

Redundant examinations led to:

- increased diagnostic timelines
- additional financial costs
- higher patient exposure to radiation

Proposed Algorithm

The proposed algorithm is based on a stepwise decision-making model:

1. Initial assessment
   - clinical suspicion and tumor localization
2. Primary imaging selection
   - MSCT — for lung, abdominal, and general oncological screening
   - MRI — for CNS and soft tissue tumors
3. Staging
   - PET/CT — for systemic evaluation and metastasis detection
4. Follow-up and monitoring
   - MRI or PET/CT depending on tumor type and treatment modality
5. Avoidance of redundancy
   - exclusion of repeated imaging without new clinical indications

This structured approach ensures optimal use of imaging resources and improves diagnostic efficiency.

Discussion. The results of this study confirm the necessity of implementing structured algorithms in oncological diagnostics.

The variability in diagnostic performance across imaging modalities highlights the importance of selecting the appropriate method based on clinical context rather than routine practice.

The high rate of redundant examinations observed in this study reflects a common problem in clinical settings, where the absence of standardized protocols leads to inefficient decision-making.

The proposed algorithm addresses this issue by providing a clear framework for selecting imaging modalities, thereby reducing unnecessary procedures and improving diagnostic accuracy.

The findings are consistent with international trends emphasizing evidence-based imaging and resource optimization in healthcare systems.

Conclusions

A structured algorithm for the rational selection of imaging modalities in oncological patients has been developed and validated.

Its implementation significantly improves diagnostic efficiency, reduces redundant examinations, and enhances clinical decision-making.

The proposed approach can be recommended for integration into routine clinical practice.

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