

Perspectives on the Use of Digital Health Technologies in Cardiology Among Specialists from an ESC Member Country: Results from a Survey

Avrupa Kardiyoloji Derneği'ne Üye Ülkeden Kardiyoloji Uzmanlarının Kardiyolojide Dijital Sağlık Teknolojilerinin Kullanımına İlişkin Bakış Açıları: Anket Sonuçları

ABSTRACT

Objective: In this study, we aimed to identify the reasons for and perceived challenges associated with the use of digital health technologies (DHT) in cardiology.

Method: We distributed an online survey to Turkish Society of Cardiology member cardiologists (n = 2789) between January 10 and March 3, 2022.

Results: A total of 308 subjects responded (27.6% females, 62.0% aged 30–44 years). Of these, 42.5% worked at university hospitals, and 44.8% at state hospitals. Smart devices were used by 44.2% (136/308) for personal health monitoring. Additionally, 40.3% (117/290) used social media to provide medical information to patients, while 64.6% (193/299) did so for communication with other physicians. The self-reported recommendation frequencies of wearables, cardiac implantable electronic device telemonitorization, mobile health applications, and teleconsultation/televisit technologies were lower than the proportion of respondents who found DHT beneficial for both patients and physicians. The most frequently mentioned barriers for physicians were increased work burden and responsibilities (78.8%, 193/245), lack of financial compensation (66.9%, 164/245), and lack of relevant training (66.5%, 163/245). For patients, low technological adaptability (81.6%, 200/245), low health literacy (80.4%, 197/245), and low affordability (79.6%, 195/245) were the most frequently mentioned barriers. Additionally, the cost of technologies (69.4%, 170/245), concerns regarding data privacy and security (57.6%, 141/245), and data storage challenges (48.2%, 118/245) were the most significant technical impediments.

Conclusion: The findings suggest that although the majority of physicians believe DHT to be beneficial for both themselves and their patients, the frequency of recommendations to patients remains low. A large-scale joint effort is required to address these issues and facilitate the integration of DHT into clinical practice.

Keywords: Digital health and telemedicine, mobile technologies, social media, remote monitoring, barriers

ÖZET

Amaç: Kardiyolojide dijital sağlık teknolojilerinin (DST) kullanılmasının nedenlerini ve algılanan zorlukları tespit etmek.

Yöntem: Türk Kardiyoloji Derneği üyesi kardiyologlara (n = 2789) 43 çoktan seçmeli sorudan oluşan çevrimiçi anket 10 Ocak–3 Mart 2022 tarihleri arasında gönderildi.

Bulgular: Ankete 308 kişi yanıt verdi (%27,6 kadın, %62,0 30–44 yaş arası). %42,5 ve %44,8'i sırasıyla üniversite ve devlet hastanelerinde çalışmaktaydı. 136/308'i (%44,2) kişisel sağlıklarını izlemek için akıllı cihazlar kullanmaktaydı. Sırasıyla 117/290 (%40,3) ve 193/299'u (%64,6) hastaları ve diğer hekimlerle tıbbi bilgi paylaşımı için sosyal medyayı kullandığını bildirdi. Giyilebilir cihazlar, kardiyak implante edilebilir elektronik cihaz ile teletakibi, mobil sağlık uygulamaları ve telekonsültasyon/televizit teknolojilerinin kişiler tarafından belirtilen önerilme sıklığı, DST'yi hem hastalar hem de hekimler için faydalı bulan katılımcıların oranından daha düşüktü. Hekimlerin en sıklıkla karşılaştıklarını ifade ettikleri engeller; artmış iş yükü ve sorumluluklar (193/245, %78,8), maddi karşılığın olmaması (164/245, %66,9) ve ilişkili eğitim sürecinin eksikliği (163/245, %66,5) idi. Düşük teknolojik uyum yeteneği (200/245, %81,6), düşük sağlık okuryazarlığı (197/245, %80,4) ve düşük alım gücü (195/245, %79,6) hastayla ilgili en sık bahsedilen engeller olurken, teknolojilerin maliyeti (170/245, %69,4), veri gizliliği ve güvenliği ile ilgili endişeler (141/245, %57,6) ve veri depolamadaki zorluklar (118/245, %48,2) en sık karşılaşılan teknik engellerdi.


ORIGINAL ARTICLE

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Sonuç: Bulgular, hekimlerin çoğunun DST'nin hem kendileri hem de hastaları için yararlı olduğuna inanmasına rağmen, hastalara öneri sıklığının düşük kaldığını göstermektedir. Kardiyolojide DST'nin klinik pratikte uygulanmasının önündeki güçlüklerin üstesinden gelmek için çok yönlü bir iş birliğine ihtiyaç vardır.

Anahtar Kelimeler: Dijital sağlık ve telesağlık, mobil teknolojiler, sosyal medya, uzaktan takip, engeller

Digital health technologies (DHT) hold the potential to streamline both physicians' and patients' experiences in diagnosing, treating, and monitoring cardiovascular diseases. Research in this area has significantly advanced, especially following the onset of the Coronavirus Disease 2019 (COVID-19) pandemic. Although this field is rapidly developing, the integration of DHT into routine cardiovascular clinical practice has not kept pace. Recent surveys by national¹ and international^{2,3} professional associations, which gathered healthcare professionals' opinions in the field of cardiology about DHT, have revealed that technological, physician-related, and patient-related factors all play a part in this lag. However, the perspectives of cardiologists practicing in Turkey on the use of DHT in cardiology remain unexplored.

This study aims to identify factors that motivate and challenge the use of DHT in cardiology among fellow/specialist adult cardiologists who are members of the Turkish Society of Cardiology (TSC).

Materials and Methods

Study Population and Data Collection

From January 10 to March 3, 2022, a link to an online survey consisting of 43 multiple-choice questions was emailed to TSC member cardiologists (either fellows in training or experts) (n = 2789). Additionally, announcements were made on the society's official website and social media platforms. Data were collected from members who agreed to participate, using the SurveyMonkey® online survey platform.

The Medical Research Ethics Committee of Ege University (Approval Number: 21-11.1T/18, Date: 21.11.2021) approved the study, ensuring adherence to the Helsinki Declaration.

Statistical Analysis

Aiming for a response rate consistent with recent relevant survey studies,^{1,3} our objective was to reach at least 10% of the target population, comprising 2,789 full members of the TSC as of October 1, 2021.

IBM Statistical Package for the Social Sciences (SPSS) (IBM Corp., 2015 release; Armonk, NY: IBM Corp., IBM SPSS Statistics for Windows, Version 23.0) was used to analyze the data gathered through the online survey platform. Categorical variables were presented as numbers and percentages, calculated based on the

total number of participants for whom data were available. To investigate the impact of baseline characteristics on participants' recommendations regarding DHT, group comparisons were made using the chi-square test.

Statistical significance was defined as a p-value less than 0.05.

Results

Out of the 2,789 individuals invited to participate in the survey, 308 (11.04%) responded. Table 1 presents the baseline characteristics

Table 1. Baseline Characteristics of the Respondents

Sociodemographic Characteristics	
Age Group, n (%)	
<30 years	52/308 (16.9%)
30-44 years	191/308 (62.0%)
45-60 years	50/308 (16.2%)
>60 years	15/308 (4.9%)
Gender: Female, n (%)	85/308 (27.6%)
Place of Work, n (%)	
University Hospital	131/308 (42.5%)
State Hospital	138/308 (44.8%)
Private Hospital	35/308 (11.4%)
Private Practice	22/308 (7.1%)
Not Involved in Patient Care	13/308 (4.2%)
Geographic Region, n (%)	
Marmara Region	117/308 (38.0%)
Aegean Region	47/308 (15.3%)
Mediterranean Region	25/308 (8.1%)
Inner Anatolian Region	46/308 (14.9%)
Black Sea Region	30/308 (9.7%)
Eastern Anatolia Region	23/308 (7.5%)
Southeastern Anatolia Region	20/308 (6.5%)
Self-Reported Level of Engagement with DHT	
Level of Understanding of DHT, n (%)	
Very Low	12/297 (4.0%)
Low	66/297 (22.2%)
Moderate	135/297 (45.5%)
Good	62/297 (20.9%)
Very Good	22/297 (7.4%)
Usage of Smart Devices to Track Own Health Status, n (%)	136/308 (44.2%)
Self-Reported Engagement with Social Media Platforms, n (%)	
To Share Medical Information with Patients	117/290 (40.3%)
Twitter	34/117 (29.1%)
LinkedIn	16/117 (13.7%)
Facebook	27/117 (23.1%)
Instagram	48/117 (41.0%)
WhatsApp	92/117 (78.6%)
Other	8/117 (6.8%)
To Share Medical Information with Other Physicians	193/299 (64.6%)
Twitter	91/193 (47.2%)
LinkedIn	34/193 (17.6%)
Facebook	35/193 (18.1%)
Instagram	77/193 (39.9%)
WhatsApp	151/193 (78.2%)
Other	14/193 (7.3%)

DHT, digital health technologies.

ABBREVIATIONS

CIED	Cardiac Implantable Electronic Device
COVID-19	Coronavirus Disease 2019
DHT	Digital health technologies
ECG	Electrocardiogram
ESC	European Society of Cardiology
TSC	Turkish Society of Cardiology

of these respondents. Of these, 85 (27.6%) were female. A total of 191 respondents (62.0%) fell within the age range of 30-44 years. Regarding their workplace, 131 (42.5%) worked at university hospitals, and 138 (44.8%) at state hospitals. The geographic distribution of the respondents, based on their place of work, is detailed in Supplementary Table 1. A total of 84 out of 297 respondents (28.3%) claimed to have at least a good understanding of DHT in cardiology. Furthermore, 136 out of 308 respondents (44.2%) reported using smart devices (specifically, smartphones and smartwatches) for monitoring their personal health.

Regarding the use of social media to provide medical information to their patients, 117 out of 290 respondents (40.3%) reported engaging in this practice. WhatsApp and Instagram were the most popular platforms for this purpose, used by 92 out of 117 (78.6%) and 48 out of 117 (41.0%) respondents, respectively. In terms of sharing medical information with other physicians, 193 out of 299 respondents (64.6%) engaged in this practice, primarily using WhatsApp (151 out of 193, 78.2%) and Twitter (91 out of 193, 47.2%) (Table 1).

Table 2 presents the respondents' opinions about DHT in cardiology. Four-fifths of the survey participants believed that wearables and mobile health applications were beneficial for both physicians and patients, though only about two-thirds recommended their use. While almost four out of five respondents believed that DHT offered advantages for both physicians and patients, only half stated that they would recommend Cardiac Implantable Electronic Device (CIED) telemonitorization to their patients and acquaintances. Similarly, despite more than three-fifths of respondents acknowledging the benefits of teleconsultation and televisit technologies for both physicians and patients, only 42.9% indicated they would recommend these technologies to patients and acquaintances.

The relationship between the respondents' baseline characteristics and their DHT recommendation states is depicted in Table 3. Neither age nor gender of the respondents influenced the frequency of their recommendations for any of the DHTs under study (specifically, wearables, CIED telemonitorization, mobile health applications, and teleconsultation/televisit technologies) (all $P > 0.05$). However, respondents who utilized smart devices to monitor their own health were more likely to recommend wearables than those who did not (81.4% vs. 64.1%, $P = 0.001$), while the frequencies of recommendations for other DHTs were comparable (all $P > 0.05$). Respondents who reported engaging with social media platforms to share medical information with other physicians were more likely to recommend CIED telemonitorization (57.1% vs. 44.4%, $P = 0.047$) and mobile health applications (75.3% vs. 63.0%, $P = 0.047$). Similarly, those who reported using social media platforms to share medical information with patients were more likely to recommend teleconsultation/televisit technologies (53.9% vs. 33.8%, $P = 0.002$). Recommendations for the remaining DHTs were unaffected by self-reported use of social media (all $P > 0.05$) (Table 3).

Figure 1 presents the most common usage scenarios of DHTs by patients and acquaintances according to the physicians' perspectives. The most prevalent uses for wearables and mobile health applications were reportedly step counting and heart rate monitoring without an electrocardiogram (ECG). CIED telemonitorization and teleconsultation/televisit technologies were more commonly preferred for follow-up purposes.

Perceived barriers to the utilization of DHT in cardiology among Turkish cardiologists are depicted in Figure 2. The most commonly cited challenges for physicians included an increased workload and responsibilities (193/245, 78.8%), lack of financial

Table 2. Opinions of the Respondents about DHT in Cardiology and Self-Reported Patterns of Use in Practice

	Wearables	Cardiac Implantable Electronic Device Telemonitorization	Mobile Health Applications	Teleconsultation/Televisit Technologies	Information Management Using DHT
Are Beneficial for Physicians					
Don't Agree	10/296 (3.4%)	9/288 (3.1%)	6/270 (2.2%)	29/259 (11.2%)	11/254 (4.3%)
Undecided	38/296 (12.8%)	44/288 (15.3%)	35/270 (13.0%)	72/259 (27.8%)	42/254 (16.5%)
Agree	248/296 (83.8%)	235/288 (81.6%)	229/270 (84.8%)	158/259 (61.0%)	201/254 (79.1%)
Are Beneficial for Patients					
Don't Agree	8/296 (2.7%)	6/288 (2.1%)	10/270 (3.7%)	30/259 (11.6%)	-
Undecided	38/296 (12.8%)	37/288 (12.9%)	37/270 (13.7%)	64/259 (24.7%)	
Agree	250/296 (84.5%)	245/288 (85.1%)	223/270 (82.6%)	165/259 (63.7%)	
Recommend to Patients and Acquaintances	212/296 (71.6%)	152/288 (52.8%)	192/270 (71.1%)	111/259 (42.9%)	119/254 (46.9%)*
Self-Reported Change in Recommendation Frequency After the Emergence of the Pandemic					
Increased	132/210 (62.9%)	74/150 (49.3%)	126/191 (66.0%)	84/110 (76.4%)	89/119 (74.8%)*
No Change	75/210 (35.7%)	73/150 (48.7%)	64/191 (33.5%)	24/110 (21.8%)	29/119 (24.4%)*
Decreased	3/210 (1.4%)	3/150 (2.0%)	1/191 (0.5%)	2/110 (1.8%)	1/1119 (0.8%)*

DHT, digital health technologies. *Shows the number and percentage of respondents who benefit from DHT for information management (such as decision support systems and follow-up of clinical/institutional practice) themselves.

Table 3. Relationship Between Baseline Characteristics of the Respondents and Their DHT Recommendation States

	Recommendation of Wearables	P	Recommendation of Cardiac Implantable Electronic Device Telemonitorization	P	Recommendation of Mobile Health Applications	P	Recommendation of Teleconsultation/ Televisit Technologies	P
Sociodemographic Characteristics								
Age Group		0.202		0.573		0.051		0.375
<30 years	79.6%		59.6%		79.1%		42.5%	
30-44 years	71.0%		51.9%		69.0%		42.3%	
45-60 years	62.5%		46.8%		63.4%		38.5%	
>60 years	84.6%		61.5%		100.0%		66.7%	
Gender		0.244		0.421		1.000		0.561
Female	77.2%		48.6%		71.6%		39.1%	
Male	69.6%		54.2%		70.9%		44.1%	
Self-Reported Engagement with DHT and Social Media Platforms								
Usage of Smart Devices to Track Own Health Status		0.001*		0.096		0.010*		0.612
Use	81.4%		58.6%		79.3%		45.0%	
Don't Use	64.1%		48.1%		64.9%		41.2%	
Usage of Social Media Platforms to Share Medical Information with Patients		0.143		0.142		0.065		0.002*
Use	76.1%		58.0%		74.4%		53.9%	
Don't Use	67.4%		48.5%		62.6%		33.8%	
Usage of Social Media Platforms to Share Medical Information with Other Physicians		0.105		0.047		0.047		0.111
Use	75.0%		57.1%		75.3%		46.5%	
Don't Use	65.4%		44.4%		63.0%		35.6%	
Attendance at Digital Health Events in the Past Two Years								
Activities Organized by the ESC		0.109		0.017*		0.015*		0.040*
Attended	82.4%		70.6%		88.2%		58.8%	
Did Not Attend	68.2%		48.3%		67.8%		39.3%	
Activities Organized by the TSC		0.069		0.165		0.648		0.261
Attended	78.7%		58.7%		73.3%		48.0%	
Did Not Attend	66.5%		48.2%		69.4%		39.4%	

*A p-value <0.05 denotes statistical significance.

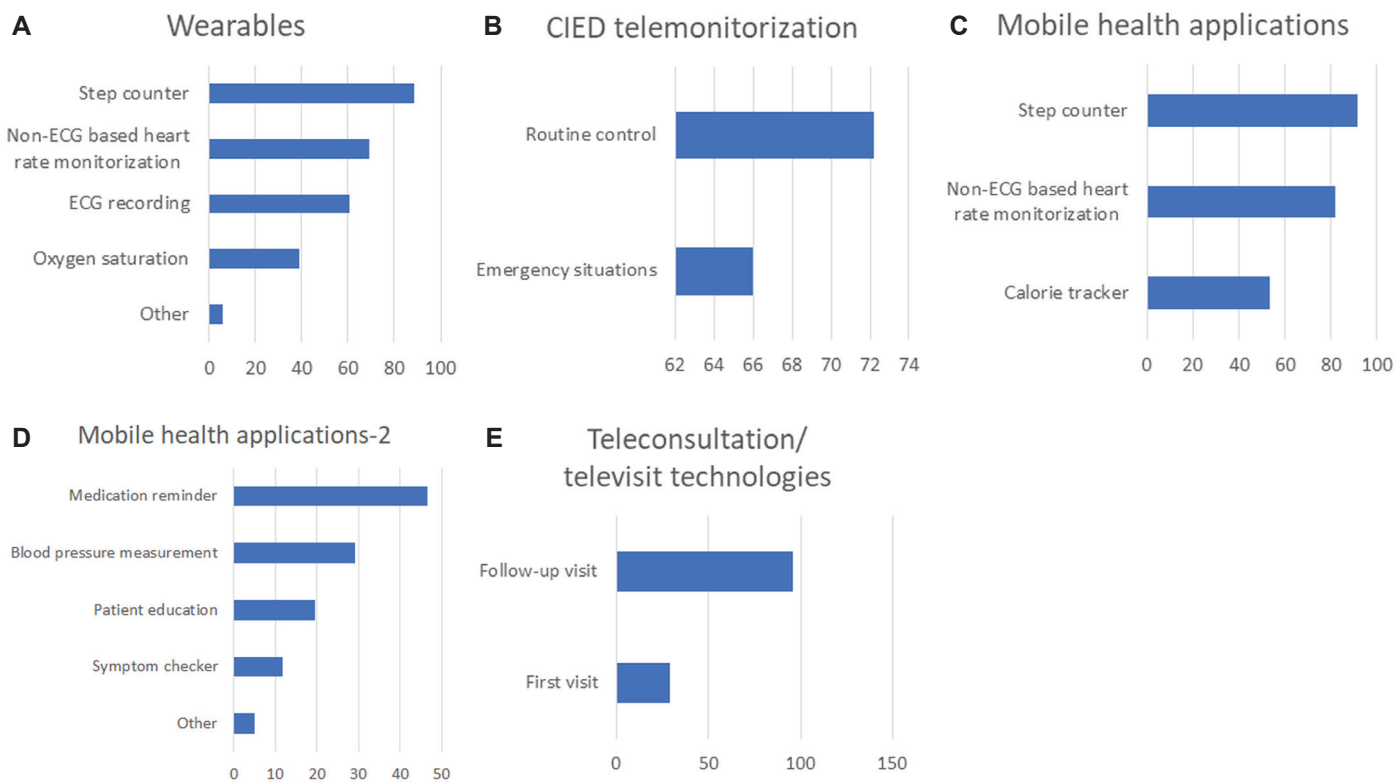


Figure 1. Bar graph depicting the most common usage scenarios of DHT by patients and their acquaintances according to physicians. (A) Wearables (n = 238), (B) CIED telemonitorization (n = 97), (C-D) Mobile health applications (n = 206), (E) Teleconsultation/televisit technologies (n = 103).

CIED, cardiac implantable electronic device; DHT, digital health technologies

compensation (164/245, 66.9%), and lack of relevant training (163/245, 66.5%). On the patient side, low technological adaptability (200/245, 81.6%), low health literacy (197/245, 80.4%), and poor affordability (195/245, 79.6%) were the most frequent barriers identified by respondents. Additionally, the cost of technologies (170/245, 69.4%), concerns about data privacy and security (141/245, 57.6%), and challenges related to data storage (118/245, 48.2%) were highlighted as significant technical impediments.

The survey also inquired about participants' awareness of ongoing initiatives in the field of digital health by the TSC and the European Society of Cardiology (ESC). A total of 60.4% (148/245) of the respondents were aware of the Digital Health Project Group within the TSC, yet only 30.6% (75/245) had attended any digital health sessions organized by the TSC in 2020 and 2021. Even fewer respondents (34/245, 13.9%) participated in digital health sessions held by the ESC in 2020 and 2021.

Respondents who attended ESC digital health activities showed a greater likelihood to recommend CIED telemonitorization (70.6% vs. 48.3%, $P = 0.017$), mobile health applications (88.2% vs. 67.8%, $P = 0.015$), and teleconsultation/televisit technologies (58.8% vs. 39.3%, $P = 0.040$), though this trend did not extend to wearables. Attendance at TSC digital health activities did not show a correlation with the frequency of DHT recommendations (all $P > 0.05$) (Table 3).

Discussion

This survey is the first nationwide study investigating the use of DHT in cardiology among fellow/specialist adult cardiologists who are members of TSC, addressing the perceived challenges as well. The key findings from this survey suggest that nearly half of the physicians utilize DHT to collect their own health data and employ social media to disseminate health information. A majority of the physicians believe that DHT is beneficial for both themselves and their patients, highlighting an increased adoption of DHT in cardiology during the COVID-19 pandemic. However, it is noteworthy that the rate of recommending these technologies to patients and acquaintances remains relatively low.

For this survey, the intended respondents were members of the TSC, and out of 2,789 full members, 308 participated, yielding a response rate of 11.04%. This response rate aligns with other survey studies conducted internationally among cardiologists to gather their perspectives on digital health.^{1,3} Demographically, about 70% of the respondents were male and 60% were aged between 30 and 44. This gender disparity could be attributed to the fact that, as of October 1, 2021, only 18% of the full members of TSC were women (501 women and 2,288 men). Additionally, although there is no official data, it is estimated that only around 20% of Turkish cardiologists are female.⁴ Although a notice was posted on the TSC website, the survey invitation was sent via email, which could mean that younger cardiologists, being

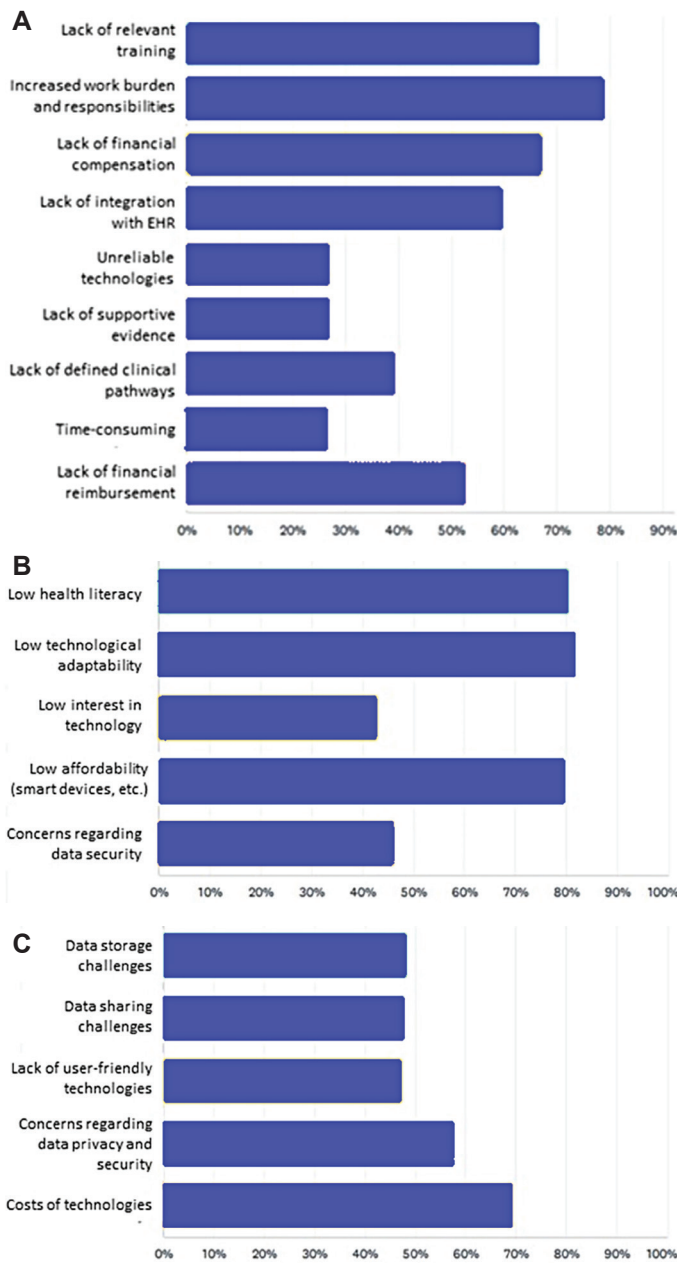


Figure 2. Bar graph illustrating the barriers to the use of DHT in cardiology among Turkish cardiologists (n = 245), categorized into (A) Physician-related, (B) Patient-related, and (C) Technical barriers. DHT, digital health technologies.

more active on their email accounts, were more likely to respond. Despite these demographic limitations, conducting the survey under the auspices of TSC, a national professional cardiology association with members spread across Turkey, seemed like a preferable approach for reaching a larger audience.

Approximately 30% of the respondents claimed to have at least a good understanding of DHT in cardiology, and this percentage is comparable to that of respondents who attended any of the TSC's digital health sessions in 2020 or 2021. Considering the rise in DHT integration into our clinical practice, we can anticipate an increase in attendance in the coming years. It is noteworthy that only a

small proportion of participants, roughly 15%, attended any of the digital health sessions held by the ESC in 2020 and 2021. This finding may be explained by the fact that most cardiologists might prefer attending sessions on clinical cardiology at the ESC Congress, resulting in digital health sessions not capturing their interest as much, especially during an online congress.

Meanwhile, the study's most striking finding is that while a sizable number of cardiologists believe DHT to be advantageous for both physicians and patients, they are less likely to recommend them. Although one might argue that a younger age could influence the frequency of recommendations, our study did not find this to be the case. However, the personal use of smart devices to monitor one's own health, as well as the use of social media platforms to communicate medical information with other physicians or patients, did determine the frequency with which DHT was recommended. These results imply that digital literacy significantly influences the likelihood of recommending DHT to patients. Interestingly, the participants' use of social media, whether for sharing medical information with other physicians or patients, was linked with their recommendation of various DHTs. Even though the observed frequency of self-reported engagement with social media platforms to share medical information with other physicians was lower than expected in our study, leading us to suspect that the point in question may not have been clearly understood by the respondents, we believe we can rely on the frequency of self-reported engagement with social media platforms to share medical information with patients. The fact that using social media platforms to interact with patients and share medical information makes one more inclined to recommend telehealth solutions is logical, given that the objectives and materials are relatively similar. Additionally, respondents who attended digital health sessions led by the ESC were more likely to recommend DHT, indicating that these activities successfully met their objectives.

Because daily step count has emerged as a prognostic factor in incident cardiovascular disease and related mortality,⁵ the findings from the current survey, which show that respondents believed wearables and mobile health applications were most frequently used for step counting, are acceptable. This is followed by non-ECG based heart rate monitoring, as heart rate trends are increasingly being employed for determining cardiovascular fitness and also for drug titration. Despite the technology still being out of reach for the majority of Turkish citizens due to its high cost, ECG recording is a benefit of capable wearables. Although time-consuming and user-dependent, the calorie tracking feature on mobile health applications is also thought to be favored by patients. Our survey found that CIED telemonitorization was mostly advised to replace scheduled in-office follow-up visits rather than for unplanned situations, despite recent ESC guidelines mentioning that remote CIED management also includes unscheduled transmission of pre-defined alert events and patient-initiated unscheduled interrogations.⁶ Teleconsultation/televisit technologies were more frequently utilized for follow-up purposes, not for initial evaluations, similar to findings from a recent US-based survey.⁷

There is scarce evidence regarding barriers to DHT in cardiovascular care. One study identified patient- and physician-related barriers

from 25 and 6 papers, respectively, in a systematic review of publications that examined the facilitators and barriers of DHT in cardiology from inception to May 2020.⁸ The more recent data comes from a survey study in which 227 World Heart Federation (WHF) members (cardiologists, other healthcare professionals, and lawmakers) from 71 countries, including Turkey, participated.⁹ In the 'WHF Roadmap for Digital Health in Cardiology' report, composed based on the results of the online survey and existing literature, the barriers to integrating DHT into routine practice were divided into four categories: health system, health workforce, patient, and technology-related factors.⁹ In the current survey, the barriers were grouped as physician- and patient-related, and technical barriers. It was interesting to note that the most commonly reported perceived barriers by the respondents were those related to patients, specifically low technological adaptability, low health literacy, and low affordability, reported by nearly 80% of the respondents. These were followed by concerns regarding increased work burden and responsibilities on the physician's side, again reported by around 80% of the respondents, while lack of financial compensation and lack of relevant training were indicated by only 66% of the respondents. 70% of respondents cited the cost of technologies as the top technology-related barrier, while more technical details such as concerns regarding data privacy, security, and storage seemed to worry the respondents less.

The results of our survey resemble those from the two aforementioned studies.^{8,9} The systematic review noted that the most frequently reported physician-related barrier was increased workload (in 4 out of 6 studies), and the most frequently reported patient-related barriers were difficulty using technology, fear of using it, lack of interest in it, and advanced age (respectively in 7, 6, 5, and 5 out of 25 studies).⁸ In contrast to our findings, the systematic review indicated that financial concerns were less of a barrier for patients (in 3 out of 25 studies) and physicians (in 2 out of 6 studies).⁸ According to the WHF roadmap paper, the main health workforce-related limitations were a lack of digital literacy and a lack of perceived effectiveness of DHT.⁹ In our survey, 66.5% of respondents indicated a lack of relevant training, while only 39.2% and 26.9% of them gave weight to lack of defined clinical pathways and lack of supportive evidence, respectively, among physician-related barriers. In the WHF roadmap paper, poor digital health literacy and a lack of physical capabilities for interaction were highlighted as the most common patient-related barriers.⁹ Although it is clear that patients with cardiovascular disease are generally older, bear a significant comorbidity burden, and may suffer from decreased physical and/or mental competence, where all these factors may diminish engagement with DHT, we did not include being incapacitated as an option in our multiple-choice questionnaire.

A multifaceted collaborative effort, encompassing patient and professional organizations, as well as technical stakeholders and lawmakers, is needed to overcome the identified challenges to the use of DHT in cardiology. Promoting health and digital literacy among patients is crucial; however, this should be complemented by more accessible DHT. Concerns regarding work burden and responsibilities can only be alleviated through the incorporation of guideline-based clinical decision support tools and the integration of DHT with electronic health records. Activities

organized by professional societies aim to address the lack of previous relevant training, while governments should address compensation issues in collaboration with expert physicians. Additionally, governments and technology companies should collaborate to ensure compliance with national regulations for data privacy and security.

Study Limitations

This study has several limitations. Being a survey, its conclusions are based more on the opinions and self-reports of the respondents than on actual facts. Second, TSC members, the target population of the survey, may not adequately represent Turkish cardiologists. However, we believed that a professional society-based call would be the best method to conduct such a survey study to minimize selection bias. Third, a low response rate of 10% of the target population was achieved; nevertheless, this is much higher than the 1.7% response rate achieved in a survey carried out by the ESC.³ Our study succeeded in reaching a number of participants that correlated with the population of cities in seven geographic regions of our country. However, we acknowledge that TSC members who responded to the survey may have been more likely to be engaged with DHT in cardiology, as the survey invitation was sent online via email. Nonetheless, online surveys have become the method of choice in recent years, particularly due to the COVID-19 pandemic, which made face-to-face survey delivery impractical.

Conclusion

The findings from this survey indicate that, although most physicians believe that DHTs are beneficial for both themselves and their patients, the frequency of recommendations to patients remains low. A comprehensive joint effort is required to overcome the barriers to DHT usage in cardiology.

Ethics Committee Approval: Ethics committee approval was obtained from the Medical Research Ethics Committee of Ege University (Approval Number: 21-11.1T/18, Date: 21.11.2021).

Informed Consent: Informed consent was obtained from the participants prior to proceeding with the online survey.

Peer-review: Externally peer-reviewed.

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

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References

1. Treskes RW, Wildbergh TX, Schaliş MJ, Scherptong RWC. Expectations and perceived barriers to widespread implementation of e-Health in cardiology practice: Results from a national survey in the Netherlands. *Neth Heart J*. 2019;27(1):18-23. [CrossRef]

2. Han JK, Al-Khatib SM, Albert CM. Changes in the digital health landscape in cardiac electrophysiology: A pre-and peri-pandemic COVID-19 era survey. *Cardiovasc Digit Health J.* 2020;2(1):55-62. [\[CrossRef\]](#)
3. Asteggiano R, Cowie MR, Richter D, Christodorescu R, Guasti L, Ferrini M. Survey on e-health knowledge and usage in general cardiology of the Council of Cardiology Practice and the Digital Health Committee. *Eur Heart J Digit Health.* 2021;2(2):342-347. [\[CrossRef\]](#)
4. Koçyiğit D, Tokgözoğlu L, Kayıkçıoğlu M. Impact of the pandemic on gender differences in scientific publication authorship among Turkish adult cardiologists. *Turk Kardiyol Dern Ars.* 2022;50(6):438-444. [\[CrossRef\]](#)
5. Del Pozo Cruz B, Ahmadi MN, Lee IM, Stamatakis E. Prospective associations of daily step counts and intensity with cancer and cardiovascular disease incidence and mortality and all-cause mortality. *JAMA Intern Med.* 2022;182(11):1139-1148. [\[CrossRef\]](#)
6. Glikson M, Nielsen JC, Kronborg MB, et al.; ESC Scientific Document Group. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. *Eur Heart J.* 2021;42(35):3427-3520. [\[CrossRef\]](#)
7. Geng S, Holobinko N, Danger T, et al. Health Care's New Reality Is Dynamic, Digital- and Here to Stay. Accessed December 31, 2022. <https://www.bcg.com/publications/2021/dynamic-and-digital-new-reality-for-health-care>
8. Whitelaw S, Pellegrini DM, Mamas MA, Cowie M, Van Spall HGC. Barriers and facilitators of the uptake of digital health technology in cardiovascular care: a systematic scoping review. *Eur Heart J Digit Health.* 2021;2(1):62-74. [\[CrossRef\]](#)
9. Tromp J, Jindal D, Redfern J, et al. World Heart Federation Roadmap for Digital Health in Cardiology. *Glob Heart.* 2022;17(1):61. [\[CrossRef\]](#)

Supplementary table 1. Geographic distribution of the respondents (n = 308).

Place of work	Number
Marmara region	
Kırklareli	1
Kocaeli	15
Bursa	6
Balıkesir	4
Edirne	2
Çanakkale	1
Tekirdağ	3
Sakarya	1
İstanbul	84
Aegean region	
Aydın	2
Uşak	2
Muğla	4
Denizli	2
İzmir	31
Manisa	1
Kütahya	5
Mediterranean region	
Adana	5
Antalya	5
Hatay	1
Isparta	3
Mersin	10
Burdur	1
Inner Anatolian region	
Ankara	21
Kırşehir	1
Kırıkkale	1
Sivas	1
Konya	8
Kayseri	5
Eskişehir	9
Black Sea region	
Bolu	2
Kastamonu	2
Artvin	2
Düzce	1
Gümüşhane	1
Zonguldak	1
Karabük	2
Trabzon	7
Tokat	4
Samsun	6
Ordu	2
Eastern Anatolia region	
Ağrı	1
Kars	1
Elazığ	4
Erzincan	2
Erzurum	2
Hakkari	1
Van	9
Muş	1
Malatya	1
Bingöl	1
Southeastern Anatolia region	
Adıyaman	1
Kilis	2
Mardin	2
Diyarbakır	5
Gaziantep	5
Batman	1
Urfa	3
Siirt	1