RESEARCH ARTICLE / *Araştırma Makalesi*

Changes in The Use of Diagnostic Imaging in Emergency Departments From 2016 To 2022: A Six-Year Analysis

2016-2022 Yılları Arasında Acil Servislerde Görüntüleme Yöntemlerinin Kullanımındaki Değişiklikler

Attila Beştemir[1], Göksu Bozdereli Berikol[2]

[1] *Department of Emergency Medicine, Department of Private Health Institutions with Outpatient Diagnosis and Treatment, Ankara, Türkiye*
[2] *Department of Emergency Medicine, Istanbul Bakırköy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Türkiye*

Yazışma Adresi / *Correspondence:*
Attila Beştemir

Department of Private Health Institutions with Outpatient Diagnosis and Treatment, Bilkent Campus, Dumlupınar Boulevard 6001. Cad. No:9 Çankaya/Ankara, Türkiye
T: **+90 532 397 77 37** E-mail **: attilabes@hotmail.com**

Geliş Tarihi / Received : **02.02.2023** Kabul Tarihi / Accepted: **01.03.2023** Çevrimiçi / Online: **16.03.2023**

Orcid ve Mail Adresleri
Attila Beştemir https://orcid.org/0000-0003-0986-9039, attilabes@hotmail.com
Göksu Bozdereli Berikol https://orcid.org/0000-0002-4529-3578, gokxsu@hotmail.com

Cite this article/Atıf:
Beştemir A., Berikol GB., Changes in The Use of Diagnostic Imaging in Emergency Departments From 2016 To 2022: A Six-Year Analysis. Sakarya Med J 2023: 13(1):179-186 DOI: 10.31832/smj.10.31832/smj.1246856

Abstract

Introduction	Due to the presence or proximity of medical imaging modalities in emergency departments, their use is becoming widespread in pediatric and adult emergency departments. Especially with the COVID-19 pandemic, the use of computed tomography as a rapid and sensitive method for the diagnosis of pneumonia has also increased. This study aimed to analyse the change in the trends of imaging modalities in emergency departments over the last 6 years in our country.
Materials and Methods	A retrospective descriptive study was conducted in the emergency departments of public and university hospitals in Turkey between January 1, 2016, and December 31, 2021. The numbers and percents of imaging requests (CT,MRI,radiographs,USG) were analyzed.
Results	Regarding imaging per ED visit were considered, Plain radiograph constituted the most requested examinations compared to all applications (31%-36%). Then, the rates were followed by CT (10.84%-23.40%), and the highest CT requests were found in 2020 (n=17.192.695). Overall, there was a statistically significant difference between years in terms of imaging types (X2 65.05, p<0.001, Friedman). All imaging modalities have changed statistically between the years 2016-2017 (p<0.001); 2017-2018 (p<0.001); 2018-2019 (p=0.02); 2019-2020 (p<0.001). While there was no statistical difference between 2020 and 2021 (p=0.614) also 2016 and 2021 (p=0.337), a statistically significant difference was found between 2016 and 2020 (p=0.046).
Conclusion	In our study, the use of imaging methods in the emergency departments in the last 6 years was examined, and the total footage showed a continuous increase in the pre-pandemic period. With the pandemic, significant changes were detected in the shooting modalities.
Keywords	Emergency Department, Computed Tomography, Ultrasound

Öz

Amaç	*Tıbbi görüntüleme yöntemlerinin acil servislerde bulunması veya yakın olması nedeniyle çocuk ve erişkin acil servislerinde kullanımı giderek yaygınlaşmaktadır. Özellikle COVID-19 pandemisi ile birlikte bilgisayarlı tomografinin pnömoni tanısında hızlı ve duyarlı bir yöntem olarak kullanımı da artmıştır. Bu çalışma, ülkemizde son 6 yılda acil servislerde görüntüleme modalitelerindeki eğilimlerin değişimini incelemeyi amaçlamıştır.*
Yöntem ve Gereçler	*1 Ocak 2016- 31 Aralık 2021 tarihleri arasında Türkiye'deki kamu ve üniversite hastanelerinin acil servislerinde retrospektif tanımlayıcı bir çalışma yapılmıştır. Görüntüleme isteklerinin (CT,MR,radyografi,USG) sayıları ve yüzdeleri analiz edildi.*
Bulgular	*Başvuru başına yapılan görüntülemeler değerlendirildiğinde, tüm başvurulara göre (%31-%36) en çok istenen tetkikleri düz grafiler oluşturdu. Ardından oranları BT (%10,84-%23,40) takip etti ve en yüksek BTtalepleri 2020'de (n=17,192,695) bulundu. Genel olarak, görüntüleme türleri açısından yıllar arasında istatistiksel olarak anlamlı bir fark vardı (X2 65.05, p<0.001, Friedman). 2016-2017 yılları arasında tüm görüntüleme yöntemleri istatistiksel olarak değişti (p<0.001); 2017-2018 (p<0,001); 2018-2019 (p=0,02); 2019-2020 (p<0.001). 2020 ile 2021 (p=0,614) ve 2016 ile 2021 (p=0,337) arasında istatistiksel olarak fark yokken, 2016 ile 2020 arasında istatistiksel olarak anlamlı bir fark bulundu (p=0,046).*
Sonuç	*Çalışmamızda acil servislerde son 6 yılda görüntüleme yöntemlerinin kullanımı incelenmiş, pandemi öncesi süreçte toplam çekim sürekli artış göstermiştir. Pandemiyle birlikte çekim modalitelerinde belirgin değişikler saptanmıştır.*
Anahtar Kelimeler	*Acil Servis, Bilgisayarlı Tomografi, Ultrasonografi*

INTRODUCTION

While 92 million patients were admitted to the emergency department in Türkiye in 2016, the number of patients increased to 129 million in 2021.Imaging methods are used frequently in the diagnosis and differential diagnosis in emergency departments and the decisions for discharge and hospitalization can be made faster.[1]

The use of imaging technologies in emergency departments plays a major role in diagnosis, exclusion, and follow-up.[2] Therefore there is an increased use in diagnostic imaging in emergency departments (ED).[3,4] More than three fold increase in use of computed tomography (CT) and magnetic resonance imaging (MRI) has been shown in ten years period after 2000.[4]

Eventhough fast and effective imaging modalities helps diagnosis and support physicians in the decision of discharge or hospitalization. However, it is also important to use these tests cost-effectively and with a benefit-harm ratio since its ineffective use causes costs and longer length of stay.[2,4]

Point of care ultrasound (USG) in emergency departments is an easy accessed modality which emergency physician interpret the images of the patients fast and avoid radiation of CT[5]. It has been shown that after the use of point of care USG, the trends in the use of CT in trauma patients have decreased.[5]

However there are studies in the literature showing that the use of computed tomography has increased due to the ease of access, especially in traumatic and nontraumatic conditions.[6] More of that after the COVID-19 pandemic, the use of computed tomography as a rapid and sensitive method for the diagnosis of pneumonia has also increased.[7]

This study aimed to assess the trends of diagnostic imaging in emergency departments over six year period.

METHODS

Study design

This was a retrospective descriptive study performed with computed tomography requests in the emergency departments of public and university hospitals in Turkey between January 1, 2016, and December 31, 2021, with approval from the Ministry of Health and the local ethics committee (E2-22-1622).

Data collection

The data of the study is obtained from the archives of the General Directorate of Health Services of Ministry of Health after the approval of ethical committee and related department. We searched the total numbers of visits and diagnostic imaging modalities requests regarding their triage codes within secondary and tertiary hospitals. In our country, there are a total of 900 public hospitals, 68 university hospitals, and 566 private hospitals that provide inpatient health services with emergency departments.8 The patients are categorized regarding their urgencies as red, yellow and green as defined in the regulation of Ministry of Health.

We included the most used requests of CT, MRI, USG and radiograms. We excluded other imaging modalities as scintigraphy requested from emergency departments.

Statistical Analysis

The descriptive statistics were given as numbers and percentages of the imaging modalities and overall visits according to triage areas. We performed ANOVA, Friedman test to calculate the statistical difference among the years regarding the imaging types. We used Mann-Whitney U to compare the change between two years. SPSS IBM v27 has been used for the analysis.

RESULTS

In the study, the number of patients who were admitted to the emergency department annually between 2016 and 2021 in our country is shown in Table 1. The highest num-

ber of visits to the emergency department was in 2019 (n=97.695.872).

Computed tomography numbers are shown in Table 2. The highest number of computed tomography requests was seen in 2020 (11,830,866). The highest rate of computed tomography requests per patient was found in 2020 (23,4%).

The most requested CT examinations compared to all CTs in the emergency department according to the years was Brain CT among all times. The year in which thorax CT was requested the most was determined to be 2020, and it increased 4.21 times compared to the previous year (Figure 1).

Table 1. The Number of Emergency Department Visits as Total and According to the Areas

	2016	2017	2018	2019	2020	2021
ED visits	72.106.289	83.731.510	91.501.535	97.695.872	73.473.350	87.956.504
Triage_Non_ Green	54.288.144	63.240.240	67.850.466	70.031.987	57.260.610	71.020.157
Triage_Green	17.818.145	20.491.270	23.651.069	27.663.885	16.212.740	16.936.347

Three level triage codes are used in emergency departments. The red triage level indicates the most urgent patients and the green level is the least urgent patients.

Table 2. The distribution of CT screening by years

CT, region	2016	2017	2018	2019	2020	2021
Brain	1.755.694	2.287.017	2.546.034	2.773.063	2.196.874	988.866
Maxillo facial	93.199	139.279	171.198	187.258	148.491	64.990
Thorax	550.817	766.145	929.559	1.063.704	5.549.561	1.950.061
Abdomen	1.044.032	1.511.456	1.877.739	2.206.713	2.148.662	1.087.950
Vertebrae	453.611	602.508	706.392	763.858	693.310	295.293
Extremity	129.842	192.517	231.873	281.968	264.413	130.002
Other	3.786.513	5.194.713	6.104.740	6.853.661	6.191.384	2.902.920
Total	7.813.708	10.693.635	12.567.535	14.130.225	17.192.695	7.420.082
CT/ED visits	10,84%	12,77%	13,73%	14,46%	23,40%	8,44%

CT/ED visits ratio: Percentage of the requested CT scans among ED visits.

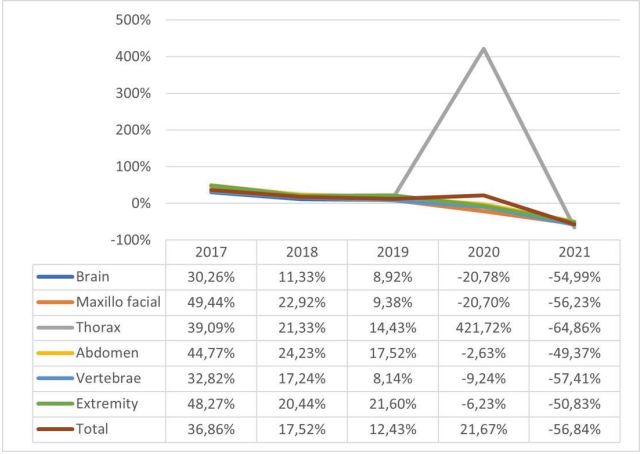

Figure 1. The rate of change in CT screening from 2017 to 2021.

The highest number of radiographic regions were determined as joints, chest and abdomen (Table 3). Chest radiography was requested the most in 2019 (n=7.835.034). The rate of change of all radiographies decreased in 2020 (Figure 2).

Diffusion weighted MRI rates among Brain MRI are higher in all years (81%,84%, 86%, 88%, 90%, 89% respectively). Musculoskeletal screening has the higher rates of joint MRI (84%, 87%,87%,88%,85%,87% from 2016 to 2021 respectively). The number of all MRI was found in 2019 (n=894.703) (Table 4)

The ultrasound numbers were highest in 2017 (n=2.797.087) and lowest in 2020 (n=1.992.401) (Table 5) (Figure 2).

Overall, there was a statistically significant difference between years in terms of imaging types (X2 65.05, p<0.001, Friedman). All imaging modalities have changed statistically between the years 2016-2017 (p<0.001); 2017-2018 (p<0.001); 2018-2019 (p=0.02); 2019-2020 (p<0.001). While there was no statistical difference between 2020 and 2021 (p=0.614) also 2016 and 2021 (p=0.337), a statistically significant difference was found between 2016 and 2020 (p=0.046). Number of USG was found decreased at a rate of 29.16% and CT has found 21.67% increase in 2020 (Figure 3).

Table 3. The distribution of plain radiographies by years

	2016	2017	2018	2019	2020	2021
Head	650.056	731.369	707.747	692.728	416.788	464.853
Chest	4.801.288	6.076.605	7.088.284	7.835.034	6.642.195	6.544.589
Abdomen	2.931.563	3.663.232	4.257.987	4.974.690	3.225.227	4.283.150
Pelvis	455.862	550.712	571.358	586.534	425.717	573.514
Joint	6.646.842	8.744.517	9.980.175	11.132.219	8.308.685	11.378.009
Other	666.3410	850.0390	909.1690	974.3190	625.9740	813.2780
Total	22.151.037	28.268.842	31.699.259	34.966.414	25.280.372	31.378.916
R/ED visits	31%	34%	35%	36%	34%	36%

R/ED visits ratio: Percentage of the requested radiographic scans among ED visits.

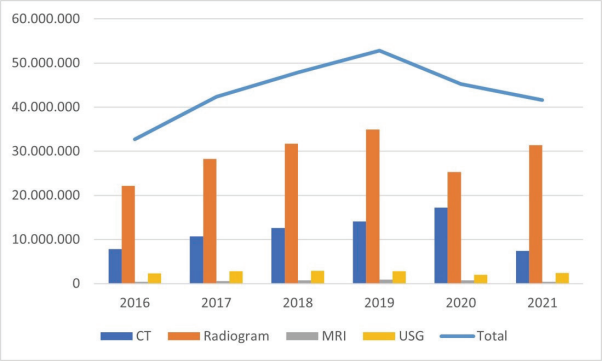

Figure 2. Distribution of emergency imaging and imaging modalities by years

Table 4. The distribution of MRI by years						
MRI	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
DWI	232.392	364.034	470.783	588.041	517.613	268.049
Brain	287.322	435.608	546.331	670.592	576.604	299.574
Vertebrae, Lumbar	33.500	41.011	48.714	57.299	37.907	23.569
Vertebrae, Thoracal	5.083	6.396	7.175	8.551	7.029	4.059
Vertebrae, Cervical	15.620	18.774	22.913	28.612	17.085	11.399
Vertebrae	54.203	66.181	78.802	94.462	62.021	39.027
Lung and Mediastinum	251	246	304	260	266	110
Abdomen	7.255	8.593	10.525	11.390	8.795	4.906
Musculoskeletal (Extremity, joint)	32.095	39.717	47.907	59.405	36.091	23.246
Other	32.588	48.970	54.013	60.613	47.213	26.911
Total	411.698	597.298	735.864	894.703	728.970	391.753
MR/ED visits	0,57%	0,71%	0,80%	0,92%	0,99%	0,45%
MRI/ED visits ratio: Percentage of the requested MR imaging among ED visits.						

Table 5. The distribution of USG by years						
USG	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Total	2.328.259	2.797.087	2.849.654	2.812.628	1.992.401	2.409.797
USG/ED visits	3,229%	3,341%	3,114%	2,879%	2,712%	2,740%
USG/ED visits ratio: Percentage of the requested US scans among ED visits.						

DISCUSSION

When the last 6 years of data on the usage of imaging methods in emergency departments were examined, the statistics showed that there was a continuous increase in the number of computed tomography scans, total number of radiograms and MR scans between 2016 and 2020 before the COVID-19 pandemic. Plain radiograph has been the most frequently used method among all imaging modalities.

When the statistics of the pandemic period were analyzed, it was observed that the total increase in the number of computed tomography scans, especially with the significant increase in thoracic CT, continued in 2020, when the pandemic began, but a decrease was observed in almost all CT scans in 2021. During the pandemic period, there was a significant decrease in Plain radiograph in 2020, and it approached the former levels by 2021. When the MRI and USG are examined, a decrease in requests has been seen since the pandemic in 2020 and 2021 when compared to the prepandemic years.

In our country under normal conditions, when we ignore extraordinary periods such as pandemics, all of these statistics have shown us a continuous increase in the usage of imaging methods each year. In addition, during the COVID-19 pandemic, which is an unusual and unexpected condition, a more than fourfold increase was seen in lung CT scans, but a decrease was observed in all other imaging. This result may be due to the avoidance of hospital admissions for other reasons during the pandemic period, the existence of restrictions, and the fact that hospitals are

seen as a contagious environment.

In the analysis of the adult emergency department in the United States between 2000 and 2005, an increase of 13% was found in the number of patients, while in the same period, an increase of 51% in cranial CT, 463% in cervical CT, 226% in thorax CT, 72% in abdominal CT and 132% in other CT was found.[9,]

In a regional study comparing the changes in the use of CT in health services during the pandemic period in our country in March, April and May of 2019 and 2020, it decreased by 53-65% in public hospitals, while it decreased by 15-24% in March and April in private hospitals, and it was found that 15% more CT was requested in May 2020 than in 2019.7 Although there were no monthly comparisons in our study, it was found that the CT change rate increased by 21.67% and USG decreased by 29.16% between 2019 and 2020.

In a study comparing another pandemic in the United States and April of the previous year, it was underlined that the use of tomography was lower in the COVID-19 pandemic, critical reports were fewer, and cranial CTs were lower in the pandemic than in previous years.10 In our study, when the change in 2019-2020 was considered, it was determined that the cranial CTs decreased by 22%. This change was also found to be inconsistent with the literature although the causative factors cannot be explained. In a study conducted at the beginning of 2000 and in which a 12-year change comparison was made[11], it was seen that the rate of CT use to the number of patients increased from 2.8% to 13.9% 4.9-fold. In a 5 years period from 2016 to 2020; CT use statistically increased 120%.

Ultrasound numbers were found to be the lowest in 2020. It has also been reported in the literature that the change in the number of ultrasounds with the pandemic is due to reasons such as the difficulty of performing it with personal protective equipment and the protection aimed at minimizing exposure in all areas of the hospital.[12] Although the use of ultrasound decreased in 2020, there are no data on the use of ultrasound at bedside. However, especially in those years, its widespread use in the diagnosis and follow-up of COVID-19 due to less radiation, bedside usage and rapidity was shown in the literature.[13] Although there has been an increase in usage since 2016, the decrease in all examinations except Plain radiograph and thoracic CT because of the pandemic may have been causing delay in the follow-up of patients.[14]

The increase in emergency department visits also causes the selection of imaging methods that provide fast and detailed information in a short time. Conditions such as a pandemic cause an increase in tests for the factors caused by the pandemic but a decrease in applications for other diseases because of restrictions.[15] It has been observed that Plain radiograph, which had an upward trend, has also decreased proportionally in the last year. The reason for this may be the change in the reasons for visit to the emergency department in the last year. The increase in the lung imaging might increase due to the overtriage since triage decisions might have an effect on radiological imaging requests[16].

Limitations

In our study, no distinction regarding the use of computed tomography could be made between pediatric and adult emergency departments. In addition, the use of thoracic tomography requires a subgroup analysis for COVID-19 or trauma patients. The analysis of ultrasound according to the shooting location could not be classified according to the process diagnosis codes. The distribution of COVID-19 patients by region may also affect the regional distribution, where public hospitals and university hospitals are concentrated, for the last 2 years. There is a need for prospective studies in which the number of CT requests for preliminary diagnosis can be compared. As stated, further prospective studies can explain the causes of these changes when there are restrictions on the epidemic. Be-

sides, further studies may determine whether this increase in the use of tomography in the emergency department is preferred due to its being close to a gold standard or because of the increased need for patients. As we analyzed the previous 6 years in our analysis, the correlation and regression analysis was hard to interpret due to the small sample size. Further investigations may ve concentrated on the monthly or seasonal changes and their correlations regarding visits.

CONCLUSION

In our study, the use of imaging methods in the last 6 years in emergency departments were analyzed, and it was observed that the total number of radiological imaging requests were changed a 6-year period from 2016 to 2022.

Especially in 2020, all methods were statistically decreased except CT (+21.67%). We think that this may be due to the increase in the use of Thoracic CT during the COVID-19 period, the decrease in applications for other diagnoses due to restrictions and the choice of examinations with short duration and social distance. We think that further prospective studies can explain this when there are restrictions on the pandemic.

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