JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1001344
J Contemp Med 2022;12(3):460-464

Original Article / Orijinal Araştırma

Analysis of 12-Lead Electrocardiograms Shared on Twitter

Twitter'da Paylaşılan 12 Derivasyonlu Elektrokardiyogramların Analizi

Hasan Sultanoğlu[1], Mustafa Boğan[1], Mehmet Cihat Demir[1], Tuba Erdem Sultanoğlu[2]

[1]Department of Emergency, Düzce University School of Medicine, Düzce, Turkey
[2]Department of Physical Medicine and Rehabilitation, Düzce University School of Medicine, Düzce, Turkey

Abstract

Aim: A large number of electrocardiograms (ECG) are shared on Twitter every day. Some of them aim to provide information to the readers, and some of them aim to provide training with a mini quiz. This study aimed to discuss the evaluability of ECG images shared on Twitter.

Material and Method: The study sample consisted of 12-lead ECG images shared on Twitter. ECG images shared on 01/08/2020 - 31/01/2021 were manually scanned.

Results: A total of 286 tweets matching the criteria were included in the study on the specified dates. The majority of them (n=231. 80.5%) asked the reader about the ECG. The average number of the tweets' interactions was 70.42±112.17, and the interaction was mainly in the form of "likes" (50.49±80.64). 83.5% of ECGs had a rhythm strip. Total interaction numbers and other parameters were compared. ECGs from which small squares could be selected collected more interactions (p=0.015). ECGs explained the case or whose diagnosis was clearly stated collected more interactions (p <0.001). Also, it was observed that ECGs without a rhythm strip contained more interaction (p <0.001).

Conclusions: We concluded that 12-derivation ECGs shared on Twitter are highly evaluable. There was also a moderate correlation between the number of followers and the number of interactions (r=0.493. p=0.001). For this reason, it is important for accounts with a high number of followers to following that are experts in their field to prevent information pollution.

Keywords: Electrocardiography, social media, Twitter messaging

Öz

Amaç: Twitter'da her gün çok sayıda elektrokardiyogram (EKG) paylaşılmaktadır. Bazıları okuyuculara bilgi vermeyi, bazıları ise mini bir quiz ile eğitim vermeyi amaçlıyor. Bu çalışma Twitter'da paylaşılan EKG görüntülerinin değerlendirilebilirliğini tartışmayı amaçlamıştır.

Gereç ve Yöntem: Çalışma örneklemi Twitter'da paylaşılan 12 derivasyonlu EKG görüntülerinden oluşturuldu. 01/08/2020 - 31/01/2021 tarihinde paylaşılan EKG görüntüleri manuel olarak taranmıştır.

Bulgular: Belirlenen tarihlerde kriterlere uyan toplam 286 tweet çalışmaya dahil edildi. Çoğunluğu (n=231, %80,5) okuyucuya EKG'yi sordu. Tweetlerin ortalama etkileşim sayısı 70,42±112,17 idi ve etkileşim ağırlıklı olarak "beğeni" (50,49±80,64) şeklindeydi. EKG'lerin %83,5'inde ritim şeridi vardı. Toplam etkileşim sayıları ve diğer parametreler karşılaştırıldı. Küçük karelerin seçilebildiği EKG'ler daha fazla etkileşim topladı (p=0,015). Vakayı açıklayan veya tanısı açıkça belirtilen EKG'ler daha fazla etkileşim topladı (p <0,001) . Ayrıca ritim şeridi olmayan EKG'lerin daha fazla etkileşim içerdiği gözlendi (p<0,001).

Sonuç: Twitter'da paylaşılan 12 derivasyonlu EKG'lerin yüksek derecede değerlendirilebilir olduğu sonucuna vardık. Takipçi sayısı ile etkileşim sayısı arasında da orta düzeyde bir ilişki vardı (r=0,493, p=0,001). Bu nedenle takipçi sayısı yüksek, alanında uzman hesapların bilgi kirliliğini önlemesi önemlidir.

Anahtar Kelimeler: Elektrokardiyografi, sosyal medya, Twitter mesajlaşma

Corresponding *(İletişim)*: Hasan Sultanoğlu, Department of Emergency, Düzce University School of Medicine, Düzce, Turkey
E-mail *(E-posta)*: drsultanoglu@hotmail.com
Received *(Geliş Tarihi)*: 27.09.2021 **Accepted *(Kabul Tarihi)*:** 05.01.2022

INTRODUCTION

Social media has an extensive place in shopping, official announcements, scientific sharing, and educational activities in addition to personal sharing. With the Coronavirus 2019 disease (COVID-19) pandemic, social media has become more prominent in education and training activities.

Twitter is a popular microblogging site with an enormous user base and free access.[1] In addition to their video, photo, and access link, users share texts of 280 characters called "tweets." Due to the limited number of characters allowed, users use abbreviations, phrases, or hashtags to convey a message. Hashtags define keywords and make certain information easy to organize and search. Followers of the person or organization that created the tweet can view, retweet, or add to likes it. Thanks to retweeting, it becomes possible for the followers of the follower to see the message, and the interest increases. This offers the advantage of quickly spreading information to large numbers of people. Users' shares are constantly updated with a timeline.[2] It has been shown that social media is an effective way of informing and educating about health.[3,4]

Electrocardiography (ECG) is the process of detecting and recording the heart's electrical activity through electrodes placed on the skin.[5] ECG training and its effectiveness on social media have been researched before, but its efficiency has not been explained well.[6] On the other hand, in a study comparing two groups who received ECG education through electronic learning (e-learning) and face-to-face training, it was shown that the ECG skills of both groups increased after the training, but there was no difference between them.[7]

A large number of ECGs are shared on Twitter every day. Some of them aim to provide information to the readers, and some of them aim to provide training with a mini quiz. It is also known that the quality of medical images shared with social media applications may deteriorate.[8] This study aimed to discuss the evaluability of ECG images shared on Twitter.

MATERIAL AND METHOD

Study Design and Sampling

The study sample consisted of 12-lead ECG images shared on Twitter. The minimum sample size required for research in proportional data for which the sample size is not known precisely was determined by performing power analysis. Accordingly, a minimum of 255 samples was required (effect size 0.5, error level 0.05, and 0.95 confidence interval). ECG images shared on 01/08/2020 - 31/01/2021 were manually scanned. The following categories were searched using the words #ECGChallenge, #ECG, #EKG, #Electrocardiography, #electrocardiogram, #ECG lovers, EKG, ECG, ECG Challenge, Electrocardiography, Electrocardiogram, and ECG lovers; the most popular tweets, the latest tweets, contacts, and photos. Detected 12-lead ECG images were included in the study. Links containing an ECG assessment were not included in the study. Retweets containing twits included in the study were excluded.

Standard ECG tracing consists of 12 leads. Electrodes are placed on all four limbs and in specific areas on the chest wall, allowing them to evaluate potential electrical changes in the heart from different locations. Bipolar leads called DI, DII, DIII, and other unipolar leads follow; aVR, aVL, and aVF limb leads, precordial leads V1-V6. The usual paper speed is 25 mm/sec, and when it is shot at this speed, the duration of a small square in the ECG is 0.04 seconds, and the duration of a large frame consisting of 5 small squares is 0.20 seconds. Heart rate in an ECG with a 25 mm/sec paper speed It is calculated using 1500/small square number between two consecutive R waves or 300/a large number of frames between two consecutive R waves.[9]

Data Collection

The date of the tweeted images, the total number of interactions (comment, like, retweet), and the number of followers of the tweeted user were recorded. The photos in the tweets were evaluated on a desktop computer monitor. The evaluation was done by an emergency medicine specialist and a cardiologist in a single-blind fashion. Both evaluators were asked whether the ECGs were suitable for evaluation. During the assessment, the 12 leads should be indicated on the ECG strips, the clear visibility of the squares on the paper (large and small squares separately), the presence of the rhythm strip, the status of aVR (positive/negative), the ECG paper speed, the predictability of the heart rate, the prediction of the rhythm, and the selectability of the isoelectronic line was examined. Afterward, it was checked whether the tweet was a question or a direct explanation, whether the tweet owner provided sufficient proof, and whether it stated a precise diagnosis. A rubric was used for ECG evaluation. Pearson correlation test was used to show agreement between raters, and there was a very high correlation between raters ($p < 0.05$, $r = 0.94$).

Ethical statement

All information collected from this study was from open accessed Twitter accounts. This study contains publicly available data.

Statistical Analysis

The compliance of the data to normal distribution was examined with the Kolmogorov Smirnov test. The student's t-test was used to compare normally distributed characteristics in two independent groups. A one-way analysis of variance (ANOVA) test was used to compare more than two independent groups. The Mann-Whitney U test was used to compare the features that were not normally distributed in two independent groups, and the Kruskal Wallis test was used to compare more than two independent groups. Pearson Correlation test was used to determine rater reliability, which shows consistency between raters. Relationships between numerical variables were tested with the Pearson correlation coefficient. Simple linear regression analysis was performed between interaction number and follower values. As descriptive statistics, mean±standard deviation and median (min-max) values for numerical variables; Number and%

values are given for categorical variables. SPSS Windows version 23.0 package program was used for statistical analysis, and p <0.05 was considered statistically significant.

RESULTS

A total of 286 tweets matching the criteria were included in the study on the specified dates. The majority of them (n=231, 80.5%) asked the reader about the ECG. Tweets were created from 45 accounts, and the median number of followers of the accounts was 15125. The average number of the tweets' interactions was 70.42±112.17, and the interaction was mainly in the form of "likes" (50.49±80.64). 83.5% of ECGs had a rhythm strip, 99% had clear derivation names, 21.2% indicated paper speed, 81.9% had negative aVR, 99% had prominent large squares, small squares were also apparent in 80.8%, the heart rate could be assessed in 94.8%, the isoelectric line could be selected in 95.5%. An explanation was made about the case in 91.6%, and the diagnosis was clearly stated in 88.9% (**Table 1**).

Table 1. Descriptive data of 12-lead electrocardiographs shared on Twitter

Parameters	Value
Number of tweets (n,%)	
Total	286 (100)
Question	231 (80.5)
Explanation	55 (19.2)
Undetermined	1 (0.3)
Accounts that post tweets (n)	45
Possible personal account	182 (63.9)
Possible corporate account	103 (36.1)
Number of followers of the accounts [median (q1-q3)]	15125 (13450-28342)
Interaction count of tweets (mean ± sd)	70.42±112.17
Comment	5.13±8.98
Retweet	14.82±25.17
Like	50.49±80.64
Is there a rhythm strip? (n,%)	
Yes	240 (83.5)
No	47 (16.5)
Are the derivations clearly evident? (n,%)	
Yes	284 (99)
No	3 (1)
Is the paper speed shown? (n,%)	
Yes	61 (21.2)
No	226 (78.8)
Status of aVR (n,%)	
negative	235 (81.9)
positive	23 (8)
uncertain/not evaluated	29 (10.1)
Are large squares prominent? (n,%)	
Yes	284 (99)
No	3 (1)
Are small squares prominent? (n,%)	
Yes	232 (80.8)
No	55 (19.2)
Can the heart rate be calculated? (n,%)	
Yes	272 (94.8)
No	15 (5.2)
Can the isoelectric line be evaluated? (n,%)	
Yes	274 (95.5)
No	13 (4.5)
Is there any explanation about the case? (n,%)	
Yes	263 (91.6)
No	24 (8.4)
Is the diagnosis clearly stated? (n,%)	
Yes	255 (88.9)
No	32 (11.1)

Total interaction numbers and other parameters were compared. ECGs from which small squares could be selected collected more interactions (p=0.015). ECGs explained the case or whose diagnosis was clearly stated collected more interactions (p <0.001). Also, it was observed that ECGs without a rhythm strip contained more interaction (p <0.001) (**Table 2**).

Table 2. Comparison of interaction numbers and descriptive data

Parameters		Total number of interactions		
		Mean±sd (M)	min-max	p
Is there a rhythm strip?	Yes	55.39±87.36 (23)	0-712	<0.001
	No	146.85±176.98 (108)	2-987	
Are derivations clearly evident?	Yes	70.68±112.65 (26)	0-987	0.880
	No	46.00±52.85 (30)	3-105	
Are large squares prominent?	Yes	69.78±112.01 (26)	0-987	0.396
	No	130.67±135.34 (105)	10-277	
Are small squares prominent?	Yes	78.23±121.36 (28)	0-987	0.015
	No	37.62±48.16 (19)	2-277	
Can the heart rate be calculated?	Yes	72.68±114.53 (27)	0-987	0.064
	No	29.67±35.93 (16)	3-122	
Is the paper speed shown?	Yes	53.72±70.59 (28)	3-402	0.727
	No	74.85±120.57 (25)	0-987	
Can the isoelectric line be evaluated?	Yes	70.91±113.20 (26)	0-987	0.441
	No	60.15±990.95 (23)	3-277	
Status of aVR	Negative	72.14±120.52 (25)	0-987	0.425
	Pozitive	61.57±68.16 (28)	3-245	
	Uncertain	63.59±58.38 (36)	3-206	
Tweet feature	Question	71.46±107.23 (24)	0-712	0.089
	Explanation	67.02±132.98 (42)	3-987	
Is there any explanation about the case?	Yes	74.92±114.95 (28)	2-987	<0.001
	No	21.29±56.73 (2)	0-277	
Is the diagnosis clearly stated?	Yes	76.89±116.19 (28)	2-987	<0.001
	No	19.03±49.25 (3,5)	0-277	

There was a moderate positive correlation between interaction and number of followers (r=0.493; p=0.001). A 1 unit increase in the number of followers resulted in a 1.01 unit increase in the number of interactions (**Figure 1**). According to the univariate linear regression analysis, 24.3% of the interaction change was explained by the number of followers (**Table 3**).

Table 3. Relationship between interaction and number of followers

	Unstandardized Coefficient[a]		P
	B	Std. Error	
Constant	1.12	0.51	0.001
Number of followers	1.01	0.01	0.001

[a]Dependent variable: interaction; Independent variable: number of followers, * Significant at 0.05 level

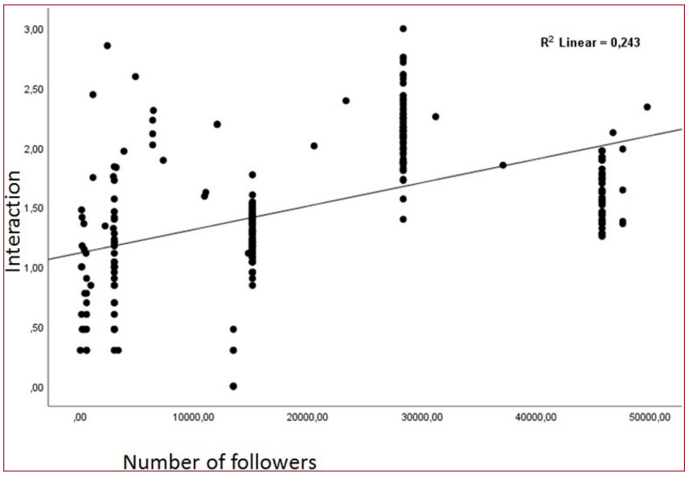

Figure 1. Distribution chart between interaction and number of followers

DISCUSSION

The most important part of this study was to investigate ECGs' evaluability shared on Twitter, the largest social media platform, due to the uptrend of internet-mediated education rather than face-to-face education due to the current COVID-19 pandemic as well as the technology age we are in. In our study, small squares were evident in more than 4/5 of the tweets, and case information was available. It was determined that ECG tweets with these features received significantly high interaction. At the same time, it was observed that the tweets that also reported the diagnosis indicated by the ECG received significantly more interaction.

Cardiovascular diseases are currently the most common cause of death worldwide.[10] An ECG reflects the heart's electrical activity, providing a tremendous amount of information about heart function, which is essential for accurate diagnosis of various diseases. ECG is still the most widely used method for examining the heart's electrical activity due to its easy and fast application, reproducibility, noninvasiveness, and cost-effectiveness.[11] Luigi Galvani first determined the electrical activity of the heart in 1791.[12] Since ECG was introduced by Einthoven in 1902, it has been an essential diagnostic modality for heart diseases.[13,14] In addition to cardiac pathologies, 12-lead ECG is one diagnostic tool that provides crucial information in examining the effect of non-cardiac causes on the heart.

Although the basic ECG interpretation skill is critical for physicians, unfortunately, most universities' education on this subject does not seem sufficient, and the knowledge gap continues.[15] The need for alternative ways to improve ECG training is obvious. Web-based education is a branch of e-learning that is increasingly used due to the advantages of the internet, such as accessibility, geographic independence, flexibility, advanced visualization, and interaction opportunity.[15,16] Medical posts by healthcare professionals are frequently encountered on social media channels such as Twitter.[17] However, there is not enough data about the evaluability of shared ECGs. These shares generally aim to transfer education, knowledge, and experience. Our study observed that approximately 81% of the tweets about ECG had the quality of teaching the reader through questions, while the posts on ECG were appreciated. These results show us that ECG, which is vital in patient evaluation, attracts healthcare professionals' attention and has teaching and learning anxiety in this area.

In our study, it was observed that the interaction was significantly high in tweets with case information sharing in addition to the ECG image. However, it is seen that the evaluability of the posts lacks at some points. It was determined that the information about the paper speed, which is essential to know in the basic ECG evaluation, was included in only 21% of the tweets. However, this may be due to the paper speed is ignored because it is generally accepted speed unless otherwise stated. It is not yet fully understood the optimal methods to improve ECG interpretation skills and maintain information persistence.[18,19] ECG teaching via Twitter, which has high interaction possibilities, should be considered an excellent alternative option. For this reason, it is crucial to provide the necessary information and to have good image quality, both in order not to be misinterpreted and to prevent underestimation.

In our study, there was a moderate correlation between the number of followers and the number of interactions. In almost all of the shared ECGs, derivations could be evaluated, paper speed was not specified in about 1/5 of them, and small squares could not be assessed. The posts that did not have a rhythm strip, small squares could be noticed, and explanations made about ECG received significantly more interaction. The fact that followers retweet, add to likes, or reply to a post can encourage the tweet's creator to post new, excessive, jarring, or funny information without being sure of the accuracy of the information being shared. The tweets sent by healthcare professionals may violate patient privacy and cause unethical behavior. Healthcare professionals may engage in risky behaviors such as not taking the possible negative effects of tweets seriously.[20,21] Therefore, linking comments to original evidence, high-quality statements, slide presentations, and lectures can add value to the tweets posted and provide a way for followers to explore the topic further, grasp the topic's nuances, and develop their perspectives.[22]

Limitations

We also believe that hundreds of 12-lead ECGs escaped from this manual scan. While publishing data belonging to a patient in any scientific journal, we get a "signed patient consent form," but it seems that we do not have such a concern in these posts made on social media. This is an important issue that concerns patient confidentiality. Also we cannot detect the healthcare professional status account.

Another limitation of our study was that the effect of twits on improving ECG knowledge was excluded from the study's scope. Studies on ECG learning via social media are needed. There is also a need for researches on how and by whom such ECG sharing should be made.

CONCLUSION

We concluded that 12-derivation ECGs shared on Twitter are highly evaluable. Although the posts are not subject to editorial and reviewer evaluation, social media's role in ECG education before and after graduation is increasing gradually due to its availability at all times. In our study, the posts where small squares could be noticed and case information was presented received significantly more interaction. There was also a moderate correlation between the number of followers and the number of interactions.

ETHICAL DECLARATIONS

Ethics Committee Approval: All information collected from this study was from open accessed Twitter accounts. This study contains publicly available data.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Alnemer KA, Alhuzaim WM, Alnemer AA, Alharbi BB, Bawazir AS, Barayyan OR, et al. Are Health-Related Tweets Evidence Based? Review and Analysis of Health-Related Tweets on Twitter. J Med Internet Res. 2015;17(10):e246.
2. Williams SA, Terras M, Warwick C. How Twitter Is Studied in the Medical Professions: A Classification of Twitter Papers Indexed in PubMed. Medicine. 2013;2(2):e2.
3. Neiger BL, Thackeray R, Burton SH, Thackeray CR, Reese JH. Use of twitter among local health departments: an analysis of information sharing, engagement, and action. J Med Internet Res. 2013;15(8):e177.
4. Edwards S, Roland D. Learning from mistakes on social media. Emerg Med J. 2019;36(8):453-5.
5. Khunti K. Accurate interpretation of the 12-lead ECG electrode placement: A systematic review. Health Educ J 2014;73(5):610-23.
6. Liu SS, Zakaria S, Vaidya D, Srivastava MC. Electrocardiogram training for residents: A curriculum based on Facebook and Twitter. J Electrocardiol. 2017;50(5):646-51.
7. Barthelemy FX, Segard J, Fradin P, et al. ECG interpretation in Emergency Department residents: an update and e-learning as a resource to improve skills. Eur J Emerg Med. 2017;24(2):149-56.
8. Goost H, Witten J, Heck A, et al. Image and diagnosis quality of X-ray image transmission via cell phone camera: a project study evaluating quality and reliability. PLoS One. 2012;7(10):e43402.
9. Khan MG. Rapid ECG interpretation: Springer Science & Business Media; 2008.
10. Barquera S, Pedroza-Tobías A, Medina C, et al. Global Overview of the Epidemiology of Atherosclerotic Cardiovascular Disease. Arch Med Res. 2015;46(5):328-38.
11. Kusumoto F. ECG interpretation: from pathophysiology to clinical application: Springer Nature; 2020.
12. Ristagno G, Tang W, Weil MH. Cardiopulmonary resuscitation: from the beginning to the present day. Crit Care Clin. 2009;25(1):133-51.
13. Einthoven W. Weiteres über das Elektrokardiogramm. Archiv für die gesamte Physiologie des Menschen und der Tiere. 1908;122(12):517-84.
14. Francis J. ECG monitoring leads and special leads. Indian Pacing Electrophysiol J. 2016;16(3):92-5.
15. Nilsson M, Bolinder G, Held C, Johansson B-L, Fors U, Östergren J. Evaluation of a web-based ECG-interpretation programme for undergraduate medical students. BMC Med Educ 2008;8(1):1-7.
16. Harris JM, Salasche SJ, Harris RB. The internet and the globalisation of medical education. BMJ. 2001;323(7321):1106.
17. Chretien KC, Kind T. Social media and clinical care: ethical, professional, and social implications. Circulation. 2013;127(13):1413-21.
18. Salerno SM, Alguire PC, Waxman HS. Training and competency evaluation for interpretation of 12-lead electrocardiograms: recommendations from the American College of Physicians. Ann Intern Med 2003;138(9):747-50.
19. Martin ML, Lewis RJ, Yealy DM. ECG competency-by whom, for whom? Acad Emerg Med 2002;9(4):348.
20. Boğan M, Karadağ M, Boğan F. Examination of emergency medicine physicians' and residents' Twitter activities during the first days of the COVID-19 outbreak. Int J Travel Med Global Health. 2020;8(2):46-50.
21. Alpert JM, Womble FE. Just what the doctor tweeted: physicians' challenges and rewards of using Twitter. Health Communicat 2016;31(7):824-32.
22. Choo EK, Ranney ML, Chan TM, Trueger NS, Walsh AE, Tegtmeyer K, et al. Twitter as a tool for communication and knowledge exchange in academic medicine: a guide for skeptics and novices. Med Teach 2015;37(5):411-6.