

# Wearable device use and technology preferences in cancer survivors with or at risk for atrial fibrillation



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**BACKGROUND** Cancer survivors face increased risk of heart disease, including atrial fibrillation (AF). Certain types of technology, such as consumer wearable devices, can be useful to monitor for AF, but little is known about wearables and AF monitoring in cancer survivor populations.

**OBJECTIVE** The purpose of this study was to understand technology usage and preferences in cancer survivors with or at risk for AF, and to describe demographic factors associated with wearable device ownership in this population.

**METHODS** Eligible patients completed a remote survey assessment regarding use of commercial wearable devices. The survey contained questions designed to assess commercial wearable device use, electronic health communications, and perceptions regarding the participant's cardiac health.

**RESULTS** A total of 424 cancer survivors (mean age 74.2 years; 53.1% female; 98.8% white) were studied. Although most participants owned a smartphone (85.9%), only 31.8% owned a wearable device. Over half (53.5%) of cancer survivors were worried about

their heart health. Overall, patients believed arrhythmias (79.7%) were the most important heart condition for a wearable to detect. Survivors reported being most willing to share blood pressure (95.6%) and heart rate (95.3%) data with their providers and were least willing to share information about their diet, weight, and physical activity using these devices.

**CONCLUSION** Understanding factors such as device ownership, usage, and heart health concerns in cancer survivors can play an important role in improving cardiovascular monitoring and its accessibility. Long-term patient outcomes may be improved by incorporating wearable devices into routine care of cancer survivors.

**KEYWORDS** Cancer survivor; Heart health; Provider communication; Technology; Wearables

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## Introduction

Cancer survivors represent a growing population as a result of advances in treatment and increased life longevity.<sup>1</sup> Because of treatment complications and increasing age, survivors may be at greater risk for chronic health conditions compared to nonsurvivors, especially cardiovascular disease.<sup>2</sup> Cancer has been reported to be an independent risk factor for atrial fibrillation (AF),<sup>3</sup> the most common cardiac arrhythmia, and a disease associated with significant morbidity and mortality.<sup>4</sup> The prevalence of AF in cancer survivors has ranged from 6% to 20%,<sup>5–7</sup> and survivors with AF have unfavorable health outcomes.<sup>8</sup> Increasing age, hypertension, obesity, diabetes, and smoking all are independently associated with AF.<sup>4,9</sup> These comorbidities

are also risk factors for cancer, so cancer survivors often are at highest risk for AF.

Management of AF risk factors and monitoring of heart rate and rhythm are important to prevent complications from AF and improve quality of life among affected individuals.<sup>10</sup> Advances in technology enable remote monitoring of heart rate and AF, including through the use of wearable devices.<sup>11</sup> Consumer wearable devices, such as the Apple Watch, Fitbit, and Garmin watch, have been used in conjunction with device-based applications to provide remote AF monitoring. The Apple Watch and Fitbit devices both have United States (U.S.) Food and Drug Administration clearance for AF detection.<sup>12–14</sup> Although similar devices have shown feasibility and acceptability in survivor populations for physical activity, heart rate, and sleep monitoring,<sup>15</sup> less is known about AF monitoring. Previous concerns about the use of technology for AF surveillance in cancer survivor populations include older age, because older adults have a higher prevalence of AF and cancer (64% of adults with cancer are aged 65 years or older). However, access and

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### KEY FINDINGS

- Most cancer survivors owned a smartphone (85.9%), but only 31.8% owned a wearable device.
- Over half (53.5%) of cancer survivors were worried about their heart health, and overall, patients believed arrhythmias (79.7%) were the most important heart condition for a wearable to detect.
- Survivors were most willing to share blood pressure (95.6%) and heart rate (95.3%) data with their providers and were the least willing to share their diet, weight, and physical activity data using these devices.
- Using wearable devices to collect cardiovascular metrics or to detect AF, a known concern of many cancer patients, may also be beneficial for long-term cancer survivor outcomes.

familiarity with health technologies are increasing in older adults,<sup>16</sup> and, with added support, older adults may perceive the benefits of wearables and integrate the devices into their daily lives.<sup>17</sup>

Understanding technology usage and preferences among cancer survivors with or at risk for AF is critical. As wearable device ownership grows, third-party payers cover the costs of devices, payors reimburse providers for device data interpretation, and informaticists incorporate these data into electronic health records (EHRs), the opportunity to scale wearables for surveillance of populations at risk for AF is manifesting itself.<sup>18</sup> Gaining an understanding of the current use and preferences of older adult populations at risk for AF is essential to surveil and engage these groups. We describe device ownership, usage, heart health concerns, and preferences for incorporating wearable devices into routine care in cancer survivors with or at risk for AF. We also investigated demographic factors associated with wearable device ownership in this population.

## Methods

### Study design and participants

This study used data acquired from a remote survey assessment of patients with or at risk for AF regarding use of commercial wearable devices. The study is described in detail elsewhere.<sup>19</sup> In brief, the study included individuals receiving care through the University of Massachusetts Memorial Health system who were eligible for the study. Eligibility included receiving cardiology or internal medicine care at University of Massachusetts Memorial Health, having an e-mail address in the EHR, and having a diagnosis of AF or being at high risk for developing AF (defined as being >65 years of age and having a CHA<sub>2</sub>DS<sub>2</sub>-VASC stroke risk score >2).<sup>20</sup> Exclusion criteria included non-English speaking, incarcerated, or <18 years of age. Eligible potential participants were sent an e-mail in January 2021 inviting

them to participate in an online survey. Participants who completed the survey were entered into a raffle to receive either a wrist-based wearable activity tracker or a \$25 gift card. The study was reviewed and approved by the institutional review board at the University of Massachusetts Chan Medical School (IRB #H00021909).

### Materials and measurement

Study survey data were collected and managed using REDCap electronic data capture tools hosted at the University of Massachusetts Chan Medical School ([projectredcap.org](http://projectredcap.org)). The survey was developed by content experts in digital health, cardiology, and medical devices, with questions designed to assess commercial wearable device use, electronic health communications, and perceptions regarding the participant's cardiac health. (For survey questions, see [Supplemental Appendix A](#)). In the invitation e-mail, participants were sent a link to the survey in REDCap. After survey completion, participants' demographic and medical information, including cancer diagnosis, was extracted from the EHR.

### Data analysis

A descriptive analysis of patient characteristics, technology usage, heart health and concerns, and wearable technology preferences was performed. Continuous variables are given as mean  $\pm$  SD, and categorical variables are given as number (frequency). Logistic regression analyses were used to examine associations between wearable device ownership and demographics, with  $P < .05$  considered significant. Participants with missing data for measured variables were not included in the analysis. Full data were available for 424 participants. STATA Version 15 (StataCorp, College Station, TX) was used for all statistical analyses.

## Results

The study cohort of 424 cancer survivors consisted of 53% female ( $n = 225$ ), mostly white ( $n = 419$  [98.8%]) non-Hispanic ( $n = 416$  [98.1%]) participants (mean age  $74.2 \pm 6.7$  years).

### Technology ownership and use

Most participants owned a smartphone ( $n = 364$  [85.9%]) and/or a tablet computer ( $n = 307$  [72.4%]). Fewer participants reported owning a wearable device ( $n = 135$  [31.8%]) ([Table 1](#)).

### Heart health and wearable devices

More than half of the cancer survivors included in our sample (53.5%) were worried about their heart health, and almost 90% agreed that having a wearable device detect a heart problem would give them peace of mind ([Table 2](#)). Arrhythmias ( $n = 338$  [79.7%]) were the most commonly reported heart condition participants responded that a wearable should detect, followed by heart attacks ( $n = 317$  [74.8%]).

**Table 1** Technology ownership and use

Device ownership	
Tablet computer (iPad or Kindle Fire)	307 (72.4)
Smartphone (iPhone, Samsung, or Google phone)	364 (85.9)
Commercial wearable device (eg, smartwatch, activity monitor)	135 (31.8)
Basic cell phone that can receive text messages	151 (35.6)
I have none of the above devices	16 (3.8)
Use applications related to health*	
Yes	256 (63.4)
No	147 (36.6)
Have the MyChart application*	
Yes	287 (71.2)
No	116 (28.8)
Frequency of wearing wearable device†	
Only while exercising	9 (6.7)
All day, not sleeping	38 (28.1)
All day and sleeping	76 (56.3)
Length of time owning device‡	
<3 months	18 (13.3)
4 months to 1 year	17 (12.6)
>1 year	100 (74.1)
Share information with doctor†	
Yes	27 (20)
No	108 (80)
Type of information shared‡	
Heart rate	16 (59.3)
Irregular rhythm	6 (22.2)
Physical activity	10 (37)
Sleep	7 (25.9)
Other	3 (11.1)

Values are given as n (%).

\*Of those with smartphones/tablets (n = 403).

†Of those with wearable devices (n = 135).

‡Of those who shared information (n = 27).

### Preferences for sharing wearable device data with providers

Blood pressure and heart rate were the 2 highest preferred wearable device data to be shared with providers, with only 4.5% (n = 19) and 4.7% (n = 20) of patients preferring to not share these data, respectively (Table 3). The least preferred health measures to share with providers were diet (n = 78 [18.4%]), weight (n = 59 [13.9%]), and physical activity (n = 55 [13%]).

### Factors associated with owning a wearable device

We conducted logistic regression analyses to examine the association of age, gender, race, and ethnicity on ownership of a wearable device. Age was significantly and inversely associated with the likelihood of owning a wearable device. As age increased, the likelihood of owning a wearable device decreased (odds ratio 0.94; 95% confidence interval 0.91–0.97;  $P < .01$ ).

### Discussion

In this cohort of cancer survivors with or at risk for AF, most participants (86%) owned a smartphone and/or a tablet computer (72%) compared to 61% and 44%, respectively, among adults aged 65 years or older as reported by a 2021 survey on

**Table 2** Heart health concerns and wearable devices (n = 424)

Heart/health diagnoses	
Atrial fibrillation or atrial flutter	104 (24.5)
Hypertension	277 (65.3)
Congestive heart failure	42 (9.9)
Diabetes mellitus	67 (15.8)
Medicine to treat atrial fibrillation or flutter	90 (21.2)
Ablation, electrical or chemical cardioversion	35 (8.3)
Worried about heart health	
No	197 (46.5)
Somewhat to very worried	217 (53.5)
It would give me peace of mind to know that a commercial wearable will detect a heart problem if I had one.	
Agree or strongly agree	379 (89.4)
Disagree or strongly disagree	45 (10.6)
Most important heart health-related conditions that your commercial wearable device should detect:	
Hypertension (high blood pressure)	272 (64.2)
Myocardial infarction (heart attack)	317 (74.8)
Arrhythmia (heart rhythm problem)	338 (79.7)
Heart failure (fluid retention or heart failure)	215 (50.7)
Other	9 (2.1)

Values are given as n (%).

U.S. adults conducted by Pew Research.<sup>21</sup> Similarly, although only 32% of the sample reported owning a wearable device, this proportion was higher than what was previously reported in studies on wearable devices for both the general public and other cancer survivors in this age range.<sup>22</sup> Age was associated with wearable device ownership, and overall wearable device usage was high in individuals who owned one. Studies in the general population with more diverse participants showed that race (white), higher education levels, gender (female),<sup>22</sup> and higher socioeconomic status<sup>23</sup> were associated with owning a wearable device, and lower socioeconomic status was associated with less wearable device usage.<sup>22,24</sup>

Previous cancer diagnoses and subsequent worries over heart health, such as AF concerns, may also have played a role in the greater levels of device usage in this cohort compared to the public, particularly as 63% of those who owned either a smartphone or tablet use health-related applications. Additionally, over half of survivors were at least somewhat worried about their heart health. Most individuals indicated it would give them peace of mind to know a wearable device would detect an existing heart problem, with arrhythmias being ranked as the most important detectable condition followed by myocardial infarctions, hypertension, and heart failure. Given the high risk of AF in survivors and its associations with mortality and morbidity,<sup>3</sup> AF monitoring could be prudent and provide peace of mind to patients.

Survivors were most open to sharing wearable device cardiovascular-related information compared to other types of data. Information about blood pressure, followed by

**Table 3** Preferences for wearable device information to share with provider (n = 424)

Variable	None	If there is a problem	All the time
Sleep	36 (8.5)	200 (47.2)	188 (44.3)
Physical activity	55 (13)	181 (42.7)	188 (44.3)
Heart rate	20 (4.7)	175 (41.3)	229 (54)
Pulse oximetry	24 (5.7)	179 (42.2)	221 (52.1)
Health-related conditions	29 (6.8)	161 (38)	234 (55.2)
Diet	78 (18.4)	178 (42)	168 (39.6)
Weight	59 (13.9)	180 (42.5)	185 (43.6)
Blood pressure	19 (4.5)	169 (39.9)	236 (55.7)

Values are given as n (%).

health-related conditions, heart rate, and pulse oximetry, were among the top types of information that patients in this cohort would prefer to share with their provider, regardless of whether or not the individual owned or used a wearable device. However, only a small percentage of survivors (20%) shared health data with their providers. Of those who did, 59% shared their heart rate, followed by 37% physical activity and 26% sleep. Interestingly, fewer participants reported wanting behavioral factors of diet, weight, sleep, and physical activity shared with their providers compared to cardiovascular-related data. One study of 66,105 participants found that only 1% of patients were willing to upload their wearable device data to the EHR.<sup>25</sup>

Compared to patients with certain conditions (eg, hypertension, diabetes), survivors are less likely to adopt wearable devices and share data with providers.<sup>23</sup> This could be due to underutilization of these devices in post-oncology treatment care by providers, particularly as cancer survivors lack trackable signs and symptoms that are specific to them as a cohort, unlike patients with hypertension who can track and report blood pressures to gain an idea of how well-controlled their condition is.<sup>23,26</sup> Previous evidence shows the positive impact of wearable devices on physical activity levels in survivors through real-time feedback, but few report the impact of data collection and sharing in this population.<sup>27</sup> Low rates of patient data-sharing may be related to provider uncertainty about using wearable devices in clinical practice.<sup>28</sup> Collecting patient-generated health data is challenging because of the extensive cleaning and processing needed for the data to be interpretable and useful.<sup>29</sup> Unless data are integrated with an EHR system, there also may be difficulties with data storage, ease of access, and confidentiality.<sup>18,29</sup> Despite these barriers, device data can help improve providers' decision-making and patient care.<sup>30</sup> Using wearable devices to collect cardiovascular metrics or to detect AF, a known concern of many cancer patients, may also be beneficial for long-term cancer survivor outcomes.

### Study limitations

Limitations to our study include the lack of generalizability to other patients outside of our health care system. Our study lacked racially and ethnically diverse survivors, and we did not have access to socioeconomic status data, including edu-

cation, income, and employment status. However, our medical center is situated in a diverse urban city, so we assume there is some variability in socioeconomic status. Future studies should examine these data in conjunction with provider perceptions of shared patient-generated health data. There also may be an element of selection bias through our recruitment method of e-mailing potential participants, which may not make these results generalizable to patients who do not use e-mail.

### Conclusion

Cancer survivors often are concerned about their heart health and are interested in sharing cardiovascular data generated from wearable devices with their health care providers. Using wearable devices to monitor cardiovascular parameters and collect data on heart rhythm status could be helpful in assuaging patient concern, improving connections between patients with chronic conditions and their health care teams, and possibly enhancing quality of life. In our study, older age was associated with lower digital device ownership. This should be considered by health care providers, because as wearable devices become more integrated into routine clinical practice, key populations at risk, including older cancer survivors at risk for AF, may be left behind. Cancer survivors were less likely to want to share with their providers other lifestyle data on physical activity, diet, and sleep, but our results suggest that their motivation to share cardiovascular metrics may help them to overcome their reluctance to share other valuable information. Long-term survivor outcomes may be improved by incorporating wearable devices into routine care of cancer survivors.

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### Disclosures

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## Authorship

All authors attest they meet the current ICMJE criteria for authorship.

## Patient Consent

All patients provided informed consent.

## Ethics Statement

The study was reviewed and approved by the institutional review board at the University of Massachusetts Chan Medical School (IRB #H00021909).

## Disclaimer

Given his role as Editor-in-Chief, Dr David McManus had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Dr Chunyu Liu.

## Appendix

### Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.cvdhj.2022.08.002>.

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