

## SYSTEMATIC REVIEW ARTICLE

# Social Media in Heart Failure: A Mixed-Methods Systematic Review

Yousif Eliya<sup>1,#</sup>, Danielle Pellegrini<sup>2,#</sup>, Andreas B. Gevaert<sup>3</sup>, Jillianne Code<sup>4</sup> and Harriette G.C. Van Spall<sup>1,2,5,\*</sup>

<sup>1</sup>Department of Health Research Methods, Evidence and Impact, McMaster University, Hamilton, Canada; <sup>2</sup>Population Health Research Institute, McMaster University, Hamilton, Canada; <sup>3</sup>Research Group Cardiovascular Diseases, GEN-COR Department, University of Antwerp, Antwerp, Belgium; <sup>4</sup>Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia, Vancouver, Canada; <sup>5</sup>Department of Medicine, McMaster University, Hamilton, Canada

**Abstract: Background:** Among social media (SoMe) platforms, Twitter and YouTube have gained popularity, facilitating communication between cardiovascular professionals and patients.

**Objective:** This mixed-methods systematic review aimed to assess the source profile and content of Twitter and YouTube posts about heart failure (HF).

**Methods:** We searched PubMed, Embase and Medline using the terms “cardiology,” “social media,” and “heart failure”. We included full-text manuscripts published between January 1, 1999, and April 14, 2019. We searched Twitter and YouTube for posts using the hashtags “#heartfailure”, “#HF”, or “#CHF” on May 15, 2019 and July 6, 2019. We performed a descriptive analysis of the data.

**Results:** Three publications met inclusion criteria, providing 677 tweets for source profile analysis; institutions (54.8%), health professionals (26.6%), and patients (19.4%) were the most common source profiles. The publications provided 1,194 tweets for content analysis: 83.3% were on education for professionals; 33.7% were on patient empowerment; and 22.3% were on research promotion. Our search on Twitter and YouTube generated 2,252 tweets and > 400 videos, of which we analyzed 260 tweets and 260 videos. Sources included institutions (53.5% Twitter, 64.2% YouTube), health professionals (42.3%, 28.5%), and patients (4.2%, 7.3%). Content included education for professionals (39.2% Twitter, 62.3% YouTube), patient empowerment (20.4%, 21.9%), research promotion (28.8%, 13.1%), professional advocacy (5.8%, 2.7%), and research collaboration (5.8%, 0%).

**Conclusion:** Twitter and YouTube are platforms for knowledge translation in HF, with contributions from institutions, health professionals, and less commonly, from patients. Both focus largely on education for professionals and less commonly on patient empowerment. Twitter includes more research promotion, research collaboration, and professional advocacy than YouTube.

**Keywords:** Social media, heart failure, twitter, YouTube, cardiology.

## 1. INTRODUCTION

Social media (SoMe) originated as a tool for connectivity and networking through creating and sharing information online [1]. The exponential growth of SoMe has enabled its extension for the access and dissemination of health information [2]. With 70% of U.S. adults actively searching the internet for health topics, SoMe has become a powerful tool for the exchange of medical information [3].

Among SoMe platforms - which include Facebook, Twitter, YouTube, Instagram, LinkedIn, and Blogs - Twitter and YouTube provide mechanisms to broadcast presentations, promote research, and engage health care professionals and patients [4]. Twitter is a free microblogging platform that allows up to 280 characters per message [5], and YouTube is an internet video sharing service [6]. Both platforms can be searched using keywords or hashtags, which involve the use of a symbol (#) attached to a word or phrase. The post and other related posts using the same hashtag can then be found when searched on Twitter or YouTube. On Twitter, users interact with tweets by posting a comment, liking, and/or retweeting it; users are often displayed with the symbol "@"

\*Address correspondence to this author at the Population Health Research Institute, McMaster University, Hamilton, Canada; Tel: (905) 521-2100 x40601; Fax: (905) 297-3785; E-mail: [harriette.vanspall@phri.ca](mailto:harriette.vanspall@phri.ca)

#Denotes shared 1<sup>st</sup> authorship.

## ARTICLE HISTORY

Received: July 27, 2019  
Revised: November 19, 2019  
Accepted: November 21, 2019

DOI:  
[10.2174/1573403X15666191210143657](https://doi.org/10.2174/1573403X15666191210143657)

before their name (known as a Twitter ‘handle’), followed by a digital identifier and profile picture. While Twitter is currently the most popular form of SoMe used in health care communication [7], YouTube is increasingly used for disseminating health information [8].

Heart failure (HF), a global epidemic affecting over 26 million people [9], is estimated to have an economic cost of \$108 billion to health care systems each year [10]. A chronic, progressive condition characterized by debilitating symptoms [11], decreased quality of life [12], and limited survival [13], it places a tremendous burden on patients. HF also has a large impact on health care systems due to its disease trajectory, with recurrent exacerbations that require frequent hospitalizations and prolonged length of stay, particularly in the last two years of life [14].

Although the use of SoMe among cardiologists is increasing, the application of SoMe in HF is not well understood. SoMe has the potential to enhance communication and facilitate HF education and engagement of both health care professionals and patients. This can foster evidence-informed and patient-centered care delivery by professionals, and treatment uptake and self-management among patients [14]. SoMe also has the potential to influence health care policy through the engagement of decision-makers across health care systems [15]. To capitalize on this potential, it is important to understand the profiles of those who post material (source profiles) on SoMe and the content with the greatest uptake in HF.

The purpose of this mixed-method systematic review is to assess the source profiles and content of relevance to users of Twitter and YouTube. We focused on Twitter and YouTube as the discussions on these platforms are public, and topics can be easily searched using hashtags. We hypothesized that the platforms have an important role in patient empowerment, education for professionals, research promotion, research collaboration, and professional advocacy.

## 2. METHODS

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines in the design of this study [16]. We obtained cross-sectional data from 2 SoMe platforms, Twitter and YouTube, which are among the most popular SoMe websites used by health care professionals, and Twitter, in particular, has gained great acceptance among cardiology professionals [4, 17, 18]. These data relied on publicly anonymized information that adheres to terms of use and privacy by Twitter and YouTube [19, 20].

### 2.1. Data Sources and Search Strategy

We searched PubMed, Embase, and Medline for articles published between January 1, 1999 and April 14, 2019 using a combination of medical subject heading (MeSH) and text terms encompassing “cardiology,” “social media,” and “heart failure” (Appendix).

In addition, we searched Twitter and YouTube for posts that contained at least 1 of the following hashtags: “#heartfailure”, “#HF”, or “#CHF” (congestive heart failure). The

Twitter dataset was collected using Twitonomy [21], a Twitter analytical tool, and searched on May 15, 2019 and again on July 6, 2019 to update the sample for analysis. We captured YouTube videos using the YouTube web search function and using the hashtags outlined. We searched YouTube on May 15, 2019 as well as on July 6, 2019 so an additional search could update the sample used for analysis. Using the YouTube search function, we sorted videos based on relevance to HF for both searches.

### 2.2. Predefined Eligibility Criteria

We included English-language research studies related to HF posts on SoMe platforms of Twitter and YouTube, including full-length manuscripts. We excluded publications that did not report primary research data on source profiles and/or content. We excluded published abstracts and studies unrelated to HF.

We included English-language Twitter and YouTube posts from identifiable sources (*i.e.* source with a profile picture, and biography statement on Twitter, verified by opening the specific Uniform Resource Locator (URL) for each tweet). If a thread of consecutive, related tweets (*i.e.* ‘tweetotrials’) was posted on a subject, only the first tweet was included in the analysis. We excluded tweets unrelated to HF or with fewer than 3 retweets.

### 2.3. Study and SoMe Post Selection

Two authors independently screened titles, abstracts, and full-text from the original search in duplicate against the predefined eligibility criteria, and resolved discrepancies *via* discussion and if needed, *via* consultation of a third author. Twitter data were selected for data analysis as the included studies reported proportions of tweets related to HF.

We screened SoMe posts independently and in duplicate for major themes as outlined above. We organized the results of the Twitter search in descending number of retweets, and we selected the first 260 tweets to analyze those tweets with the widest dissemination. The YouTube simple search function did not specify a total number of videos generated from the search; we screened the first 400 videos (20 pages) - ordered by relevance - and selected the first 260 videos for analysis.

### 2.4. Data Abstraction and Management

We independently extracted the following in duplicate: study design (for publications), type of SoMe platform (Twitter or YouTube), source profile (*i.e.* institution), and content of a post (*i.e.* patient empowerment). We resolved discrepancies in extraction through discussion and consensus.

We collected data from Twitter using Twitonomy [21]. Twitonomy provided data on the date and time of each tweet, the composition of the tweet in terms of text, whether the tweet was a retweet or an original tweet, the number of retweets a tweet received, the number of likes (previously known as favorites) a tweet received, URL, number of followers per source, and the platform from where the tweet

was sent (*i.e.* mobile, computer). We collected data from YouTube using the platform query search function. Independently and in duplicate, we extracted the following: gender of the poster (determined from profile picture or profile biography), number of views (for YouTube) or retweets (for Twitter), followers (for Twitter), likes (for Twitter), date the post was published, post URL, source profile (*i.e.* institution) as defined in the profile biography, and post content (*i.e.* patient empowerment).

## 2.5. Data Synthesis

In the absence of primary research articles suitable for meta-analysis, we summarized results narratively following guidelines provided in *the Cochrane Handbook for Systematic Reviews* [22].

We applied a conceptual thematic analysis approach to synthesizing the publications included in this study. We pooled the tweets across studies and applied a thematic coding framework to the data. The analytic process followed the accepted 7 phases for conceptual framework mapping adopted from *Jabareen* (2009) [23]. The process was followed to code and conceptualized data into a matrix of 5 themes: patient empowerment, education for professionals, research promotion, research collaboration, and professional advocacy. This allowed the reviewers to interpret qualitative data and develop concepts and patterns.

Data from Twitter and YouTube posts were analyzed manually to adhere to the established conceptual framework.

We used descriptive analysis for all data, using proportions and ranges; means and standard deviations (SDs) for normally distributed data; and median and interquartile ranges (IQRs) for non-normally distributed data.

## 2.6. SoMe Source Profile and Content Classification Scheme

Upon screening the articles and SoMe source profile and content, we developed the following classification system for this study.

### 2.6.1. Source Profile

*Institution:* A third-party organization such as government, university, hospital, research group, journal, or HF advocacy group.

*Health Professional:* A person engaged in one or all of clinical care, research, and education.

*Patient:* A person diagnosed and living with HF.

### 2.6.2. Source Content

*Patient Empowerment:* Provision of HF awareness, online support, testimonials, sense of community; targeted to patients.

*Education for Professionals:* HF knowledge dissemination, including clinical cases and general content on management (lifestyle recommendations, services, invasive care), symptoms, risk factors, prevention, medication, disease mechanism, and outcomes; targeted to professionals.

*Research Promotion:* Knowledge dissemination and discussion related to basic or clinical research design or results (scientific conferences and publications); targeted to professionals.

*Research Collaboration:* Exchange of ideas, collaboration, and engagement related to basic or clinical research projects; recruitment of professionals for research networks or peer-review activities; targeted to professionals.

*Professional Advocacy:* Discussion related to professionalism, equality, equity, diversity, inclusion, remuneration, career advancement, work-life balance; targeted to professionals.

## 3. RESULTS

### 3.1. Study Characteristics

The systematic literature review yielded 996 unique citations from PubMed, Embase, and Medline. We excluded 955 citations on the basis of title and abstract review, assessed the full texts of the 41 remaining articles, and identified 3 for inclusion (Fig. 1). All 3 included publications were cross-sectional in design and each used Twitter as their some platform of study, analyzing HF tweets (Table 1). Of the 3 included studies, 2 were from the USA [24, 25], and 1 was from Canada [26] (Table 1).

The primary search of Twitter and YouTube posts yielded 2,252 eligible tweets and >400 YouTube videos, of which we analyzed 260 tweets and 260 YouTube videos. Among the 260 tweets analyzed, there was a median of 559 followers (IQR, 144-2112) per tweet; 6 retweets (IQR, 4-10); and 13 likes (IQR, 4-24) per tweet within a period of 135 days since the most remote tweet and 1 day since the most recent tweet. Of the 260 videos analyzed, there was a median of 2,188 views (IQR, 251-13,474); and 10 likes (IQR, 2-82) per video within a period of 1,460 days (*i.e.* 4 years) since the most remote video and 1 day since the most recent video analyzed.

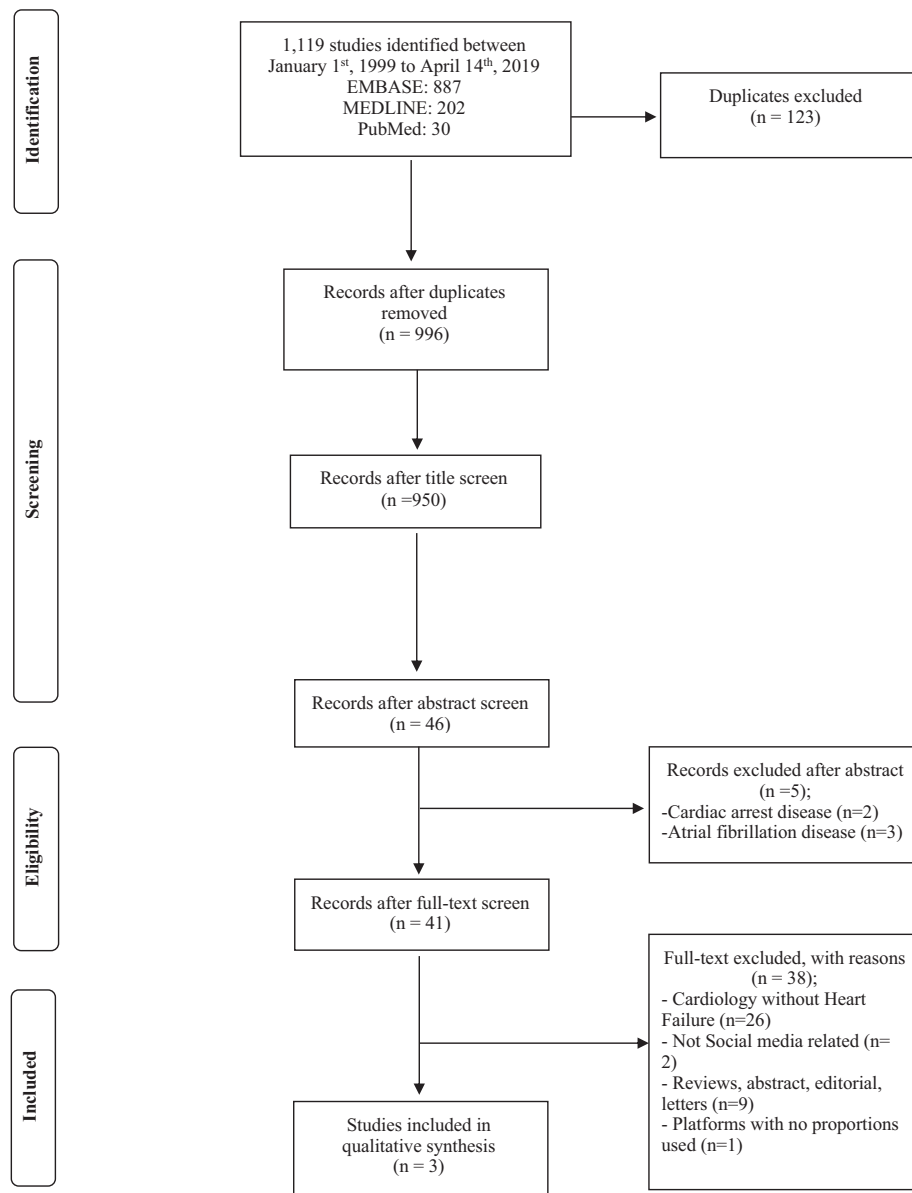
### 3.2. Source profiles of Social Media

Two of 3 publications reported source profiles of SoMe posts [25, 26] (Table 2). Among 677 tweets analyzed for source profile across publications, the most frequent sources were institutions (54.8 %) [25, 26], health professionals (26.6 %)[25, 26], and patients (19.4 %)[25, 26] (Table 2).

In the cross-sectional sample of 260 Twitter posts, institutions (53.5%) and health professionals (42.3%) were more common sources of tweets than patients (4.2%). A similar trend was observed among the 260 YouTube videos, which were more commonly posted by institutions (64.2%) and health professionals (28.5%) than patients (7.3%). (Table 3; Fig. 2).

### 3.3. Patient Empowerment

Among 1,194 tweets analyzed for Twitter source content across publications, 402 (33.7%) were empowering to HF patients [24, 25], of which 74.8% raised HF awareness [24, 25] and 25.1% offered online support [24, 25] (Table 2).



**Fig. (1).** Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) flow diagram included studies.

**Table 1.** Summary of the studies included in the systematic review.

Author, Year (Country)	Study Design	SoMe Plat- form	Total Number of HF Tweets	SoMe Source Profile	SoMe Content
Gouda <i>et al.</i> , 2017 [26] (Canada)	Cross- sectional	Twitter	400	Institutions (55%), health professionals (38.5%), patients (6.5%)	Education for professionals (51.8%), research promotion (48.2%)
Hand <i>et al.</i> , 2016 [25] (USA) <sup>ab</sup>	Cross- sectional	Twitter	294	Institutions (41.7%), health professionals (6.6%), patients (29%)	Patient empowerment (45.7%), education for professionals (41.1%), research promotion (11.1%)
Sinnenberg <i>et al.</i> , 2016 [24] (USA) <sup>a</sup>	Cross- sectional	Twitter	500	NR	Patient empowerment (22.1%), education for professionals (77.9%)

**Note:** NR= Not reported.

<sup>a</sup>These studies included classified tweets in multiple categories, if appropriate.

<sup>b</sup>Hand *et al.* [25] included undefined source content as ‘other’ or ‘unable to identify’.

**Table 2. Summary of source profiles and content from heart failure tweets\* obtained from 3 publications.**

	Examples	Number of Tweets in Category / Total Number of Tweets Assessing Source Profile or Content (%)
<b>Source Profile</b>		
Institution	Universities, hospitals, research institutes	371/677 (54.8)
Health Professional	Clinicians, researchers	180/677 (26.6)
Patient	Patients, family members, caregivers	131/677 (19.4)
<b>Source content</b>		
<b><i>Patient empowerment</i></b>		
HF Awareness	"#heartfailureawareness2019 has begun! #SuckaLemonChallenge because #HeartFailureSucks #HeartFailure".	301/1194 (25.2)
Online Support	"A super story about our inspirational fellow, managing his #heartfailure, taking control and walking 1000 miles while he's at it, 3 years after receiving his diagnosis!"	101/1194 (8.5)
<b>Subtotal 'Patient empowerment'</b>		<b>402/1194 (33.7)</b>
<b><i>Education for professionals</i></b>		
Management	"Following DASH #diet can reduce #heartfailure risk in people under 75".	254/1194 (21.3)
General HF Education	"Conclusion: In a contemporary ambulatory cohort of #HeartFailure patients, 77% of patients receiving a #DOAC received the appropriate dose. Careful review of renal function, age, weight and bleeding risk factors is necessary to ensure correct dosing of these agents. #HRS2019"	207/1194 (17.3)
Risk Factors	"@JACCJournals that #women are more likely to have #heartfailure compared to men, #hypertension & #diabetes are the greatest risk factors. #SoMe #MedEd #4patients"	204/1194 (17.1)
Outcomes	"What are the long-term clinical outcomes in selective vs. non-selective His Bundle Pacing? This #HRS2019 LBCT by colleagues reports on 350 patients with a combined endpoint of mortality or #heartfailure hospitalization".	145/1194 (12.1)
Symptoms	"My hope is for greater awareness of all signs and symptoms of #HeartFailure and heart attack. More awareness needed for the prolonged symptoms; shortness of breath, fatigue, dizziness, cold sweats - before it's too late. #hopeforheartfailure"	97/1194 (8.1)
Disease Mechanism	"Tet2-Mediated Clonal #hematopoiesis accelerates #HeartFailure through a mechanism involving IL-1 $\beta$ /NLRP3 inflammasome"	44/1194 (3.7)
Medication	"Heart bypass surgery is performed on people with blocked arteries. The surgery creates a detour and enhances the flow of the blood to enhance health. The surgery comes with various advantages as well as risk factors. #heartattack #heartfailure"	34/1194 (2.8)
Prevention	"Earlier #heartfailure detection + intervention needed, NHS Long Term Plan says. 80% of patients diagnosed in hospital, but 40% have symptoms that should trigger earlier assessment".	10/1194 (0.8)
<b>Subtotal 'Education for professionals'</b>		<b>995/1194 (83.3)</b>
<b><i>Research promotion</i></b>		
Promotion of HF Research	"More young adults in the US are dying from #heartfailure today than a decade ago, a new #JACC study suggests".	274/1194 (22.3)
<b>Subtotal 'Research promotion'</b>		<b>274/1194 (22.3)</b>

Note: \*Examples describing source content subcategories were obtained from the cross-sectional sample of tweets collected on May 15, 2019 and July 6, 2019.

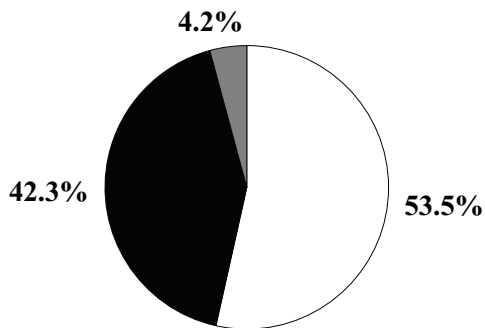
**Table 3.** Summary of source profile and content from a sample of the 260 Twitter and 260 YouTube videos on heart failure. The most retweeted tweets and most relevant videos during the study period\* were selected for analysis.

Content	Twitter Sources			Total Tweets	YouTube Sources			Total Videos
	Institution	Health Professional	Patient		Institution	Health Professional	Patient	
Patient empowerment N (%)	30 (56.6)	14 (26.4)	9 (16.9)	53 (100.0)	37 (64.9)	3 (5.3)	17 (29.8)	57 (100.0)
Education for professionals N (%)	56 (54.9)	45 (44.1)	1 (0.9)	102 (100.0)	98 (60.5)	64 (39.5)	0	162 (100.0)
Research promotion N (%)	41 (54.7)	33 (44.0)	1 (1.3)	75 (100.0)	27 (79.4)	5 (14.7)	2(5.9)	34 (100.0)
Research collaboration N (%)	3 (20.0)	12 (80.0)	0	15 (100.0)	0	0	0	0
Professional advocacy N (%)	9 (60.0)	6 (40.0)	0	15 (100.0)	5 (71.4)	2 (28.6)	0	7 (100.0)
<b>Total N (%)</b>	<b>139 (53.5)</b>	<b>110 (42.3)</b>	<b>11 (4.2)</b>	<b>260 (100.0)</b>	<b>167 (64.2)</b>	<b>74 (28.5)</b>	<b>19 (7.3)</b>	<b>260 (100.0)</b>

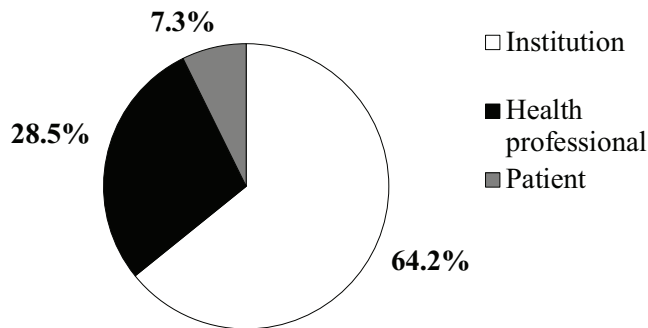
Note: \*Posts were collected on May 15, 2019 and July 6, 2019 for both platforms. Posts from Twitter were shared online between January 15, 2019 and July 6, 2019. Posts from YouTube were shared online between January 1, 2016 and July 6, 2019.

**A.**

**TWITTER SOURCES**



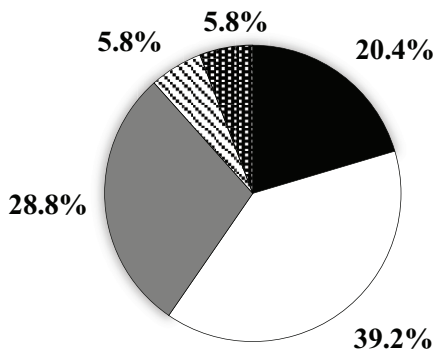
**YOUTUBE SOURCES**



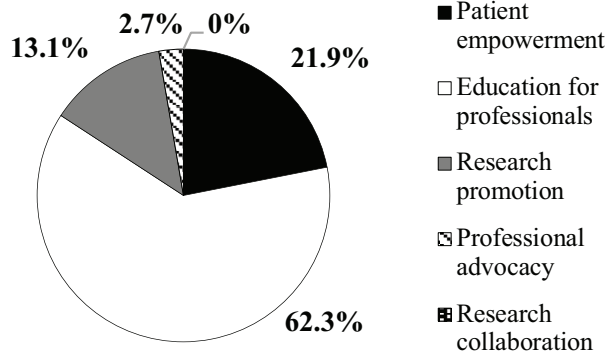
□ Institution  
 ■ Health professional  
 ■ Patient

**B.**

**TWEET CONTENT**



**YOUTUBE CONTENT**



■ Patient empowerment  
 □ Education for professionals  
 ■ Research promotion  
 ▨ Professional advocacy  
 ■ Research collaboration

**Fig. (2).** Chart summary of (A) source profile, and (B) source content of heart failure-related posts from 260 tweets and 260 YouTube videos.

In the cross-sectional sample of 260 tweets, 53 (20.4%) were classified as empowering to HF patients (Fig. 2). Tweets in this category were posted mainly by institutions (56.6%) and health professionals (26.4%), with a smaller contribution by patients (16.9%) (Table 3). In the sample of 260 YouTube videos, 57 (21.9%) were for patient empowerment (Fig. 2), of which 64.9% were posted by institutions, 5.3% by health professionals, and 29.8% by patients (Table 3).

### 3.4. Education for Professionals

Among 1,194 tweets analyzed for Twitter source content across publications, 995 (83.3%) were educational for professionals [24-26], of which 25.5% focused on management, 20.8% on general HF education [26], 20.5% on risk factors [24], 14.6% on outcomes [24, 25], 9.7% on symptoms [24, 25], 4.4% on disease mechanism [24], 3.4% on medication [25], and 1.0% on prevention [24] (Table 2).

In the cross-sectional sample of 260 tweets, 102 (39.2%) provided HF education for professionals (Fig. 2), of which 54.9% were posted by institutions, 44.1% by health professionals, and 0.9% by patients (Table 3). Among 260 YouTube videos, 162 (62.3%) provided HF education for professionals (Fig. 2); of which 60.5% were posted by institutions, 39.5% by health professionals, and none by patients (Table 3). Twitter posts included educational series called ‘tweetorials,’ (a list of consecutive tweets containing in-depth educational content) [17], clinical cases with teaching points, and ‘live-tweeting’ (tweets posted in real-time about conference/workshop material) [27]. YouTube content was limited to educational videos, which were typically not found on Twitter (though Twitter did have video clips of diagnostic imaging).

### 3.5. Research promotion

Among 1,194 tweets analyzed for Twitter source content across publications, 274 (22.3%) promoted research [25, 26] (Table 2).

In the cross-sectional sample of 260 tweets, 75 (28.8%) promoted HF research (Fig. 2), of which 54.7% were posted by institutions, 44.0%, by health professionals, and 1.3% by patients (Table 3). Promoted research content on Twitter included links to original journal articles, guidelines, figures, and tables. Among 260 YouTube videos, 34 (13.1%) promoted HF research (Fig. 2), of which 79.4% were posted by institutions, 14.7% by health professionals, and 5.9% by patients (Table 3). Promoted research content on YouTube included videos with updates on clinical trials and interviews discussing emerging research presented at conferences.

### 3.6. Research Collaboration

None of the publications reported tweets on research collaboration.

In the cross-sectional sample of 260 tweets, 15 (5.8%) mentioned research collaboration among professionals (Fig. 2), and of these, 80.0% were posted by health professionals, 20.0% by institutions, and none by patients (Table 3).

Among 260 YouTube videos, none mentioned HF research collaboration (Table 3; Fig. 2).

### 3.7. Professional Advocacy

None of the publications contained tweets on professional advocacy.

In the cross-sectional sample of 260 tweets, 15 (5.8%) advocated for HF professionals (Fig. 2), and of these, 60.0% were posted by institutions and 40.0% by health professionals (Table 3). Among 260 YouTube videos, 7 (2.7%) advocated for HF professionals (Fig. 2), and of these, 71.4% were posted by institutions and 28.6% by health professionals. Neither platform identified patients posting about HF professional advocacy (Table 3).

## 4. DISCUSSION

To the best of our knowledge, this is the first systematic review that reports the source profile and content of Twitter and YouTube posts on HF. Using mixed-methods, we combined a robust review of the published literature with primary research of 520 Twitter and YouTube posts. We found that institutions and health professionals were more common sources of SoMe content than patients. Both Twitter and YouTube focused primarily on professional education and to a lesser extent, on patient empowerment. Relative to YouTube, Twitter more frequently included content on HF research promotion, research collaboration, and professional advocacy; the latter two categories of content (research collaboration and professional advocacy) were not reported in the literature but were found in the cross-sectional sample of 520 SoMe posts on Twitter and YouTube.

The finding that institutions and health professionals post HF content on SoMe more commonly than patients is not surprising, given that institutions and health professionals typically create this knowledge. From our primary analysis of Twitter and YouTube posts, it appears that patients post content primarily targeting other patients rather than professionals. Thus, knowledge transfer between institutions/professionals and patients appears to be unidirectional. Our findings may represent an opportunity to engage patients in reversing the direction of knowledge transfer so that the institutions and professionals conducting research and providing care can be influenced by patients’ insights. Patients can provide unique perspectives in the design, conduct, and selection of research outcomes; and in priorities that affect clinical care. This potential remains relatively untapped on both Twitter and YouTube.

Both Twitter and YouTube posts focused primarily on HF education for professionals. While there has been little academic interest in YouTube as a SoMe platform for HF education – as evidenced by the lack of publications on YouTube – this platform had a higher proportion of HF educational postings for professionals relative to Twitter in our cross-sectional sample. While YouTube content was limited to instructional videos, Twitter posts included diverse formats, including ‘tweetorials’, clinical cases with video clips of diagnostic imaging, and live-tweeting. The breadth of educational content targeting professionals on Twitter – in-

cluding case discussions, live-tweeting, and real-time interactive learning – likely explains the greater academic interest in Twitter among professionals.

Twitter and YouTube play an important role in empowering patients with HF. While we neither assessed patient engagement on both platforms nor the impact of postings on patient-important outcomes, there is evidence that postings on SoMe are associated with patients feeling more prepared to consult and share decision-making with their health professionals [28].

Our sample did not unearth the potential of Twitter or YouTube as a recruitment tool for clinical trials in HF. SoMe has recently been described as an efficient and feasible tool that increases the number of clinical trial participants compared to standard techniques [29]. Potential challenges to this application include barriers to accessing SoMe and the risk of misinformation due to limited quality assurance or character limits on Twitter [30]. Future investigations could explore the role of SoMe in the recruitment of clinical trial participants.

While both Twitter and YouTube play a role in disseminating HF research, Twitter plays a unique role in facilitating research collaborations and growing research networks. Articles published in a large-circulation internal medicine journal were more widely accessed when promoted using SoMe platforms, including Twitter [31]. Alternative research impact metrics, known as ‘altmetrics’, quantify the impact of scientific output in different social networks [32]. Articles from journals with more active Twitter accounts are associated with higher altmetric scores, which in turn is associated with a higher journal impact factor [33]. SoMe can also create a supportive, interactive environment that enhances research collaboration. By providing a forum for discussion and critical appraisal of research, Twitter provides a forum for professionals with similar or complementary research interests to collaborate on new research [34].

Our review likely underestimates the contribution of SoMe for professional advocacy as our search focused on HF and did not include hashtags to capture content on advocacy. Twitter provides a platform for health professionals to advocate for physician well-being, equity, and work-life integration, and to address workplace harassment, toxic behaviors, gender- or race-based discrimination, and burnout [35, 36]. These issues are not specific to practice in HF, and other hashtags (*i.e.* ‘#WomenInCardiology’, ‘#diversityandinclusion’, ‘#professionalism’, ‘#physicianadvocacy’, and ‘#thefaceofcardiology’) may have generated a larger collection of tweets in this area. However, we aimed to keep the search strategy on SoMe platforms broad and consistent in order to minimize selection bias.

## 5. LIMITATIONS

Our study is constrained by the limited quantity and methodological quality of research publications included in this review. We noted variation in the definitions and classification schemes across studies. For example, while we defined categories and classified content into mutually exclusive categories in our primary review of SoMe content, the

publications included in our review did not do so. Some publications did not provide definitions for categories and some categorized Twitter posts with overlapping themes into multiple categories [24, 25], but did not reveal how many tweets were coded multiple times.

The findings from our primary review of Twitter and YouTube postings are based on a limited number of public postings and are subject to selection bias. We selected 260 most retweeted Twitter posts and 260 most relevant YouTube videos to assess content that users find most relevant, and the postings are not comprehensive in content or in time. We did not assess temporal trends or influence of geography in SoMe source profile or content. We did not measure user engagement in this study. Our intention to include tweets with at least 3 retweets aimed to exclude posts with low engagement activities but may have also introduced selection bias.

## CONCLUSION

Among SoMe platforms, Twitter and YouTube give a voice to institutions, health professionals, and patients living with HF to educate professionals and empower patients. Both platforms provide an opportunity to reach a global audience. Twitter enables institutions and health professionals to promote HF research, form research collaborations, and advocate for professionals beyond institutional and geographic boundaries.

## LIST OF ABBREVIATIONS

SoMe	=	Social Media
HF	=	Heart Failure
MeSH	=	Medical Subject Heading
CHF	=	Congestive Heart Failure
NR	=	Not Related
DASH	=	Dietary Plan to Stop Hypertension
DOACs	=	Direct-Acting Oral Anticoagulants

## CONSENT FOR PUBLICATION

Not applicable.

## STANDARD OF REPORTING

PRISMA guidelines have been followed.

## FUNDING

None received.

## CONFLICT OF INTEREST

None to disclose.

## ACKNOWLEDGEMENTS

Dr. Van Spall receives research support from the Hamilton Health Sciences Early Career Award and the Canadian Institutes of Health Research.



# APPENDIX

**Table 1. Search strategy.**

Search Strategy		
Date: 12/4/2019		
OID MEDLINE	EMBASE	PubMed
1. Cardiology [Mesh] 2. Cardiovascular Disease [Mesh] 3. Heart Failure [Mesh] 4. Heart Failure OR HF OR heart failure OR Cardiac Attack OR cardiac attack 5. Social media [Mesh] 6. Social platform OR Twitter OR twitter OR Facebook OR Facebook OR Youtube OR YouTube 7. 1 OR 2 or 3 or 4 8. 5 OR 6 9. 7 AND 6 [LIMIT TO ENGLISH 1999 → CURRENT]	1. Cardiology [Mesh] 2. Cardiovascular Disease [Mesh] 3. Heart Failure [Mesh] 4. Heart Failure OR HF OR heart failure OR Cardiac Attack OR cardiac attack 5. Social media [Mesh] 6. Social platform OR Twitter OR twitter OR Facebook OR Facebook OR Youtube OR YouTube 7. 1 OR 2 or 3 or 4 8. 5 OR 6 9. 7 AND 6 [LIMIT TO ENGLISH 1999 → CURRENT]	1. Cardiology [Mesh] 2. Cardiovascular Disease [Mesh] 3. Heart Failure [Mesh] 4. Heart Failure OR HF OR heart failure OR Cardiac Attack OR cardiac attack 5. Social media [Mesh] 6. Social platform OR Twitter OR twitter OR Facebook OR Facebook OR Youtube OR YouTube 7. 1 OR 2 or 3 or 4 8. 5 OR 6 9. 7 AND 6 [LIMIT TO ENGLISH 1999 → CURRENT]
<b>Total= 202</b>	<b>Total= 887</b>	<b>Total= 30</b>

## REFERENCES

[1] Kietzmann JH, Hermkens K, McCarthy IP, Silvestre BS. Social media? Get serious! Understanding the functional building blocks of social media. *Bus Horiz* 2011; 54(3): 241-51. <http://dx.doi.org/10.1016/j.bushor.2011.01.005>

[2] Thackeray R, Crookston BT, West JH. Correlates of health-related social media use among adults. *J Med Internet Res* 2013; 15(1): e21. <http://dx.doi.org/10.2196/jmir.2297> PMID: 23367505

[3] Smith AA, Anderson M. Social media use 2018. Available from: <https://www.pewinternet.org/2018/03/01/social-media-use-in-2018/>

[4] Walsh MN. Social Media and Cardiology. *J Am Coll Cardiol* 2018; 71(9): 1044-7. <http://dx.doi.org/10.1016/j.jacc.2018.01.037> PMID: 29495984

[5] 2019. Available from: [https://about.twitter.com/en\\_us/lets-go-twitter.html](https://about.twitter.com/en_us/lets-go-twitter.html)

[6] 2019. Available from: <https://www.youtube.com/intl/en/yt/about/>

[7] Pershad Y, Hangge PT, Albadawi H, Oklu R. Social medicine: twitter in healthcare. *J Clin Med* 2018; 7(6): 121. <http://dx.doi.org/10.3390/jcm7060121> PMID: 29843360

[8] Madathil KC, Rivera-Rodriguez AJ, Greenstein JS, Gramopadhye AK. Healthcare information on YouTube: A systematic review. *Health Informatics J* 2015; 21(3): 173-94. <http://dx.doi.org/10.1177/1460458213512220> PMID: 24670899

[9] Savarese G, Lund LH. Global public health burden of heart failure. *Card Fail Rev* 2017; 3(1): 7-11. <http://dx.doi.org/10.15420/cfr.2016.25:2> PMID: 28785469

[10] Cook C, Cole G, Asaria P, Jabbour R, Francis DP. The annual global economic burden of heart failure. *Int J Cardiol* 2014; 171(3): 368-76. <http://dx.doi.org/10.1016/j.ijcard.2013.12.028> PMID: 24398230

[11] Zambroski CH, Moser DK, Bhat G, Ziegler C. Impact of symptom prevalence and symptom burden on quality of life in patients with heart failure. *Eur J Cardiovasc Nurs* 2005; 4(3): 198-206. <http://dx.doi.org/10.1016/j.ejcnurse.2005.03.010> PMID: 15916924

[12] Bekelman DB, Havranek EP, Becker DM, *et al.* Symptoms, depression, and quality of life in patients with heart failure. *J Card Fail* 2007; 13(8): 643-8. <http://dx.doi.org/10.1016/j.cardfail.2007.05.005> PMID: 17923356

[13] Taylor CJ, Ordóñez-Mena JM, Roalfe AK, *et al.* Trends in survival after a diagnosis of heart failure in the United Kingdom 2000-2017: Population based cohort study. *BMJ* 2019; 364: 1223. <http://dx.doi.org/10.1136/bmj.l223> PMID: 30760447

[14] Steiner JM, Kirkpatrick JN, Heckbert SR, *et al.* Hospital resource utilization and presence of advance directives at the end of life for adults with congenital heart disease. *Congenit Heart Dis* 2018; 13(5): 721-7. <http://dx.doi.org/10.1111/chd.12638> PMID: 30230232

[15] Charalambous A. Social media and health policy. *Asia Pac J Oncol Nurs* 2019; 6(1): 24-7. [http://dx.doi.org/10.4103/apjon.apjon\\_60\\_18](http://dx.doi.org/10.4103/apjon.apjon_60_18) PMID: 30599012

[16] Liberati A, Altman DG, Tetzlaff J, *et al.* The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ* 2009; 339: b2700. <http://dx.doi.org/10.1136/bmj.b2700> PMID: 19622552

[17] Parwani P, Choi AD, Lopez-Mattei J, *et al.* Understanding social media: Opportunities for cardiovascular medicine. *J Am Coll Cardiol* 2019; 73(9): 1089-93. <http://dx.doi.org/10.1016/j.jacc.2018.12.044> PMID: 30846102

[18] Shiffman DS. Twitter as a tool for conservation education and outreach: What scientific conferences can do to promote live-tweeting. *J Environ Stud Sci* 2012; 2(3): 257-62. <http://dx.doi.org/10.1007/s13412-012-0080-1>

[19] 2018. Available from: <https://twitter.com/en/privacy>

[20] 2018. Available from: <https://www.youtube.com/static?gl=CA&template=terms>

[21] 2019. Available from: <https://www.twitonomy.com/>

[22] Ryan R. Cochrane consumers and communication review group. Cochrane consumers and communication review group. Cochrane - consumers and communication review group: data synthesis and analysis 2013. Available from: <http://ccrg.cochrane.org>

- [23] Jabareen Y. Building a conceptual framework: Philosophy, definitions, and procedure. *Int J Qual Methods* 2009; 8(4): 49-62. <http://dx.doi.org/10.1177/160940690900800406>
- [24] Sinnenberg L, DiSilvestro CL, Mancheno C, *et al.* Twitter as a potential data source for cardiovascular disease research. *JAMA Cardiol* 2016; 1(9): 1032-6. <http://dx.doi.org/10.1001/jamacardio.2016.3029> PMID: 27680322
- [25] Hand RK, Kenne D, Wolfram TM, Abram JK, Fleming M. Assessing the viability of social media for disseminating evidence-based nutrition practice guideline through content analysis of twitter messages and health professional interviews: an observational study. *J Med Internet Res* 2016; 18(11): e295. <http://dx.doi.org/10.2196/jmir.5811> PMID: 27847349
- [26] Gouda P, Das D, Clark A, Ezekowitz JA. The impact and implications of twitter for cardiovascular medicine. *J Card Fail* 2017; 23(3): 266-7. <http://dx.doi.org/10.1016/j.cardfail.2016.12.005> PMID: 28010999
- [27] Tanoue MT, Chatterjee D, Nguyen HL, *et al.* Tweeting the Meeting. *Circ Cardiovasc Qual Outcomes* 2018; 11(11): e005018. <http://dx.doi.org/10.1161/CIRCOUTCOMES.118.005018> PMID: 30571329
- [28] Benetoli A, Chen TF, Aslani P. How patients' use of social media impacts their interactions with healthcare professionals. *Patient Educ Couns* 2018; 101(3): 439-44. <http://dx.doi.org/10.1016/j.pec.2017.08.015> PMID: 28882545
- [29] Shere M, Zhao XY, Koren G. The role of social media in recruiting for clinical trials in pregnancy. *PLoS One* 2014; 9(3): e92744.
- [30] Sedrak MS, Sun V, Liu J, George K, Wong AR, Dale W, *et al.* Physician perceptions of the use of social media for recruitment of patients in cancer clinical trials. *JAMA Netw Open*. 2019; 2(9): e1911528.
- [31] Widmer RJ, Mandrekar J, Ward A, *et al.* Effect of promotion via social media on access of articles in an academic medical journal: A randomized controlled trial. *Acad Med* 2019; 94(10): 1546-53. <http://dx.doi.org/10.1097/ACM.0000000000002811> PMID: 31149923
- [32] Priem J, Piwowar HA, Hemminger BM. Hemminger BM. Altmetrics in the wild: Using social media to explore scholarly impact *rXiv preprint arXiv* 2012; 1203: 4745.
- [33] Han J, Ziaieian B. Social media usage, impact factor, and mean altmetric attention scores: characteristics and correlates in major cardiology journals. *J Am Coll Cardiol* 2019; 73(9): 3027. [http://dx.doi.org/10.1016/S0735-1097\(19\)33633-2](http://dx.doi.org/10.1016/S0735-1097(19)33633-2)
- [34] Yeh RW. Academic cardiology and social media: Navigating the wisdom and madness of the crowd. *Circ Cardiovasc Qual Outcomes* 2018; 11(4): e004736. <http://dx.doi.org/10.1161/CIRCOUTCOMES.118.004736> PMID: 29650720
- [35] Lewis SJ, Mehta LS, Douglas PS, *et al.* American College of Cardiology Women in Cardiology Leadership Council. Changes in the Professional Lives of Cardiologists Over 2 Decades. *J Am Coll Cardiol* 2017; 69(4): 452-62. <http://dx.doi.org/10.1016/j.jacc.2016.11.027> PMID: 28012614
- [36] Sanghavi M. Women in cardiology: Introspection into the underrepresentation. *Circ Cardiovasc Qual Outcomes* 2014; 7(1): 188-90. <http://dx.doi.org/10.1161/CIRCOUTCOMES.113.000449> PMID: 24347662