Computerized Tomography: an overutilized resource?

Study of the prevalence of non-indicated tomographic studies in an emergency service

Tomografía axial computarizada (TAC): ¿un apoyo sobreutilizado?

Prevalencia de estudios no indicados de TAC en un servicio de urgencias

María Lucía Morillo-Peña[1]
Nicolás Francisco Rojas Serrano[2]
Carlos Andrés Corredor Silva[3]
https://doi.org/10.53903/01212095.340

Key words (MeSH)

Multidetector computed tomography
Prevalence
Therapeutic uses
Cross-sectional studies

Palabras clave (DeCS)

Tomografía computarizada multidetector
Prevalencia
Usos terapéuticos
Estudios transversales

Summary

Introduction: The request for Computerized Tomography (CT) has significantly increased in emergency departments. They have become an overutilized resource, as many performed CT scans do not meet appropriateness criteria. In Colombia, we aren't exempt from this problem, so it is important to evaluate the current situation to avoid dire consequences in the short and long term. ***Objectives:*** To calculate the prevalence of non-indicated computerized tomographic studies as part of the attention given in the emergency department of a fourth level university hospital from Bogotá, Colombia during October 2022 seeking differences between subgroups such as body regions, and requesting services. ***Methods:*** We conducted a census of all requested tomographic studies as part of the attention given in emergency services in a fourth level university hospital during October 2022. These were classified among three categories based on their indication. Additionally, they were sorted amongst different body regions and requesting services, so that we could have a subgroup analysis. Results: We registered 1447 CT studies taken in October 2022, from those 80.7% were indicated and 8.98% were not indicated. The study with the most prevalence of non-indication was the simple brain CT (70.77%). On the other hand, the services that requested the most studies without indications were neumology (66.67%) and otorhinolaryngology (33.3%). ***Conclusions:*** We found a high prevalence of non-indicated studies. Most of the studies requested by the specialties with a higher number of patients in emergency services are indicated. The most requested non-indicated study can have severe consequences for patients if the diagnosis isn't clear. It's important to further study the possible causes behind this problem so that we can come up with solutions.

Resumen

Introducción: La solicitud de tomografía axial computarizada (TAC) ha aumentado significativamente en los servicios de urgencias. Las TAC han experimentado un uso excesivo, con un alto porcentaje de estudios realizados sin indicación clínica adecuada. Colombia no está exenta de esta problemática, por lo que es importante hacer un análisis de la situación actual para evitar consecuencias a corto y largo plazo. ***Objetivos:*** Calcular la prevalencia de estudios tomográficos no indicados solicitados como parte de la atención de urgencias en un hospital universitario de cuarto nivel de Bogotá, Colombia, durante octubre del 2022, estableciendo diferencias entre regiones corporales y servicios solicitantes. ***Materiales y métodos:*** Se realizó un censo de los estudios de TAC solicitados como parte de la atención de urgencias en un hospital universitario de cuarto nivel durante octubre del 2022. Estos se clasificaron en tres categorías según su indicación, adicionalmente se clasificaron según la región corporal y servicio solicitante para analizar los subgrupos. ***Resultados:*** Se registraron 1.447 estudios de TAC tomados en octubre de 2022, de esos, un 80,72 % fueron estudios indicados y un 8,98 % no fueron indicados. El estudio con mayor prevalencia de no indicados fue la TAC de cráneo simple (70,77 %). Por otro lado, las especialidades que más solicitaron estudios no indicados fueron neumología (66,67 %) y otorrinolaringología (33,33 %). ***Conclusiones:*** Se encontró una alta prevalencia de estudios no indicados. La mayoría de los estudios solicitados por las especialidades que manejan una mayor cantidad de pacientes en el servicio de urgencias son indicados. El estudio no indicado más solicitado puede tener consecuencias graves para los pacientes en caso de no tener certeza diagnóstica. Es importante considerar las posibles causas detrás de esta problemática para promover soluciones.

[1]Physician, Radiology and Diagnostic Imaging Research Group, Faculty of Medicine, Pontificia Universidad Javeriana. Bogotá, Colombia: https://orcid.org/0009-0001-7365-9397

[2]Physician, Department of Radiology, San Ignacio University Hospital, Pontificia Universidad Javeriana. Bogotá, Colombia. https://orcid.org/0000-0002-3607-0719

[3]Physician, Director of the Department of Radiology, San Ignacio University Hospital, Pontificia Universidad Javeriana. Bogotá, Colombia. https://orcid.org/0000-0002-1881-469X

Introduction

Data from fourteen health insurance providers (HIP) show that between 2013 and 2014, 2,355,936 computed tomography (CT) scans were performed in Colombia, equivalent to a rate of 37.5 CT scans per 1,000 members (1). Given technological advances and the constant need for diagnostic support, it is very likely that this number has increased in recent years and will continue to do so. However, one reason for the increase in the number of CT scans requested is visits to emergency departments. In the United States, it is estimated that one-third of all CT scans are performed in emergency departments (2). However, it has also been shown that at least 20-40% of the studies requested were not indicated (2-4).

The American College of Radiology (ACR) has appropriate criteria for requesting different imaging modalities, which are set out in a document entitled ACR *Appropriateness Criteria* (ACR AC) (5). This resource helps healthcare professionals make better decisions regarding the request for diagnostic imaging support to achieve a better diagnosis or treatment for patients. Although it is an easily accessible tool, very few people are aware of it; it was found that in a population of 438 physicians, only 1.59% use the ACR AC as a tool to choose the best imaging modality to request (6).

Performing CT scans without adequate indication or justification has individual repercussions on the health of those undergoing the test, as it increases their exposure to ionizing radiation, which could have short- and long-term effects (7). There are also collective consequences, as a single CT scan currently costs between 160,000 and 1,000,000 Colombian pesos (8), which varies depending on the area, location, or hospital where it is performed. These costs end up affecting the budget of the General Social Security System for Health (GSSSH) and, in the long term, the possibility of performing these tests on all those who require them. For this reason, it is important to analyze the current situation in Colombia in order to develop and implement improvement plans.

Materials & methods

A census was conducted of CT scans requested during emergency assessments in different departments at a tertiary university hospital in Bogotá, Colombia, during October 2022. Subsequently, medical records were compiled to determine the clinical indication or suspicion that led to the request for the procedure. These requests were subdivided into three categories according to their indication, based on institutional guidelines and the ACR AC (5): "indicated," "probably indicated," and "not indicated." All reference criteria are found in Appendix 1. If the procedure or indication was not covered in Appendix 1, each case was analyzed using the data available in the medical record to determine which category it could be included in. This study did not seek to define the concordance between clinical suspicion and radiological findings.

Subsequently, an analysis was performed using relative frequency measures to calculate the prevalence of indicated, probably indicated, and non-indicated studies for each of the fifteen modalities obtained, as well as an analysis by subgroups divided into body regions (head, chest, abdomen, and pelvis) and by requesting specialty.

Results

During October 2022, 1,447 CT scans were performed as part of initial emergency care in different departments available at the institution. Of these, the most common scan was a simple cranial CT scan (45.5%), followed by an abdominal and pelvic CT scan with contrast medium (14.7%). The least common scan was a simple cranial CT scan with contrast medium (0.07%). Figure 1 shows the prevalence of scans according to compliance with indication criteria.

In the subgroup of "non-indicated studies," the most frequently performed CT scan without indication was the simple cranial CT scan, followed by the simple facial CT scan. In the subgroup of "indicated studies," the most prevalent CT scan was the simple cranial CT scan, followed by the abdominal and pelvic CT scan with contrast medium (Table 2). Finally, the most prevalent CT scan in the "probably indicated" subgroup was also the simple skull scan, followed by the simple chest scan. The above data are summarized in Figure 2.

With regard to the requesting parties, it was found that, when adjusting the prevalences to the total number of studies requested by specialty, the ones that requested the most unindicated studies were pulmonology, otolaryngology, gynecology, general medicine, and internal medicine (Figure 3).

Discussion

The prevalence of unnecessary studies requested varies depending on the geographical location being evaluated. The study with the highest prevalence of unnecessary requests was simple cranial CT scans, which can be explained in part by the fact that 45.47% of the studies requested are simple cranial CT scans; additionally, headache is a frequent reason for consultation in which unnecessary studies are requested. Similarly, the high prevalence of unindicated studies for simple facial CT scans can be explained by the low number of requests for this exam, since they account for only 5.60% of all requested studies; although, comparatively, the number of unindicated studies requested is much lower, when considering the total number of studies requested, this prevalence increases.

In Australia, it was found that 96.37% of imaging studies requested by the emergency department during night hours met appropriate indication criteria (9). However, when evaluating whether indications were followed when requesting outpatient imaging studies in Italy, it was found that 56% did not meet the appropriate criteria for an indication for the study (4). In the present case, a high prevalence was found, considering that the initial suspicion was that the prevalence of unindicated studies was low or even zero. However, considering that in the United States it is estimated that at least one-third of CT scans are requested and performed in the emergency department (2) and that, in addition, the institution is a hospital that usually experiences significant overcrowding in the emergency department, this may have affected the figure. On the other hand, it is important to note that the hospital where the study was conducted receives patients from a wide range of economic backgrounds, including patients living in rural areas. Therefore, it can be assumed that in some cases, the requesting professionals considered the study to be a good diagnostic aid, given that access to these studies is very difficult for some patients in their areas of residence.

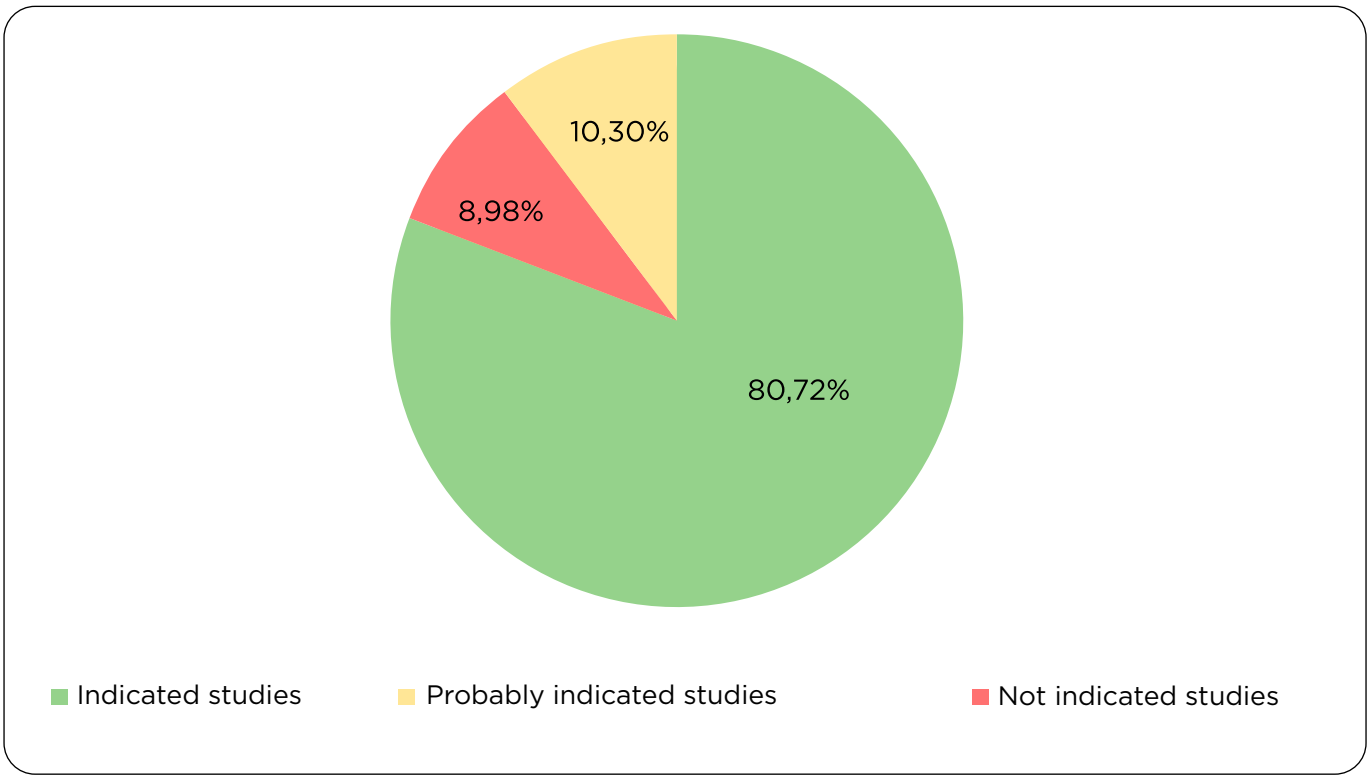


Figure 1. Prevalence of studies according to indication.

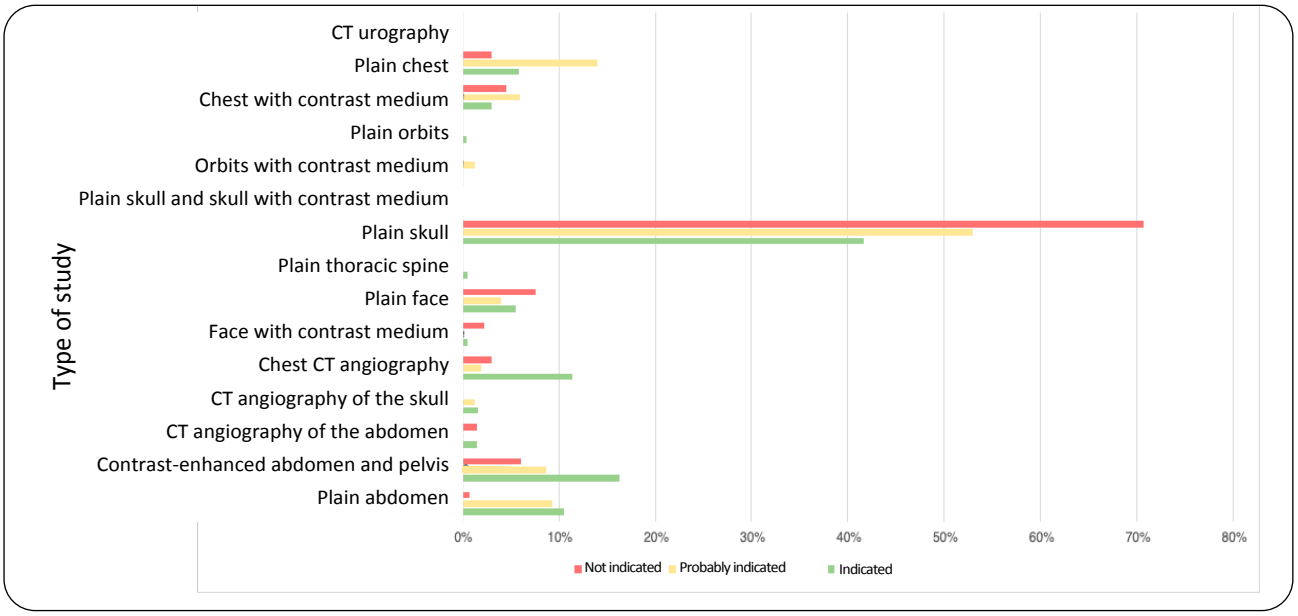


Figure 2. Prevalence of CT scan type according to indication

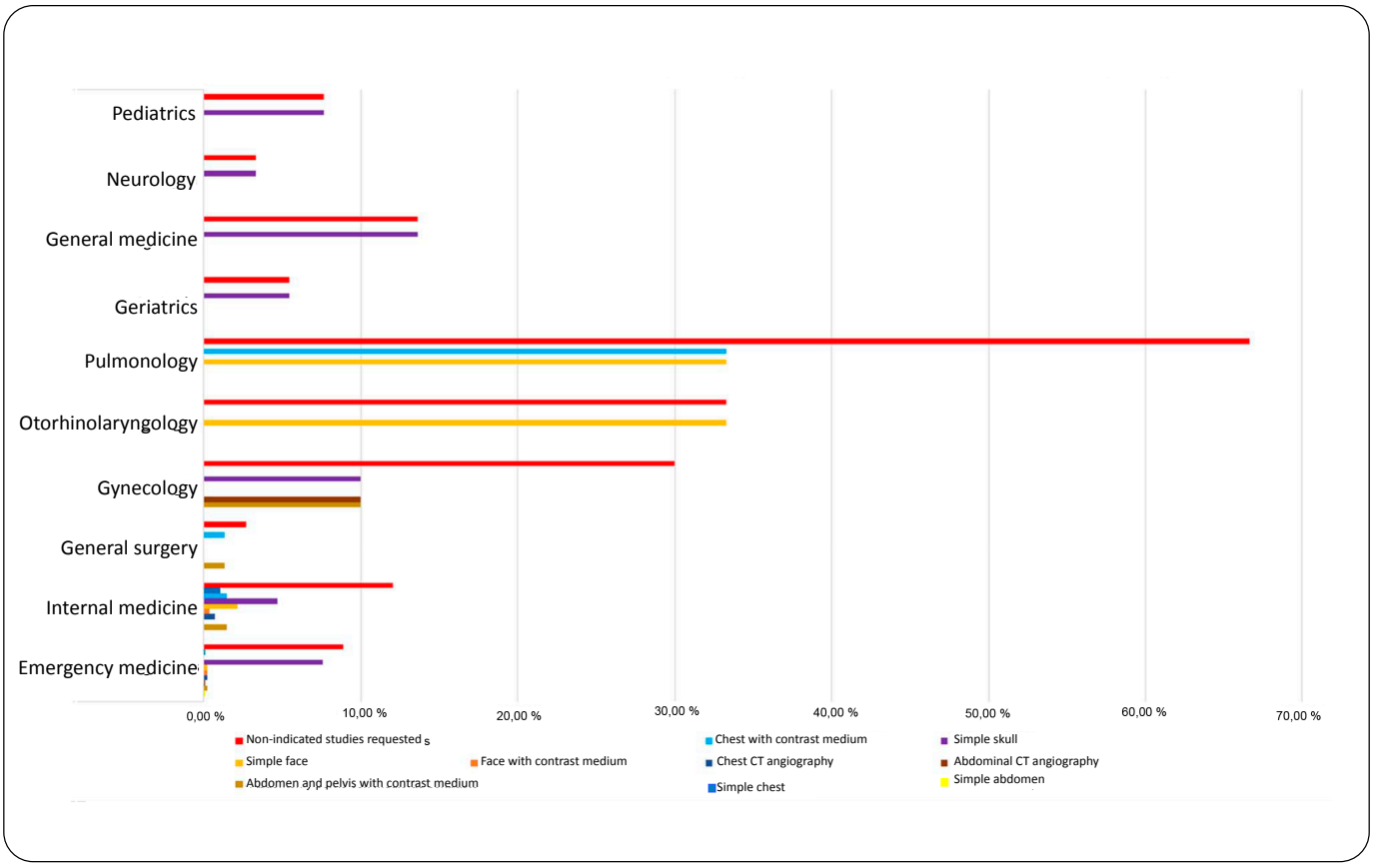


Figure 3. Prevalence of non-indicated CT scans, adjusted for the total number of studies requested by specialty.

However, with regard to the requesting specialties, this study has an important difference. The literature evaluates the excess of requests for inappropriate studies based on the analysis of an emergency department, but not according to the different specialties that may treat a patient in an emergency. At this institution, several specialties have access to the "direct triage" modality, so it is possible to differentiate according to the requesting specialties. Even so, the literature has described that at least 85% of emergency physicians believe that their patients undergo too many diagnostic tests (10) and that at least 97% are aware of having requested at least one unnecessary diagnostic image (10). Furthermore, it should be noted that in some cases these requested images may be unnecessary because the patient already has diagnostic support that allows the necessary area to be evaluated, but these previous studies have not been adequately followed up and are repeated or requested without indication. On the other hand, the possibility of an institutional culture of requesting certain studies based on the patient's clinical presentation must also be taken into account, and this culture could be reflected in the institutional guidelines created and followed by the professionals working in the institution, which usually do not include ACR AC (5).

In this case, an adjustment was made based on the total number of studies requested by specialty to assess what percentage of the studies requested by each service are not indicated. Based on this, it was found that more than half of the studies requested by the pulmonology service as part of emergency care are not indicated. This can be explained by the fact that they only requested 0.21% of the total studies, but more than half of their requests were not indicated. No comparison with other subspecialty services can be found in the literature since, as mentioned, the literature evaluates the emergency department in general and does not individualize the treating specialties. In this case, the percentage of studies not indicated for which the emergency medicine service is responsible is low (8.94%) compared to other specialties.

In Colombia, no studies have been conducted to investigate the causes of the "overuse" of unnecessary tests. It is important to have an idea of the causes according to geographical location, since health systems differ immensely and this, of course, has different implications. In any case, several reasons for requesting additional tests that do not necessarily meet the criteria for indication were found in the US literature, some of which could also be found in the Colombian context. Among the causes are: the financial incentives available to those requesting tests, depending on how the US healthcare system works; the referral procedures for imaging (which also allow for "self-referral") (11); the legal consequences that may arise if no life-threatening condition is found (11); patient expectations (11), requests for duplicate tests (11), lack of education or knowledge regarding indicated and necessary requests (12), easy access to new technologies (12), and intolerance to uncertainty (13). According to the results presented here, the causes mentioned above, such as access to studies, patient follow-up, and a possible institutional culture, should also be taken into account as

reasons for requesting studies without indication. If a solution is not found to reduce the request for unnecessary studies, there is a risk to the health of people exposed to the procedure, since a direct relationship has been found between receiving a low dose of radiation (such as that received when exposed to the performance of studies) and the onset of cancer, especially in the pediatric population (7).

Challenges for clinical practice

The American College of Radiology has taken on the task of publishing, for many years, the appropriate criteria that should be met when requesting studies, known as the ACR *Appropriateness Criteria* (ACR AC). These can be found on the ACR website and are easily accessible to anyone who wishes to read them. However, it was found that despite being a very good resource and easily accessible, only 1.59% of physicians use the tool as their first option when considering ordering studies for their patients (6). It is important that the ACR AC be widely known, as it was found that following the criteria could reduce the costs associated with diagnostic imaging by 39% and decrease unnecessary radiation exposure by 44% (3). In the United States, it has been found that *Radiology Business Managers* (14) can help verify that studies requested comply with the ACR AC; however, this is a role that only exists in the US healthcare system and is not available in all institutions.

Limitations

The data collected and analyzed were taken from a single month, a single institution, and only studies requested as part of emergency care were taken into account. In addition, there may have been a bias in the interpretation of the justification for requesting CT scans, since the analysis of each of the medical records and those not included in Annex 1 was carried out by a student specializing in Radiology and Diagnostic Imaging (resident), without consulting the applicants for the studies. Furthermore, no distinction was made as to whether the studies were requested by a professional or a resident, as the hospital's medical record system does not make such a distinction. It would be interesting to evaluate the different behaviors observed in different cities, institutions, and imaging modalities, not only in the Colombian context, but also in Latin America.

Conclusions

There is a high prevalence of inappropriate tests requested as part of emergency care at a fourth-level university hospital in Bogotá. However, those who request the highest number of inappropriate tests are uncommon specialties with a lower volume of patients in the emergency department compared to other services, such as the emergency department or general surgery, which represent a low percentage of all inappropriate tests requested. Additionally, the most requested non-indicated study (simple cranial CT scan) can help rule out pathologies with a high impact on patient morbidity and mortality, and these are usually cases in which it is very important for the professional to have diagnostic certainty. Although the purpose of this study was not to determine the causes behind this prevalence, it is important to consider some possibilities in order to implement solutions that improve different aspects of the health system's economy as well as the possible risks to which patients may be exposed.

References

1. Ministerio de Salud y Protección Social. Atlas de Variaciones Geográficas en Salud de Colombia – Informe de Investigación. Bogotá; 2017.
2. Linton O, Tenforde TS, Amis ES, Sierzenski P. Summary of workshop on ct in emergency medicine: Ensuring appropriate use. J Am Coll Radiol. 2011;8(5):325-9. https://doi.org/10.1016/j.jacr.2010.09.004
3. Hadley JL, Agola J, Wong P. Potential impact of the American College of Radiology Appropriateness Criteria on CT for Trauma. Am J Roentgenol. 2006;186(4):937-42. https://doi.org/10.2214/AJR.05.0041
4. Cristofaro M, Busi Rizzi E, Schininà V, Chiappetta D, Angeletti C, Bibbolino C. Appropriateness: analysis of outpatient radiology requests. La Radiologia Médica. 2012;17(2):322-32. https://doi.org/10.1007/s11547-011-0725-2
5. American College of Radiology. ACR Appropriateness Criteria [internet]. S. f. [citado: 2024 nov. 16]. Disponible en: https://www.acr.org/Clinical-Resources/ACR-Appropriateness-Criteria
6. Bautista AB, Burgos A, Nickel BJ, Yoon JJ, Tilara AA, Amorosa JK. Do clinicians use the American College of Radiology Appropriateness Criteria in the management of their patients? Am J Roentgenol. 2009;192(6):1581-5. https://doi.org/10.2214/AJR.08.1622
7. Weidman EK, Loftus ML. The consequences of inappropriate use of emergency imaging. En: Kelly A, Cronin P, Puig S, Applegate K. (eds). Evidence-Based emergency imaging. Springer; 2018. pp. 37-46. https://doi.org/10.1007/978-3-319-67066-9_4
8. Manual Tarifario de Salud SOAT. 2024. Consultorsalud. Disponible en: https://consultorsalud.com/manual-tarifario-soat-2024-version-pdf/
9. Gardiner FW, Zhai S. Are all after-hours diagnostic imaging appropriate? An Australian Emergency Department pilot study. Ann Med Surg. 2016;12:75-8. https://doi.org/10.1016/j.amsu.2016.11.019
10. Kanzaria HK, Hoffman JR, Probst MA, Caloyeras JP, Berry SH, Brook RH. Emergency physician perceptions of medically unnecessary advanced diagnostic imaging. Acad Emerg Med. 2015;22(4):390-8. https://doi.org/10.1111/acem.12625
11. Hendee WR, Becker GJ, Borgstede JP, Bosma J, Casarella WJ, Erickson BA, et al. Addressing overutilization in medical imaging. Radiology. 2010;257(1):240-5. https://doi.org/10.1148/radiol.10100063
12. Dunnick NR, Applegate KE, Arenson RL. The inappropriate use of imaging studies: a report of the 2004 intersociety conference. J Am Coll Radiol. 2005;2(5):401-6. https://doi.org/10.1016/j.jacr.2004.12.008
13. Lysdahl KB, Hofmann BM. What causes increasing and unnecessary use of radiological investigations? a survey of radiologists' perceptions. BMC Health Serv Res. 2009;9(1):155. https://doi.org/10.1186/1472-6963-9-155
14. Armao D, Semelka RC, Elias J. Radiology's ethical responsibility for healthcare reform: Tempering the overutilization of medical imaging and trimming down a heavyweight. J Magnet Res Imag. 2012;35(3):512-7. https://doi.org/10.1002/jmri.23530

Correspondence

María Lucía Morillo-Peña
Faculty of Medicine
Pontificia Universidad Javeriana
Carrera 7 # 40-62
morillop_ml@javeriana.edu.co

Received for evaluation: October 10, 2023
Accepted for publication: December 12, 2023