



The Role and Impact of Social Media in Cardio-oncology During the COVID-19 Pandemic

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Abstract

Purpose of Review To give an overview of the role of social media (SoMe) in cardio-oncology during the COVID-19 pandemic. **Recent Findings** SoMe has been critical in fostering education, outreach, awareness, collaboration, dissemination of information, and advocacy in cardio-oncology. This has become increasingly evident during the COVID-19 pandemic, during which SoMe has helped share best practices, community, and research focused on the impact of COVID-19 in cardiology and hematology/oncology, with cardio-oncology at the interface of these two subspecialty fields.

Summary A strength of SoMe is the ability to amplify a message in real-time, globally, with minimal investment of resources. This has been particularly beneficial for the emerging field of cardio-hematology/cardio-oncology, a field focused on the interplay of cancer and cardiovascular disease. SoMe field especially during the COVID-19 pandemic. We illustrate how social media has supported innovation (including telemedicine), amplification of healthcare workers' voice, and illumination of pre-existing and continued health disparities within the field of cardio-oncology during the pandemic.

Keywords Social media · Cardio-oncology · COVID-19 · Health disparities · Pandemic · Advocacy

Introduction

Cardiovascular disease is the second leading cause of death in cancer survivors, following recurrence of the primary cancer or diagnosis with a secondary malignancy [1]. In 2019, there were 17 million cancer survivors in the USA, and it is

estimated that there will be 22 million by 2030 [2]. Cardio-oncology is an emerging discipline that addresses this unique population and is centered on preventing, monitoring, and treating cardiovascular toxicity from pharmacologic and radiation cancer therapies. Cardio-oncology is a relatively young field, and a wealth of information is rapidly being produced,

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due to the increasing recognition of cancer therapy-related cardiovascular toxicity, the growing number of cancer survivors, and research in this interdisciplinary field [2]. However, there is still limited knowledge of this field among most healthcare professionals and patients. Thus, efforts are needed to increase awareness.

The development of cardio-oncology has occurred in parallel with the increasing presence of social media in medicine. SoMe platforms such as Twitter, Facebook, Instagram, and LinkedIn have been critical in spreading awareness of cardio-oncology, enabling advocacy for clinicians and patients, and providing online resources. Given that this field is in its early stages, social media has been important in helping clinicians and researchers navigate in real-time novel research findings, as well as providing the opportunity to connect, share discoveries, and discuss cardio-oncologic care [3–12]. Aligning with the rapid progress and novel therapies in cancer treatment, knowledge of the cardiovascular impact of these cancer therapies continues to grow at an exponential pace and is well suited for the real-time environment of SoMe. Furthermore, as a foundation for networking and collaboration, SoMe has been essential in bridging the fields of cardiology and hematology/oncology [2]. Additionally, the use of mobile health platforms has been promoted and highlighted on SoMe to enable earlier detection and better management of disease states in cardio-oncology, such as arrhythmias and heart failure. Using artificial intelligence to distinguish signatures of disease versus health states in continuous biosensor data, and perhaps using artificial intelligence to analyze the social media posts themselves to detect relevant trends in dissemination of information, may help enable the optimization of innovation for patients and healthcare workers in cardio-oncology [13–15].

In this review, we present examples of these roles of SoMe, highlighting studies leveraging SoMe during the initial shut down due to the peak of the pandemic, and its interplay in cardio-oncology. This study highlights quantitative and qualitative data supporting the efficacy of using Twitter for educational and advocacy campaigns in cardio-oncology, as well as the ability to rapidly disseminate medical information to a large, widespread audience [16, 17].

The Rise of #COVID-19

On March 11, 2020, the World Health Organization declared the novel coronavirus disease of 2019 (COVID-19) a pandemic. As of March 2021, COVID-19 had infected 122 million individuals, killing more than 2.6 million around the world and more than 539,000 in the USA [18]. COVID-19 has demonstrated wide-ranging effects on all organ systems, resulting in respiratory failure, heart failure, myocarditis, strokes, chronic neurologic symptoms, kidney failure, and gastroenteritis, among other manifestations of organ toxicity [19]. Early data have demonstrated that


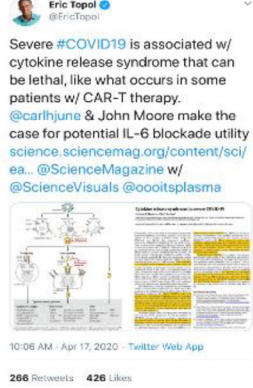

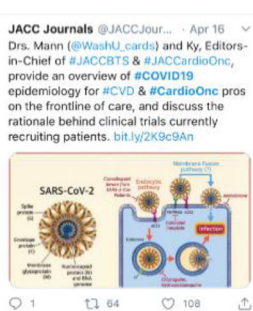
individuals with underlying heart disease or cancer experience worse clinical outcomes [19–25]. Furthermore, cancer patients are at increased risk of cardiovascular disease/myocardial infarction due to shared risk factors, cancer itself and its [26] and various antineoplastic therapies, including increased risk of atherosclerosis or myocardial infarction with agents such as checkpoint inhibitors or 5 FU [27, 28]. Many of these high-risk, immunocompromised patients also experience decreased access to cardiovascular care during the pandemic, due to nonessential tests being postponed to help preserve personal protective equipment and reduce unnecessary exposure [29]. Voluntary avoidance of the healthcare system by these patients led to many not seeking care even after developing cardiac symptoms [30]. Added stressors from the pandemic are likely to worsen the situation on top of the added stress of a cancer diagnosis, trying to navigate therapy, follow-up, and particularly for those whose cardiovascular health has been affected by their cancer therapy.

COVID-19 has also had a devastating impact worldwide, leading to large-scale forced isolation, death, and economic instability [31]. Healthcare workers, in particular, have been at increased risk of psychological distress due to the pandemic, leading to reflections of appreciation of healthcare and frontline workers on SoMe. As interactions have moved to online platforms, SoMe has been a platform to boost camaraderie and community, including among health professionals in cardio-oncology [2, 13, 16, 32].

SoMe platforms such as Twitter (www.twitter.com), Instagram (www.instagram.com), Facebook (www.facebook.com), and YouTube (www.youtube.com) have been critical in helping healthcare workers and the general public keep pace with the exponential increase in updates and information on COVID-19 (Table 1). They can also serve several purposes. In brief, Twitter allows for users to share “Tweets” or short statements and phrases that can serve to update, educate, or promote advocacy to the user’s followers. Instagram allows for sharing of photos and short videos which can serve to update, entertain, advertise or promote advocacy to the user’s followers. YouTube allows users to share videos which can serve as a platform for entertainment, advocacy, and education. Facebook gives users the power to share all of these forms of media, enabling users to keep up to date with other users such as friends, family, and colleagues whom they add as “friends.” Hashtags are common to all of these platforms. A hashtag is a metadata tag that is prefaced by the hash symbol (#) and is user-generated that enables cross-referencing of content sharing of a subject or theme.

A recent study found that among 453 healthcare workers, 61% of participants used SoMe to obtain information on COVID-19 [33]. SoMe has been used to spread *awareness* about COVID-19 and counter the spread of misinformation [34, 35]. Moreover, as the suggested treatments and care for patients with COVID-19 and cancer or cardiovascular disease have been quickly transformed, SoMe has been critical for helping health professionals and researchers navigate these

Table 1 Use of social media to educate and disseminate information on Cardio-oncology research and care during the pandemic

Social Media Platform	Goal	Example	Link and A
Twitter	Increasing awareness about the cardio-oncology population during the pandemic.	 <p>While we struggle to determine who does poorly w/ #COVID19, the #cardioonc population remains a vulnerable population w/ unique needs related to cancer/CV tx, & cardiotox surveillance; #ShanAshokan #SoniyaRabadia reviews these issues in #curronreports rdcu.be/645fp</p> <p>11:17 PM · May 27, 2020 · Twitter Web App</p> <p>7 Retweets and comments 34 Likes</p> <p>Farmakis D, Keramida K, Filippatos G. Cardio-Oncology services during the COVID-19 pandemic: Practical considerations and challenges [published online ahead of print, 2020 May 22]. <i>Eur J Heart Fail</i>. 2020;10.1002/ehf.1838.</p>	<p>https://twitter.com/datsunian/status/1265844713543753728</p> <p>(Accessed September 2020)</p>
Twitter	Education about the similarities between COVID -19 and CAR - T therapy-related cytokine storm.	 <p>Severe #COVID19 is associated w/ cytokine release syndrome that can be lethal, like what occurs in some patients w/ CAR-T therapy. @carlhjune & John Moore make the case for potential IL-6 blockade utility science.science.org/content/sci/ea... @ScienceMagazine w/ @ScienceVisuals @oooitplasma</p> <p>10:06 AM · Apr 17, 2020 · Twitter Web App</p> <p>266 Retweets 426 Likes</p>	<p>https://twitter.com/EricTopol/status/1251165176318922753</p> <p>(Accessed September 2020)</p>
Twitter	How to adapt cardio-oncology services during the COVID-19 pandemic.	 <p>European Society of Cardio... · Apr 17</p> <p>Routine #cardiotoxicity echo screening for chemotherapy patients during #COVID19 bit.ly/2sFwd4C</p> <p>A Consensus Document from #ESCCardioOnc Council of @escardio</p> <p>#cardiotwitter #medtwitter #cardioonc #cardioonc #Covid_19 #coronavirus</p> <p>In all settings</p> <p>24 38</p>	<p>https://twitter.com/escardio/status/1251122727412551680</p> <p>(Accessed September 2020)</p>
Twitter	COVID-19 related clinical trials and Cardio-Oncology patients.	 <p>JACC Journals @JACCJour... · Apr 16</p> <p>Drs. Mann (@WashU_cards) and Ky, Editors-in-Chief of #JACCBTS & #JACCARDIOonc, provide an overview of #COVID19 epidemiology for #CVD & #CardioOnc pros on the frontline of care, and discuss the rationale behind clinical trials currently recruiting patients. bit.ly/2K9c9An</p> <p>SARS-CoV-2</p> <p>1 64 108</p>	<p>https://twitter.com/JACCJournals/status/125085146268458986</p> <p>(Accessed September 2020)</p>
Twitter	Avoidance of the healthcare system due to COVID-19 in cardio-oncology patients. Depending on the chemotherapy or cancer type, cancer patients are at higher risk for STEMI. Cancer patients may be hesitant to receive care due to being immunocompromised, and more likely to		<p>https://twitter.com/FrailyMD/status/1261658854338805763</p> <p>(Accessed September 2020)</p>

See online collage: #COVID-19 #Cardiooncology SoMe Collection capturing the pulse of the COVID-19 pandemic (<http://cardiooncology.s3-website-us-west-2.amazonaws.com/>)

Table 1 (continued)

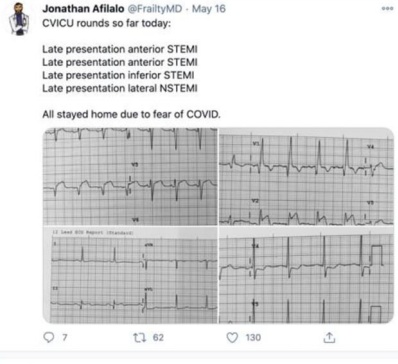
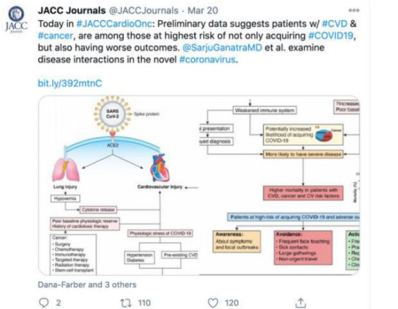




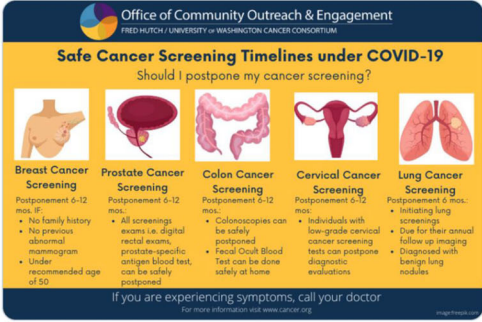

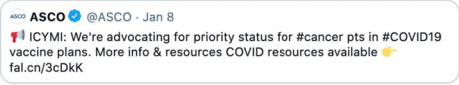


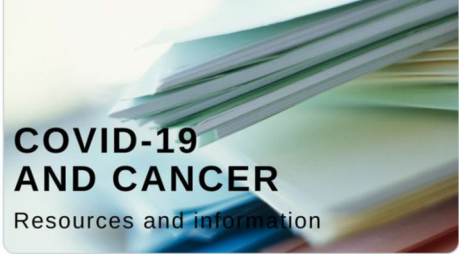
	<p>present with late heart disease.</p>	 <p>Jonathan Afialo @FrailtyMD · May 16 CVICU rounds so far today: Late presentation anterior STEMI Late presentation anterior STEMI Late presentation inferior STEMI Late presentation lateral NSTEMI All stayed home due to fear of COVID.</p> <p>7 62 130</p> <p>Replies</p> <p>Kibar Yared @KibarYared · May 16 Replying to @FrailtyMD Horrible! Even our cancer patients are staying home and not getting their #CardioOnc followup #echofirst for fear of #COVID19</p>	
<p>Twitter</p>	<p>Cardiovascular complications due to COVID-19.</p>	 <p>JACC Journals @JACCJournals · Mar 20 Today in #JACC CardioOnc: Preliminary data suggests patients w/ #CVD & #cancer, are among those at highest risk of not only acquiring #COVID19, but also having worse outcomes. @SarjuGanatraMD et al. examine disease interactions in the novel #Coronavirus. bit.ly/392mtnC</p> <p>Dana-Farber and 3 others</p>	<p>https://twitter.com/JACCJournals/status/1241086458858962944 https://twitter.com/doctorpemm/status/1251358012163440640 (Accessed September 2020)</p>
		 <p>Naveen Pemmaraju, MD @doctorpemm ST-Segment Elevation in Patients with Covid-19 — A Case Series @NEJM #COVID19 #CardioOnc #cardiotwitter #Cardiology</p> <p>9:52 PM · Apr 17, 2020 · Twitter for iPhone 6 Retweets 11 Likes</p>	
<p>Twitter</p>	<p>Use of Social Media during the COVID-19 pandemic.</p>	 <p>Sapna Kudchadkar, MD, PhD @SapnaKmd Hot off press in @PedCritCareMed! #SoMe has revolutionized how we communicate impmt information in the #COVID19 pandemic. #PedsICU is just 1 example. bit.ly/picucovid19some The data says it all. Need more evidence to get colleagues on #medtwitter? Share this now. (Thread)</p> <p>Using Social Media for Rapid Information Dissemination in a Pandemic #PedsICU and Coronavirus Disease 2019 Kudchadkar, Sapna R, MD, PhD, FCCM^{1,2}; Carroll, Christopher L, MD, MEd, FCCM³ Author information</p> <p>SCM and 9 others 8:20 AM · May 28, 2020 · Twitter Web App 63 Retweets and comments 114 Likes</p>	<p>https://twitter.com/SapnaKmd/status/1265981177057312768 (Accessed September 2020)</p>
<p>Instagram</p>	<p>Public messaging to promote healthy behaviors to avoid COVID-19 infection.</p>		


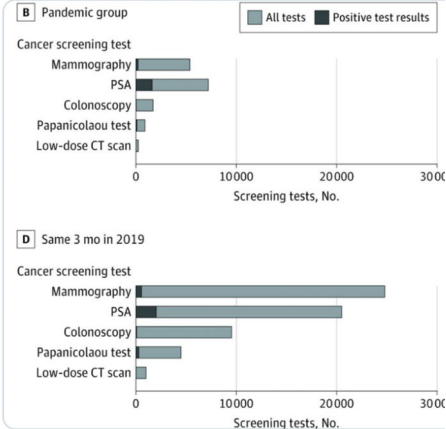



Table 1 (continued)

<p>Twitter</p>	<p>SoMe as an aid to help the public determine whether to do cancer screenings.</p>	 <p>Fred Hutch/UW OCOE @End_Disparities</p> <p>Should you postpone your cancer screenings due to #COVID19? Below is a cheat sheet letting you know when it's okay to postpone your cancer screening appointment for 6 to 12 months! Visit cancer.org for more information.</p>  <p>12:30 PM · Jul 29, 2020 · Hootsuite Inc.</p>	<p>https://twitter.com/End_Disparities/status/1288512271300415489</p> <p>(Accessed February 2021)</p>
<p>Twitter</p>	<p>Messaging to promote prioritization of vaccination for oncology patients.</p>	 <p>Dr. Amy C. Moore @acmoorephd</p> <p>All the leading oncology groups are calling for prioritization of patients with #cancer for #vaccination against #COVID19</p>  <p>9:56 AM · Jan 11, 2021 · Twitter Web App</p>	<p>https://twitter.com/acmoorephd/status/1348645027006664705</p> <p>(Accessed February 2021)</p>
<p>Twitter</p>	<p>COVID-19 delaying cancer care and screening, and increasing the risk of cancer death</p>	 <p>Lisa Kennedy Sheldon, PhD @lisaksheldon</p> <p>Cancer didn't stop during #COVID19 > 80,000 delayed or missed dx of 5 common cancers US</p> <ul style="list-style-type: none"> ⬆️ risk of death by 6-13% for 4 wk delay in cancer tx can 2.4 million people in UK waiting for cancer screening, tests, tx ⬇️ 46.4% new cancers (6 cancers combined) ⬇️ 38% cancer surgeries   <p>7:43 AM · Jan 26, 2021 · Twitter Web App</p>	<p>https://twitter.com/lisaksheldon/status/1354047207515836417</p> <p>(Accessed February 2021)</p>

changes in care, as well as disperse new research and findings. Such platforms have also served educational purposes that can lead to systemic change. SoMe has been used to highlight and

amplify health, social, and racial disparities in the USA. African Americans and Hispanics are more likely to be infected and die from the virus or its associated complications [36].

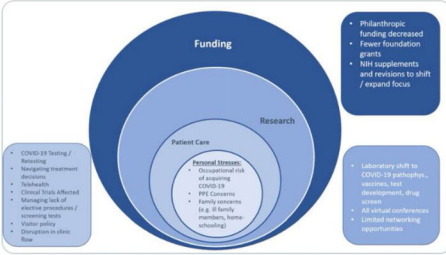
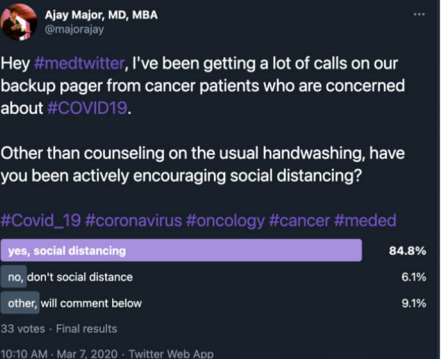
Table 1 (continued)

<p>Twitter</p>	<p>COVID-19 leading to a decrease in cancer screenings and diagnoses.</p>	<p> Stanley Y Shaw @syshaw</p> <p>Dramatic fall in cancer screening & new diagnoses during #COVID19 pandemic ja.ma/3pumFVR @JMAONc @JAMANetwork</p> 	<p>https://twitter.com/syshaw/status/1354910675345281024 (Accessed February 2021)</p>								
<p>Twitter</p>	<p>Twitter poll inquiring on COVID-19 protection practices among oncologists.</p>	<p> Ronald Hirsch, MD @signaturedoc</p> <p>Screening for COVID-19 in Asymptomatic Patients With Cancer in a Hospital in UAE ja.ma/3ejYTG2 study by @alshamsi2000 7 of 85 COVID-19 positive! @VPrasadMDMPH @VincentRK @oncology_bg @OncologyTimes</p> <p>Poll: Are you testing all patients for COVID prior to giving chemo?</p> <table border="1" data-bbox="459 1018 906 1123"> <tr> <td>All patients</td> <td>2E</td> </tr> <tr> <td>Only symptomatic patients</td> <td>33.3</td> </tr> <tr> <td>Not testing at all</td> <td>16.7</td> </tr> <tr> <td>Results pls</td> <td>2E</td> </tr> </table> <p>12 votes · Final results</p>	All patients	2E	Only symptomatic patients	33.3	Not testing at all	16.7	Results pls	2E	<p>https://twitter.com/signaturedoc/status/1265989765737984006 (Accessed February 2021)</p>
All patients	2E										
Only symptomatic patients	33.3										
Not testing at all	16.7										
Results pls	2E										
<p>Twitter</p>	<p>Promotion of cancer care resumption.</p>	<p> Memorial Sloan Kettering Cancer Center @sloan_kettering</p> <p>Many cancers are going undiagnosed or untreated because of #COVID19. MSK joins over 75 national cancer centers and organizations today in endorsing letter from @NCCN and @AmericanCancer urging Americans to resume regular cancer screening and treatment.</p>  <p>MSK and the Cancer Community Urge Americans to Resume Cancer Screening Early detection helps improve patient outcomes, but data shows that many cancers are going undiagnosed or untreated because of COVID-19. mskcc.org</p>	<p>https://twitter.com/sloan_kettering/status/1354800095317913601 (Accessed February 2021)</p>								

In addition to creating community and providing education, SoMe has been instrumental in catalyzing collaboration. Using SoMe platforms, healthcare care workers can connect quickly and globally, thus adhering to social distancing measures that

have resulted in the cancellation of conferences, closures of universities, and the institution of remote work [32]. Given the growing use of SoMe platforms, these connections have facilitated more opportunities for career development,

Table 1 (continued)

<p>Twitter</p>	<p>Summary of the impact of COVID-19 on cancer research.</p>	 <p>Ziad Bakouny @ZiadBakouny</p> <p>Replying to @ZiadBakouny</p> <p>We finally discuss the impact of the pandemic on cancer research and researchers, especially early career investigators.</p> <p>We discuss the role of cancer researchers and organizations in responding to the pandemic as well as the impact of the pandemic on funding + research.</p> <p>#CCC19</p> <p>AACR and 9 others</p>	<p>https://twitter.com/ZiadBakouny/status/1311717486182699013</p> <p>(Accessed February 2021)</p>
<p>Twitter</p>	<p>Twitter poll on social distancing among cancer #medtwitter users.</p>	 <p>Ajay Major, MD, MBA @majorajay</p> <p>Hey #medtwitter, I've been getting a lot of calls on our backup pager from cancer patients who are concerned about #COVID19.</p> <p>Other than counseling on the usual handwashing, have you been actively encouraging social distancing?</p> <p>#Covid_19 #coronavirus #oncology #cancer #meded</p> <p>yes, social distancing 84.8%</p> <p>no, don't social distance 6.1%</p> <p>other, will comment below 9.1%</p> <p>33 votes · Final results</p> <p>10:10 AM · Mar 7, 2020 · Twitter Web App</p>	<p>https://twitter.com/majorajay/status/1236308165576347650</p> <p>(Accessed February 2021)</p>

mentoring of physicians and physician scientists who are interested in cardio-oncology, and recruitment of participants in research studies on COVID-19 [37, 38]. Lastly, SoMe has been critical in providing physicians and other healthcare workers with a medium to *advocate* for themselves, particularly for increased PPE, and for the care of their patients (Fig. 1A). This is especially critical for physicians and healthcare workers treating cardio-oncologic patients as they may be immunocompromised and need further protection from COVID-19 infection. SoMe also allowed for rapid dissemination of daily clinical management decisions and provided a voice advocating against disparities in COVID-19 outcomes. Furthermore, the need to address patient care while promoting social distancing drove the need for telemedicine, and SoMe enabled sharing of best practices.

The Rise of #TelemedNow

#TelemedNow was born out of need. In the midst of the COVID-19 pandemic, a decade’s worth of telemedicine preparative work was unleashed, enabled by the Centers for Medicare and Medicaid Services (CMS) approval of the use of

telemedicine, with the release of new payment models and relaxed rules and regulations. These changes have allowed Americans to access medical care without incurring additional risk of contracting COVID-19. Because of the pressing need to share information about telemedicine, a team spearheaded by a cardiologist was coalesced in March 2020 to begin a mission-minded weekly Twitter Chat with the hashtag #TelemedNow. Symplur data show the growth of #TelemedNow. Since its creation on March 18, 2020, the dissemination and support of #TelemedNow grew in 3 months to almost one billion impressions and has continued to grow since then (Table 2).

The weekly Twitter Chat familiarizes healthcare providers, patients, advocacy groups, technology, and business leaders with various Telemedicine topics. Several chats have focused on health equity and shining a light on disparities in care by amplifying related articles. For example, the Social Vulnerability Index (SVI), created and maintained by @CDCgov, was highlighted, along with its association with COVID-19 case fatality rates and incidence. Researchers have used the SVI to delve into publicly available data and unearth troubling nationwide trends in racial and socioeconomic disparities in #COVID-19 outcomes [39].

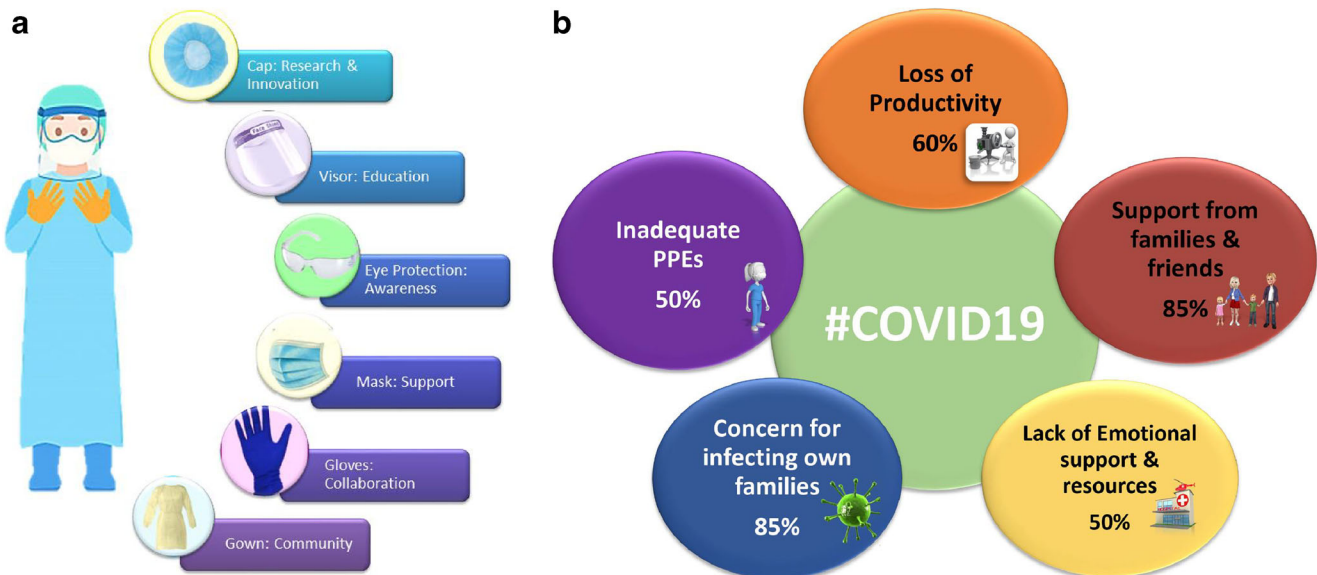


Fig. 1 Social media in the pandemic and care of cardio-oncology patients. **A** Personal protective equipment (#PPE): cap, visor with face shield, goggles, mask, gloves, and gown, each representing a component of the utility of social media pre-pandemic, during the pandemic, and post-pandemic. Overall, the image of #PPE has in part come to be associated with advocacy for obtaining appropriate #PPE and for adequately addressing health disparities. The cap represents research

and innovation; the visor with face shield represents seeing new things and being educated during the pandemic (head, mind, brain); the goggles represent raising awareness and becoming more aware (seeing is believing); the mask represents support and protecting others and ourselves; the gloves represent collaboration; and the gown represents being able to identify each other in community. **B** Cardiology survey results

#TelemedNow has also engaged the authors of papers on health equity, such as Jorge Rodriguez who has authored “Digital Health Equity as a Necessity in the 21st Century Cures Act Era” [40]. Additionally, access to telehealth visits has been highlighted in a study from the University of Pennsylvania on their Outpatient Cardiovascular Care during the COVID-19 Pandemic. This study was discussed with the authors during the Twitter Chat [41]. Several #TelemedNow chats have been devoted to leveling the playing field, to help close healthcare inequities. These threads and discussions have included CMS, as depicted in Table 2.

Although telehealth has traditionally been used in cardiology for the monitoring of rhythm, blood pressure, and heart failure exacerbations, cardio-oncology telehealth clinics have arisen in large part due to necessity in the pandemic. These telehealth clinics monitor the heart health of hematology/oncology patients who are undergoing or have completed cardiotoxic chemotherapy, with a focus on prevention and treatment. Telehealth has enabled the continuity of care for cardio-oncology patients who may have otherwise chosen to avoid receiving healthcare due to concern for COVID-19 infection. The rise of telehealth use in cardio-oncology presents an opportunity to assess its role and impact in the care and outcomes of cardio-oncology patients in an evidence-based approach that will likely last beyond the pandemic [13, 42, 43].

The Rise of the #SOMECARDIOONC PHYSICIAN VOICE

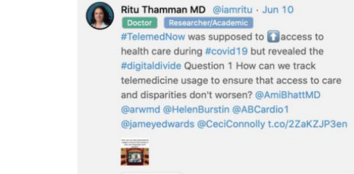
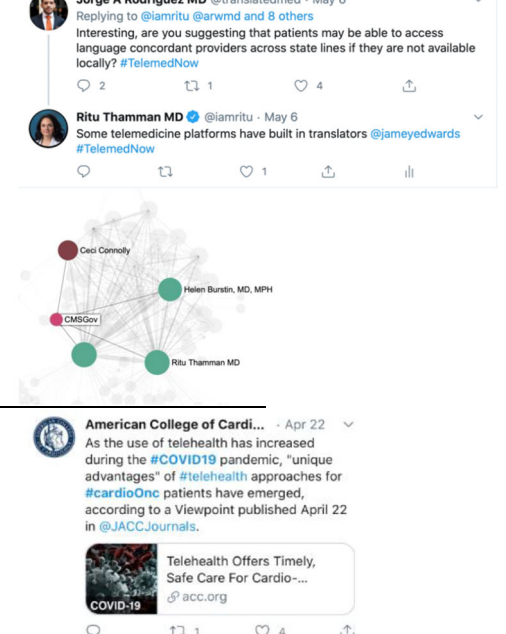
COVID-19 Survey of Providers of Cardio-oncology Care

The COVID-19 pandemic has turned hospitals into battlegrounds and doctors into soldiers. The lack of adequate personal protective equipment (PPE), the fear of infecting their own families, the shortage of ventilators, and the moral distress of having to navigate complex resource allocation decisions have created concerns among healthcare professionals. This moral dilemma and stress have paved the way for active dialogue on SoMe platforms including Twitter, Instagram, and Facebook [44].

In 2019, the World Health Organization expanded the definition of burnout from a state of exhaustion to a “syndrome resulting from chronic workplace stress.” Physician burnout was already a public health crisis that affected almost half of physicians in the USA prior to COVID-19, according to Medscape surveys [41, 42].

To gauge the impact of COVID-19 pandemic on burnout, a team of cardiologists, including providers for cardio-oncology patients, surveyed healthcare professionals in mid-April 2020 via the SurveyMonkey platform [45]. The survey assessed perceived support from healthcare systems, concerns regarding PPE availability, impact on productivity, fear of

Table 2 Care of COVID-19 patients and Leveraging Virtual Platforms

<p>Symplur</p>	<p>Popularity of telehealth during COVID-19.</p>	 <p>March 18-June 9, 2020 #TeledNow from Symplur</p> <p>June 10-July 7, 2020 #TeledNow from Symplur</p> <p>The Numbers</p> <p>43.456M Impressions</p> <p>5,109 Tweets</p> <p>891 Participants</p> <p>7 Avg Tweets/Hour</p> <p>6 Avg Tweets/Participant</p> <p>July 8-August 8, 2020 #TeledNow Symplur</p> <p>42.870M Impressions</p> <p>4,224 Tweets</p> <p>646 Participants</p> <p>6 Avg Tweets/Hour</p> <p>7 Avg Tweets/Participant</p>	<p>https://www.symplur.com/healthcare-hashtags/telednow/ (Accessed August 2020)</p>
<p>Twitter</p>	<p>Journal Clubs and Twitter Chats educating about telehealth during COVID-19.</p>		<p>https://twitter.com/iamritu/status/1270868651202273281 (Accessed September 2020)</p>
<p>Twitter</p>	<p>Access to telehealth during COVID-19 and beyond.</p>		<p>https://twitter.com/translatedmed/status/1258190798295834625</p> <p>https://twitter.com/ACCinTouch/status/1253063792059187203 (Accessed September 2020)</p>

potential job loss, anxiety about spreading illness to immediate family members, and psychosocial resources at work and

at home (Table 3). Out of the 553 responses received, 66% were from physicians and the remainder were from nurses

and allied practice providers. Women comprised 68% of those who responded. The concern about spreading infection to their own households was the most significant stressor according to 85% of all respondents. Among all the respondents, nearly 50% reported inadequate PPE, despite the fact that the survey was not limited to hot spot regions. Approximately 50% of respondents had concerns about inadequate emotional support and resources from leadership in handling work-related issues. Almost 60% of responding physicians felt the pressure of loss of productivity. One positive finding was that 85% expressed having excellent family and friend support (Fig. 1B).

Another survey by the same group was conducted via SoMe (Twitter) to assess the impact of COVID-19 on cardiac electrophysiologists and their staff [46]. Out of the 241 respondents, 51% were physicians and 20% were nurses. About 60% of the respondents were women. The practice settings included private practice, academic positions, and hospital employment. Major concerns that were reported include fear of spreading the virus to the family members, inadequate PPE, and inability to perform elective cases due to lack of standardized testing and resources (Table 3).

COVID-19 Physician Scientists Survey

Physician scientists can play a key role in the evolution and resolution of the pandemic, as well as the advancement of cardio-oncology through research. Thus, assessment of the effect of the COVID-19 pandemic on this biomedical workforce is important [47]. A survey targeting this cohort, from trainees to faculty, leveraged SoMe platforms such as Twitter, Facebook, and LinkedIn to help raise awareness of the survey and increase response rates (Table 3) [48]. Leaders of the American Physician Scientists Association (APSA) developed the survey to include issues such as social isolation and the need to take care of children, as well as research activities and perceptions on productivity and patient care. The survey was distributed nationally to institutions with MD/PhD programs with the help of the Association of American Medical Colleges (AAMC) Graduate Research, Education, and Training (GREAT) group and via APSA's Institutional representatives.

The survey garnered >2100 responses from around the country from medical students, graduate students, residents, fellows, and faculty. The survey found high levels of stress across all training stages, with perceived detriment to research productivity in the short and long terms due to COVID-19. Five percent of respondents were in cardiology and close to 10% were in hematology/oncology. These are physicians and physician scientists involved in the care of cardio-oncology patients as well as moving research insights forward. On platforms such as Twitter, this garnered attention and highlighted the vulnerability of female physician scientists, who in

particular have already been shown to have a reduction in first and corresponding author publications during the pandemic [49]. SoMe facilitated discussions regarding the need to address these challenges and helped raise awareness [50]. Women were more likely to voice that they were under a great amount of stress and that this stress was shown to adversely affect their academic productivity.

Institutional leaders and foundations are recognizing these challenges faced by our physician scientists and have responded with providing funds to support those with high caregiving needs, as well as creating supportive programs to deal with stress [51, 52].

As the endangered phenomenon of physician scientists is a challenge and potential threat to human health, we must shine a light on the role of SoMe in helping physician and physician scientist careers within cardiology and oncology. SoMe has given physicians and physician scientists a voice and has also helped with career development in cardio-oncology, serving as a platform to raise visibility for our work, and this growing importance of SoMe has led universities to include SoMe scholarship as part of their metrics for promotion [53–57]. In fact, while citations and publications are traditional metrics for academic promotion in tenure tracks, SoMe has been shown to help increase citations [58–61]. In a study randomizing some articles to SoMe promotion compared to articles with no SoMe promotion, SoMe promotion increased article dissemination by fourfold [62]. Further, at scientific and medical meetings, which provide another venue to help with career visibility, SoMe can help facilitate sharing of work in its early stages, which can foster collaborations and networking in cardio-oncology, as well as assist with further dissemination of content [63–68].

COVID-19 Cardio-oncology Survey

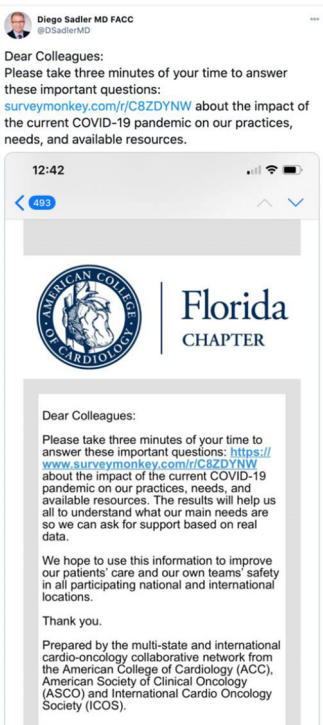
A Cardio-oncology International Collaborative Network conducted an international survey via SurveyMonkey to assess the impact of the COVID-19 pandemic during its initial phase in March and April 2020 on the practices of cardiologists and oncologists; the effects of the pandemic on re-allocation of resources for elective procedures, testing, scheduling, and access to telemedicine services; the early utilization of new COVID-19 therapies; and providers' opinions on national healthcare policies [69]. Approximately 1500 providers from 43 countries responded to this survey, which provided new data on the similarities and differences experienced by physicians in different geographic locations and the impact of this pandemic on both academic-based practices and private practice settings [70].

The use of electronic platforms and SoMe allowed for promotion, enrollment, and amplification of the response to this survey by providing a heterogeneous target audience practicing in various geographic locations. There was participation of

Table 3 Pulse of Health Care Professionals Taking Care of Cardio-Oncology Patients.

<p>Twitter</p>	<p>COVID-19 Cardiology and EP surveys</p>	 <p>Kamala Tamirisa MD @KTamirisaMD</p> <p>post-gazette.com/opinion/Op-Ed/... 👉 for helping w our survey! Results: 553 responded Stressors: 🔴 85% concerned abt bringing covid home 🔴 60% docs felt pressure of 📈 productivity 🔴 50% w inadequate #PPEs despite the fact that our survey was not limited to hot spot regions**</p> <p>Kamala Tamirisa, Ritu Thamman and Martha Gulati: There are no heroes in this war. Health care professionals need more support. 📷 post-gazette.com</p> <p>8:57 AM · May 21, 2020 · Twitter for iPhone</p>	<p>https://twitter.com/KTamirisaMD/status/1263453818479693826</p> <p>(Accessed September 2020)</p>
<p>Twitter</p>	<p>APSA survey to assess the impact of COVID-19 on physician scientists, a group that moves research forward in cardio-oncology.</p>	 <p>Jennifer Kwan MD PhD @jennkwanMDPhD</p> <p>Yes, we're seeing this disparity for early career 👩‍🔬 physician scientists, particularly if they have children 🙄 from our @A_P_S_A #COVID19 survey. Goal: assess impact of #COVID19 on MD/PhD trainees to residents/fellows/junior faculty in terms of training/career/wellness #advocacy</p> <p>Eric Topol @EricTopol · Jun 21 #COVID19 and the gender inequity in academics pnas.org/content/pnas/... @PNASNews @MalschPhd and colleagues @AAUW and a broader analysis sciencemag.org/content/366/64... @ScienceMagazine @JoeCimplan #WomenScience Both are compelling</p> <p>Understanding persistent gender gaps in STEM</p>	<p>https://twitter.com/jennkwanMDPhD/status/1274827929021820929</p> <p>https://twitter.com/BriChristophers/status/1253441517735182336</p> <p>(Accessed September 2020)</p>
		 <p>Briana Ruiz Christophers @BriChristophers</p> <p>Calling all #DoubleDocs: @A_P_S_A is collecting information from physician-scientists about how #COVID19 is affecting them.</p> <p>Applicants 📄 medical/graduate students 🎓👩‍🔬👨‍🔬 residents/fellows 🏠👩‍🔬👨‍🔬 junior faculty 🏠👩‍🔬👨‍🔬 are welcome to fill out ~10 min survey: surveymonkey.com/r/NB7Q3VR</p> <p>APSA CONNECTING PHYSICIAN-SCIENTISTS IN TRAINING Physician-scientists, how has COVID-19 affected you? Tell us in the Impact of COVID-19 on Physician-Scientists (COVOPS) survey Perspective from applicant, student, training, and junior faculty physician-scientists are welcome!</p> <p>All survey participants will be entered in a drawing to win one of three cash prizes: \$1000, \$500, or \$250. To be eligible, you must complete the survey by June 30, 2020. Prizes will be awarded by random drawing. The survey is open to all physician-scientists in training and those who are currently practicing. For more information, visit www.apsa.org.</p> <p>If you have any questions, please email the organizers of the study listed below: Jennifer M Kwan MD, PhD @jennkwanMDPhD Kwan@apsa.org Briana Ruiz MD, PhD @BriChristophers bruc@apsa.org</p> <p>Keywords: The American Physician Scientists Association (APSA)</p>	<p>https://twitter.com/brichristophers/status/1253441517735182336</p>
<p>Twitter</p>	<p>Collaborative survey via Cardio-Oncology International Collaborative Network with international reach.</p>	 <p>Diego Sadler MD FACC @DSadlerMD</p> <p>Gracias Sociedad Mexicana de Cardiología por su participación en esta importante encuesta!! Necesitamos gran participación multinacional!! @DLenihanICOS_MD @ICOSociety @ACCinTouch @oncology_cardio @smexcardiologia @SAC_54 @CardiOncoSAC</p> <p>Translate Tweet</p> <p>Sociedad Mexicana de Cardiología @smexcardiologia · Mar 24 Los invitamos a completar una encuesta: bit.ly/3aIMhUm sobre el impacto de #COVID19 sus practicas, necesidades y recursos disponibles. Para la red colaborativa de @ACCinTouch ASCO e @ICOSociety</p> <p>@drbrowncares @arjunk @DSadlerMD @sdent_ouke @dr_manist @DanieSiemaMDS Show this thread</p> <p>8:30 AM · Mar 26, 2020 from West Palm Beach, FL · Twitter for iPhone</p>	<p>https://twitter.com/DSadlerMD/status/1243878163454853120</p> <p>https://twitter.com/DSadlerMD/status/1242495723947667456</p> <p>(Accessed September 2020)</p>

Table 3 (continued)

			
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members from state chapters from the American College of Cardiology (ACC) and the American Society of Clinical Oncology (ASCO) and regional chapters from the International Cardio-Oncology Society (ICOS). The use of SoMe, particularly Twitter, improved the visibility of our invitation to physicians to participate in this survey. Some participating sites, such as the Florida Chapter of the ACC, the Illinois Chapter of the ACC, and the Sociedad Mexicana de Cardiología, among others, utilized the Twitter platform to promote this survey among members and local practicing physicians, thus increasing physician engagement (Table 3).

The Rise of #HEALTHDISPARITIES

COVID-19 has shed a light on the various health disparities that have long affected vulnerable groups [71, 72]. Cardiac disease and cancer, among others, are of high concern for patients who may be infected. Some authors have pointed to the vulnerability of those who are not able to undergo screening exams pertinent to their age and sex, such as for breast, prostate, or colon cancer [73]. The number of missed diagnoses has been estimated at 80,000 during the first 3 months of the pandemic [74]. This number has likely grown as the pandemic has continued. A delayed diagnosis can be harmful. A recent study showed that each 4-week delay in cancer treatment increased cancer mortality by 10% [75]. The American Association for Cancer

Research virtual meeting featured a dedicated session on the impact of health inequities and disparities caused by the pandemic on cancer care, recognizing the need to prevent and treat COVID-19 and address quality health access overall—not limited to the pandemic [76].

Health disparities between non-white individuals and their white counterparts have been well documented across medical subspecialties long before COVID-19 emerged [77–80]. As more states release sociodemographic data, the disproportionate morbidity and mortality for Black and Latino patients associated with COVID-19 has made these pre-existing disparities even clearer [36]. Once data have become public, the popular press and academic journals have been publishing pieces calling for action to change the course to protect people of color, specifically by addressing the structural inequalities that predispose ethnic minorities to developing comorbidities [81–83].

On Twitter, National Public Radio sounded the alarm in April 2020 about the risk for racial minorities with heart disease to be disproportionately exposed to COVID-19 infection [84, 85]. *Circulation* journal published a commentary by representatives of the Association of Black Cardiologists that likens the broad causes of COVID-19 health disparities to those that lead to higher comorbidities in everyday life, including discrimination and lack of access to care [86, 87]. Data from New York City about the high COVID-19 mortality rates seen for Black and Latino patients is similar to mortality rates from breast cancer for

these groups [88]. Those living in regions of worse air quality near chemical plants and other manufacturers, associated with increased risk for developing cancer, also appear to be at higher risk for COVID-19, which links environmental racism with cancer and infectious disease [89, 90]. A webinar offered as part of the #EmPOWERChange SoMe campaign educated healthcare professionals about the risk that cardiac comorbidities pose for Latino communities during the pandemic [91]. Table 4 shows examples in which SoMe shed light on health disparities and pushed for equality and health equity. SoMe has played an important role in amplifying the magnitude of the impact of COVID-19 on cancer care and patients from minority groups, and we hope this will motivate health professionals to use this knowledge and opportunity to make broader change. SoMe may also be used to promote vaccination in these groups, to answer questions these patients may have about the vaccine, and to push for access for equity in the distribution of vaccines. Table 4 shows several tweets in which individuals have pushed for increased access to vaccines among African American and Latino populations who have been disproportionately impacted by the pandemic.

Discussion

As the number of COVID-19 patients continues to rise around the world and in the USA, short- and long-term health sequelae will be a major challenge for healthcare providers in cardio-oncology and the rest of society due to lost productivity, increased costs, and impaired quality of life. Dealing with challenges that arise and finding effective solutions in the pandemic will continue to require collective efforts from healthcare professionals, policy makers, patients, and society. SoMe has the power to connect all of us and facilitate education, behavioral changes, and research. We have seen healthcare professionals and patients embrace SoMe to help educate and advocate, and SoMe has facilitated research on the effects of the pandemic on healthcare workers, patients, and healthcare systems [92–94].

The need to “flatten the curve” has arisen as a persistent challenge in the pandemic to deal with limited hospital resources and PPE. This has included reducing patient visits and non-urgent procedures. To keep up with patient care, telemedicine, which was already routinely being used in more remote settings, stepped in to provide virtual patient care. SoMe was used to raise awareness of telemedicine and exchange information about best practices. SoMe was also used to highlight the importance of determining outcomes associated with telemedicine-mediated healthcare and the need for research to determine which patients would benefit versus those who should be seen in person.

While the potential as a research tool has been demonstrated, more safeguards may be needed to ensure surveys disseminated via SoMe channels are reaching the intended target audience and that responses are from the target audience. SoMe can also effectively disseminate research information, such as for COVID-19 and cardio-oncology. Early on in the pandemic, the healthcare community was grasping to obtain information related to COVID-19 infection, including which populations are more vulnerable and likely to have a worse outcome, and what treatments are effective for the novel virus that seems to spread and kill at a higher rate than the flu. Research from China, the initial infection hotspot, identified cohorts that were more vulnerable and had worse outcomes. These included those with underlying heart disease as well as those with cancer, particularly metastatic disease. This information reached those at risk and healthcare providers in part via SoMe channels, to encourage these patients to be more cautious. This helped guide US healthcare providers evaluating various therapies. For cardio-oncology patients, some cancer treatment and screenings were postponed during initial lockdowns, and SoMe served as a way to educate patients about when to seek medical attention.

The COVID-19 pandemic has exacerbated pre-existing health and financial disparities, which have afflicted underrepresented minorities for centuries [83, 95, 96]. This has been the case within cardiovascular medicine and oncology. SoMe has helped to highlight studies that have provided these insights and has played a major role in advocacy to address these disparities. Thus, advocacy from all fronts and support from the highest levels of government, as well as all echelons of society, including institutional support will be needed to safeguard these vulnerable populations. Mining SoMe data and evaluating mobile health platform data and electronic health records using artificial intelligence (AI) may provide us insights on ways to help improve health disparities during the pandemic and beyond [97–102]. At the same time, we must ensure that datasets used to train AI algorithms appropriately represent patient diversity, so that health disparities can be curbed instead of exacerbated by use of these powerful informatics tools [103]. Specific to cardio-oncology, AI may also be used in combination with ECGs to detect atrial fibrillation and predict cardiomyopathy. In addition, for various potentially cardiotoxic oncologic therapies including CAR-T therapy, AI may also be used to elucidate risk factors for adverse outcomes due to these therapies.


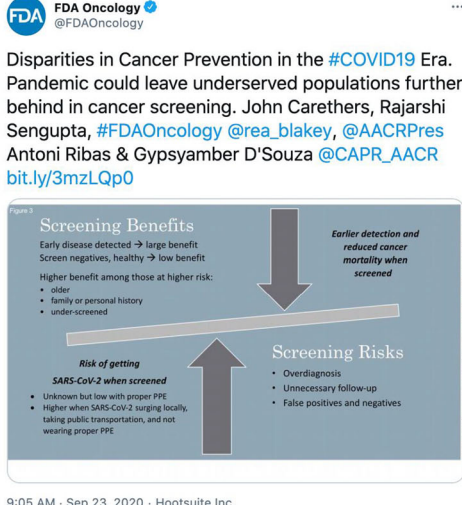

In some ways, physician scientists have been jeopardized by this pandemic in terms of their ability to apply their training and skills to tackling disease. Many physician scientists, including those who care for cardio-oncology patients, have expressed high levels of stress and decreased research productivity during the pandemic. Continuation of some kinds of research has been threatened due to institutional hiring freezes, as a result of financial hits to healthcare systems.

Table 4 Health Disparities in the Context of COVID-19 and Cardio-Oncology

Social Media Platform	Message	Example
Twitter	African Americans have higher rates of Cardiovascular toxicity.	<p>https://twitter.com/DrRayMD/status/1270291261048700932 (Accessed February 2021)</p>
Twitter	Social unrest due to unfair treatment of underrepresented minorities.	<p>https://twitter.com/RamalingamMD/status/1266851013962665985 (Accessed February 2021)</p>
Twitter	Access to telehealth lower for certain groups.	<p>https://twitter.com/iamritu/status/1270873963913248774 (Accessed February 2021)</p>
Twitter	The impact of COVID-19 on tribal communities.	<p>https://twitter.com/RepDebHaaland/status/1353840073566015488 (Accessed February 2021)</p>

See online collage: #COVID-19 #Cardiooncology SoMe Collection capturing the pulse of the COVID-19 pandemic <http://cardiooncology.s3-website-us-west-2.amazonaws.com/> (107)

Table 4 (continued)

<p>Twitter</p>	<p>Encouraging for the vaccination of diverse groups impacted by the pandemic.</p>	 <p>Elizabeth Warren @SenWarren</p> <p>Black, Latino, Indigenous, & immigrant communities hit hardest by COVID-19 need equitable access to vaccines. @RepPressley, @SenMarkey & I are urging @HHSgov to publish racial, ethnic & demographic data on vaccine recipients so we can address disparities.</p> <p>Democratic lawmakers push for race data in vaccinations Democratic lawmakers are urging federal health officials to address racial disparity in vaccine access nationwide, as ... apnews.com</p> <p>7:08 PM · Jan 28, 2021 · Twitter Web App</p>	<p>https://twitter.com/SenWarren/status/1354944545750986759</p> <p>(Accessed February 2021)</p>
<p>Twitter</p>	<p>Information on how COVID-19 has furthered cancer disparities.</p>	 <p>FDA Oncology @FDAOncology</p> <p>Disparities in Cancer Prevention in the #COVID19 Era. Pandemic could leave underserved populations further behind in cancer screening. John Carethers, Rajarshi Sengupta, #FDAOncology @rea_blakey, @AACRPres Antoni Ribas & Gypsyamber D'Souza @CAPR_AACR bit.ly/3mzLQp0</p> <p>Screening Benefits Early disease detected → large benefit Screen negatives, healthy → low benefit Higher benefit among those at higher risk: • older • family or personal history • under-screened</p> <p>Screening Risks • Overdiagnosis • Unnecessary follow-up • False positives and negatives</p> <p>Risk of getting SARS-CoV-2 when screened • Unknown but low with proper PPE • Higher when SARS-CoV-2 surging locally, taking public transportation, and not wearing proper PPE</p> <p>Earlier detection and reduced cancer mortality when screened</p> <p>9:05 AM · Sep 23, 2020 · Hootsuite Inc.</p>	<p>https://twitter.com/FDAOncology/status/1308754258054045697</p> <p>(Accessed February 2021)</p>
<p>Twitter</p>	<p>Highlighting how telemedicine can impact rural populations.</p>	 <p>JS @SempriniJason</p> <p>Teleoncology policies can be critical tools for mitigating rural cancer disparities, but also preventing delays in cancer screening and treatment from covid-19 restrictions. #ruralhealth #cancer #telehealth #medicaid #covid19</p> <p>Expanding the Capacity of Rural Cancer Care With Teleo... Background: In the United States, 6 of the 25 leading causes of death stem from site-specific cancers, resultin... newprairiepress.org</p> <p>10:38 AM · Jun 4, 2020 · Twitter Web App</p>	<p>https://twitter.com/SempriniJason/status/1268552699726962688</p> <p>(Accessed February 2021)</p>

However, it is important to recognize the importance of supporting the biomedical workforce through the pandemic, "to help us develop effective solutions in this current pandemic and future pandemics, and advance research to improve outcomes for patients in cardio-oncology.

While SoMe has a myriad of benefits, there can be limitations. It is crucial to ensure the accuracy of information posted on SoMe platforms, particularly for scientific and health information [104]. Advocacy for SoMe platforms to counter and report misinformation will be crucial now and in decades to come as more individuals use SoMe platforms as sources of trusted information.

Given that SoMe is an important and increasingly used tool, the medical profession should adhere to professional standards for respect and protection of patients, with the goals of collaboration, education, and advocacy. There should be increased training during medical education on how to harness SoMe as a tool to improve clinical care, research, and medical care related to COVID-19 and cardio-oncology [105]. In summary, SoMe has successfully helped with education and career development and promotion and has served as a platform and data source for research for cardio-oncology and other areas of medicine in the pandemic.

Conclusions

The importance of SoMe in public health and medicine has become more pronounced during the COVID-19 pandemic. In cardio-oncology, SoMe has fostered education, outreach, awareness, collaboration, dissemination of information, and advocacy. SoMe has also been critical in uniting the fields of cardiology and hematology/oncology so that physicians may navigate the obstacles that the pandemic has placed on patient care. More broadly, during the pandemic, SoMe has also supported patient care innovation, particularly, telemedicine, the amplification of healthcare workers' voices, and the illumination of pre-existing and continued health disparities. Other advantages of SoMe have included the ability to disseminate a message rapidly and globally, with minimal resources. Future research should monitor the utility and impact of social media among physicians during the pandemic and beyond. Furthermore, healthcare professionals, including those in cardio-oncology, may benefit from increased training on how to harness SoMe to support their efforts in clinical care, education, research, and advocacy.

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Declarations

Conflict of Interest None of the authors has any potential conflicts of interest to disclose.

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