Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Handwashing videos on TikTok during the COVID-19 pandemic: Potential for disease prevention and health promotion

Corey H. Basch a,*, Joseph Ferab b, Alessia Pellicane a, Charles E. Basch c

a Department of Public Health, William Paterson University, Wayne, NJ 07470, USA
b Department of Mathematics, Lehman College, The City University of New York Bronx, NY, USA
c Department of Health and Behavior Studies, Teachers College, Columbia University New York, NY 10027, USA

Received 20 June 2021; received in revised form 24 August 2021; accepted 29 September 2021
Available online 7 October 2021

KEYWORDS
TikTok; Handwashing; Social media; Public health

Abstract  Background: Handwashing has long been promoted to maintain health and in preventing disease transmission. One of the most valuable ways to convey messages related to handwashing is through visual display, such as video for educational purposes and to enhance learning. Social media is an important and popular way to disseminate messages to a wide audience.

Methods: In this cross-sectional, descriptive study, two hashtags, #WashYourHands and #Safe-guardSplash were used to select the sample of 100 from available TikTok videos. In order to code each video, the same coding categories were used for both hashtags, including (1) wetting and rinsing hands (2) lathering soap (3) time used for scrubbing (4) drying hands (5) mentions COVID-19 (6) mentions using hand sanitizer instead of soap (7) mentions how germs spread (8) mentions key times to wash hands (9) and actual depiction of washing hands. Additional descriptive categories were coded as well. The observations recorded were tabulated and descriptive statistics were performed. Independent one-tailed t-tests (α = .05) were calculated to determine if a video’s hashtag had a significant association with its garnered views, likes, and/or comments.

Results: In total, the 100-video sample received 1,990,834,567 views, 40,355,468 likes, and 173,422 comments. Despite the fact that each hashtag made up an equal proportion (50%) of the total sample, videos with #WashYourHands accounted for 93.3% of the total views. Coverage of the important steps involved in handwashing, such as drying hands, was minimal as was relevant background information.

Conclusion: The results indicate that while this opportunity is being realized to some degree, the majority of videos did not cover topics related important concepts of hand hygiene. Given

* Corresponding author. Department of Public Health, William Paterson University, University Hall, Wayne, NJ, 07470, USA.
E-mail address: baschc@wpunj.edu (C.H. Basch).

https://doi.org/10.1016/j.idh.2021.09.039
2468-0451/ © 2021 Australasian College for Infection Prevention and Control. Published by Elsevier B.V. All rights reserved.
Introduction

Handwashing has long been promoted to maintain health and has been referred to as “public health 101” in reference to its simplicity in preventing disease transmission [1]. In 1847, Dr. Ignaz Semmelweis proved that the simple act of handwashing could reduce rates of puerperal fever caused by bacterial infection [2,3]. Despite the findings, recommendations by Semmelweis for mandatory handwashing were rejected [3]. In the ensuing decades, as other innovative thinkers confirmed the findings and germ theory evolved, this theory became more widely accepted [3]. Globally, many people do not have access to clean water and soap [4,5], but even when soap and water are accessible, handwashing is often not initiated in recommended situations or completed properly [6–9]. The United States Centers for Disease Control and Prevention (CDC) highlight five steps to follow when washing hands. “1) Wet your hands with clean, running water (warm or cold), turn off the tap, and apply soap. 2) Lather your hands by rubbing them together with the soap. Lather the backs of your hands, between your fingers, and under your nails. 3) Scrub your hands for at least 20 s 4) Rinse your hands well under clean, running water. 5) Dry your hands using a clean towel or air dry them.” Yet, proper handwashing following these steps is often not achieved [10].

Flash forward to the present day, and the necessity of handwashing could not be more relevant. Messages promoting handwashing became abundant with emergence of COVID-19 [2]. The CDC and the World Health Organization (WHO) set specific guidelines for handwashing to curb COVID-19 transmission [10,11]. Hand hygiene has and continues to be one of the most important ways to prevent transmission of many important infectious diseases, including a variety of respiratory and gastrointestinal illnesses [12–14].

Children are especially vulnerable and face increased consequences of these illnesses [15,16]. Hence, many intervention efforts have been designed to increase proper handwashing with children in mind [17–21]. Handwashing is critical in improving development in children [22], but doing so is largely dependent on access to clean water and soap [23] and the direction of caretakers, which is often low [24]. Recent studies have found that handwashing rates are low in adolescents [25] with roughly one out of three participating in appropriate hand hygiene [26,27].

One of the most valuable ways to convey messages and observe behaviors related to handwashing is through visual display [28–31]. The value of visual learning has been well established [32], for example using video for educational purposes and to enhance learning [33]. Social media is an important and popular way to disseminate messages to a wide audience, especially those in younger age brackets who are frequent users of social media.

A highly popular video sharing social media networking service is TikTok, which has increased in popularity in recent years, so much so that it was declared one of the most downloaded apps in 2020 [34]. TikTok has nearly 700 million users across the world and is most commonly used in those aged 10–19 years [35]. Several studies on TikTok examined factors related to COVID-19 [36–39], however there is a gap in the literature related to handwashing on TikTok, which is especially of importance as adolescents are frequent users and have been found to have low rates of handwashing [25]. Therefore, the purpose of this study was to describe content on TikTok related to handwashing.

Methods

In this cross-sectional, descriptive study, two hashtags were used to select the sample from available TikTok videos. Using this social media networking service, #WashYourHands and #SafeguardSplash were found using the discover feature to identify the most viewed hashtags in regards to handwashing. The purpose of choosing these two hashtags was to account for any differences that may be apparent in a hashtag challenge such as #SafeguardSplash versus a general consumer driven hashtag, #WashYourHands. A hashtag challenge is a trending activity that is widespread on TikTok and is usually accompanied by a song and/or dance with prompts. While this hashtag challenge is...
Results

In total, the 100-video sample received 1,990,834,567 views, 40,355,468 likes, and 173,422 comments. The respective averages (SDs) of views, likes, and comments for these videos were as follows: 19,908,345.67 (91,376,575.39), 403,554.68 (690,110.4), and 1734.22 (3076.12). The 50-video sample with #WashYourHands had a combined 1,857,280,100 views, 33,274,800 likes, and 141,256 comments. The averages (SDs) of these videos were 37,145,602 (129,183,248.98), 665,496 (816,995.59), and 2825.12 (3645.22), respectively. The 50-video sample with #SafeGuardSplash had a total of 133,554,467 views, 7,080,668 likes, and 32,166 comments. The respective averages (SDs) of views, likes, and comments for these videos were: 2,671,089 (14,535,026.85), 141,613 (423,398.11), and 643 (1980.16), respectively. The mean number of days that videos at #WashYourHands were posted was 20 s to Safeguard your family and wash away germs [40].”

A total of 50 relevant videos were drawn from each hashtag. It’s important to note that these were the most popular hashtags in the challenge and consumer categories at the time the study was conducted. In order to code each video, the same coding categories were used for both hashtags, including (1) wetting and rinsing hands (2) lathering soap (3) time used for scrubbing (4) drying hands (5) mentions COVID-19 (6) mentions using hand sanitizer instead of soap (7) mentions how germs spread (8) mentions key times to wash hands (9) and actual depiction of washing hands. Additional data coded included number and percent of views (how many times the video was viewed), likes (a simply click of a button to indicate approval and/or enjoyment of a video), comments (a space where viewers can add text-based commentary), and whether or not music, dance, and humor were involved. The observations recorded were tabulated and descriptive statistics were performed. Independent one-tailed t-tests (α = .05) were calculated to determine if a video’s hashtag had a significant association with its garnered views, likes, and/or comments. A single reviewer (AP) coded all 100 videos and a second coder (CHB) then coded a 10% random sample to demonstrate inter-rater reliability. The two reviewers differed in only 3 out of 320 data points resulting in high agreement (κ = 0.9593). Since human subjects were not involved in this study, it was not reviewed by the Institutional Review Board (IRB) at William Paterson University; the study was deemed exempt by the IRB at Teachers College, Columbia University.

Discussion

The findings of this study indicate that handwashing videos are being widely viewed on TikTok, however the number of views and type of coverage differs across categorical criteria. Because the challenge hashtag is set to a specific song with specific steps to follow, handwashing techniques were exhibited to a greater extent in these videos. These techniques were absent from many videos not linked to a challenge. Further, coverage of the important steps involved in handwashing such as drying hands was minimal as was background information related to how germs
spread and the key times to wash hands. This knowledge can be integral in motivating an individual to wash hands and to follow through with doing so completely.

One of the most important findings from this study is that the general handwashing videos were viewed nearly 2 billion times. This widespread viewership indicates that there is a great opportunity to educate the public for disease prevention and health promotion. There is a paucity of literature which compares the two efforts, a campaign driven by a product versus one driven by consumers, with the same purpose in mind, to promote hand washing. In one respect, a campaign can be very effective if it gains popularity and the demonstration of an activity (such as handwashing) is done so in an accurate and comprehensive way. In this case, we identified key components of the handwashing process that were not or rarely included in the videos in this sample. Social media is a powerful communication medium with widespread, rapid reach that spans the globe. Unfortunately, our results show that while this opportunity is being realized to some degree, some important topics related to handwashing need more attention.

Table 1  Observed characteristics, content, and views of 100 handwashing videos, 50 with #WashYourHands and 50 with #SafeguardSplash.

|                              | Total (n = 100) | #WashYourHands (n = 50) | #SafeguardSplash (n = 50) |
|------------------------------|----------------|------------------------|---------------------------|
|                              | N   | Views          | % of Total Views | N   | Views          | % of # Views | N   | Views          | % of # Views |
| Uses Music                   | 77  | 1,423,101,567  | 71.48%           | 27  | 1,289,699,300  | 69.44%       | 50  | 133,554,467  | 100.00%      |
| Uses Dance                   | 45  | 142,961,908    | 7.18%            | 6   | 11,900,000     | 0.64%        | 39  | 131,214,108  | 98.25%       |
| Uses Humor                   | 60  | 733,504,644    | 36.84%           | 25  | 606,154,100    | 32.64%       | 35  | 127,502,744  | 95.47%       |
| Wet Hands With Clean Running Water | 19  | 90,056,008    | 4.52%            | 14  | 87,354,100     | 4.70%        | 5   | 2,790,908   | 2.02%        |
| Lather Soap Between Hands    | 72  | 261,856,367    | 13.15%           | 22  | 128,454,100    | 6.92%        | 50  | 133,554,467  | 100.00%      |
| Scrub Hands For At Least 20 Seconds | 24  | 147,254,100    | 7.40%            | 7   | 35,500,000     | 1.91%        | 17  | 111,754,100  | 83.68%       |
| Use A Song To Determine How Long They Wash Their Hands | 55  | 141,591,967    | 7.11%            | 5   | 8,189,700      | 0.44%        | 50  | 133,554,467  | 100.00%      |
| Rinse hands Under Clean Running Water | 68  | 282,220,967    | 14.18%           | 20  | 149,054,100    | 8.03%        | 48  | 133,319,067  | 99.82%       |
| Dry Their Hands On Clean Towel | 3   | 9,023,500      | 0.45%            | 2   | 8,400,000      | 0.45%        | 1   | 623,500      | 0.47%        |
| Air Dry Hands                | 4   | 6,909,336      | 0.35%            | 2   | 4,300,000      | 0.23%        | 2   | 2,609,336    | 1.95%        |
| Use Sanitizer Instead Of Soap | 6   | 25,500,000     | 1.28%            | 6   | 25,500,000     | 1.37%        | 0   | 0           | 0.00%        |
| Mention COVID 19             | 22  | 601,270,700    | 30.20%           | 21  | 601,195,300    | 32.37%       | 1   | 75,400       | 0.06%        |
| Mention How Germs Spread     | 2   | 17,000,000     | 0.85%            | 2   | 17,000,000     | 0.92%        | 0   | 0           | 0.00%        |
| Mention Key Times To Wash Hands | 5   | 502,044,500    | 25.22%           | 5   | 502,044,500    | 27.03%       | 0   | 0           | 0.00%        |
| Actually Washing Hands       | 76  | 345,402,531    | 17.35%           | 28  | 212,009,600    | 11.42%       | 48  | 133,545,131  | 99.99%       |
The findings of this study are consistent with those from the few studies that examined consumer content on social media related to handwashing. Handwashing was a common theme present in YouTube videos related to COVID-19 specifically [41–44], however existing studies simply noted presence or absence of a number of themes rather than level of comprehensiveness. Studies of handwashing content on other social media platforms are sparse and varied. For instance, one study examined social media use and other characteristics as predictors of self-reported handwashing. The findings indicated that gender and number of children were predictors of handwashing moderated by the amount of time one spends on social media [45]. Others examined use Twitter to bolster dialogue at a professional conference [46] or to measure behaviors and sentiment related to COVID-19 [47].

This study has limitations that should be mentioned. The design was cross-sectional and the sample is small, which limits generalizability. Further, any study of social media is limited by the constant fluctuation in information. In addition, the search results attained did not adjust for algorithms, as they are not made public. TikTok is an emerging social media platform, with far fewer published studies on content than others (e.g. YouTube, Twitter, Facebook, Instagram). While the methods used in this study were based on several prior research studies [36–39], emerging research will may reveal methods that lead to greater generalizability of results. On TikTok, there is no way to account for a viewer who has not watched the complete video. Despite having several limitations, this study addresses a gap in the literature related to handwashing videos on a highly popular social media networking service.

While the effort to promote an important behavior is commendable, lack of comprehensive information could negate efforts to provide information and raise awareness. In promoting health on TikTok, a challenge is to work within time constraints of short videos to provide comprehensive messaging. In an era of information abundance, an ideal scenario for public health messaging would be one whereby professionals form partnership with content creators to inform campaign efforts and overall messaging. Thus, increasing the likelihood for increased accuracy while retaining popularity. Given the high engagement of younger audiences with TikTok, an opportunity exists for demonstrating and encouraging proper handwashing in a population with low rates of handwashing.

**Ethics**

Since human subjects were not involved in this study, it was not reviewed by the Institutional Review Board (IRB) at William Paterson University; the study was deemed exempt by the IRB at Teachers College, Columbia University.

**Authorship statement**

CH Basch and CE Basch conceptualized the study. AP collected the data. JF conducted the data analysis. All authors contributed to the manuscript production.
The World Health Organization. Interim recommendations on hand hygiene in health care facilities. 2020 Nov;25(4):319–20. https://doi.org/10.1016/j.id.2020.08.001. Epub 2020 Sep 3. PMID: 32891583; PMCID: PMC7467877.

Gawande A. On washing hands. N Engl J Med 2004 Mar 25;350(13):1283–6. https://doi.org/10.1056/NEJMp0408025. PMID: 15044638.

Best M, Neuhauser D. Ignaz Semmelweis and the birth of infection control. BMJ Qual Saf 2004;13:233–4.

Brauer M, Zhao JT, Bennitt FB, Stanaway JD. Global access to clean water and basic sanitation. J Plann Educ Res 2020. https://doi.org/10.1016/s0196-6553(98)80011-4. PMID: 9638290.

Swain M, McKinney E, Susskind L. Water shutoffs in older American cities: causes, extent and remedies. J Plann Educ Res 2020. https://doi.org/10.1080/0739456X20904431.

Ballard J. Many Americans don’t always wash their hands. Available from: https://today.yougov.com/topics/lifestyle/articles-reports/2020/01/30/hand-washing-soap-poll-survey/ 2020.

Dancer SJ. Covid-19 exposes the gaps in infection prevention and control. Infect Dis Health 2020;25(4):223–6. https://doi.org/10.1016/j.idh.2020.08.005.

Pittet D, Boyce J. Hand hygiene during patient care: pursuing the Semmelweis legacy. Lancet Infect Dis 2001;1(April):9–30. https://doi.org/10.1016/s1473-3099(09)70295-6.

Haston JC, Miller GF, Berendes D, Andujar A, Marshall B, Cope J, et al. Characteristics associated with adults remembering to wash hands in multiple situations before and during the COVID-19 pandemic - United States, October 2019 and 2020. MMWR Morb Mortal Wkly Rep 2020 Oct 9;69(40):1443–9. https://doi.org/10.15585/mmwr.mm6940a2. PMID: 33031363; PMCID: PMC7561222.

United States Centers for Disease Control and Prevention. When and how to wash your hands. 2020. Available from: https://www.cdc.gov/handwashing/when-how-handwashing.html.

The World Health Organization. Interim recommendations on obligatory hand hygiene against transmission of COVID-19. 2020. Available from: https://www.who.int/publications/m/item/interim-recommendations-on-obligatory-hand-hygiene-against-transmission-of-covid-19.

Aiello AE, Coulborn RM, Perez V, Larson EL. Effect of hand hygiene on infectious disease risk in the community setting: a meta-analysis. Am J Publ Health 2008;98(B):1372–81. https://doi.org/10.2105/AJPH.2007.124610.

Curtis V, Caimcros S. Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. Lancet Infect Dis 2003;3(5):275–81.

Rabie T, Curtis V. Handwashing and risk of respiratory infections: a quantitative systematic review. Trop Med Int Health 2006;11(3):258–67.

GBD 2015 LRI Collaborators. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory tract infections in 195 countries: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Infect Dis 2017 Nov;17(11):1133–61. https://doi.org/10.1016/s1473-3099(17)30396-1. Epub 2017 Aug 23. PMID: 28843578; PMCID: PMC5666185.

GBD Diarrhoeal Diseases Collaborators. Estimates of global, regional, and national morbidity, mortality, and aetiologies of diarrhoeal diseases: a systematic analysis for the Global Burden of Disease Study 2015. Lancet Infect Dis 2017 Sep;17(9):909–48. https://doi.org/10.1016/s1473-3099(17)30276-1. Epub 2017 Jun 1. Erratum in: Lancet Infect Dis 2017 Sep;17(9):897. PMID: 28579426; PMCID: PMC5589208.

Tidwell JB, Gopalakrishnan A, Unni A, Sheth E, Daryanani A, Singh S, et al. Impact of a teacher-led school handwashing program on children’s handwashing with soap at school and home in Bihar, India. PLoS One 2020 Feb 27;15(2):e0229655. https://doi.org/10.1371/journal.pone.0229655. PMID: 32106240; PMCID: PMC7046199.

Early E, Battle K, Cantwell E, English J, Lavin JE, Larson E. Effect of several interventions on the frequency of handwashing among elementary public school children. Am J Infect Control 1998 Jun;26(3):263–9. https://doi.org/10.1016/s0196-6553(98)80011-4. PMID: 9638290.

Tofail F, Fernald LC, Das KK, Rahman M, Jannat KK, et al. Effect of water quality, sanitation, hand washing, and nutritional interventions on child development in rural Bangladesh (WASH Benefits Bangladesh): a cluster-randomised controlled trial. Lancet Child Adolesc Health 2018 Apr;2(4):255–68. https://doi.org/10.1016/S2352-4648(18)30031-2. PMID: 29616235; PMCID: PMC5859216.

Joshi A, Amadi C. Impact of water, sanitation, and hygiene interventions on improving health outcomes among school children. J Environ Public Health 2013;2013:984626. https://doi.org/10.1155/2013/984626. Epub 2013 Dec 28. PMID: 24454415; PMCID: PMC3888759.

Jasper C, Le TT, Bartrum J. Water and sanitation in schools: a systematic review of the health and educational outcomes. Int J Environ Res Publ Health 2012 Aug;9(8):2772–87. https://doi.org/10.3390/ijerph9082772. Epub 2012 Aug 3. PMID: 23066396; PMCID: PMC3447586.

Bowen A, Agboatwalla M, Luby S, Tobery T, Ayers T, Hoekstra RM. Association between intensive handwashing promotion and child development in Karachi, Pakistan: a cluster randomized controlled trial. Arch Pediatr Adolesc Med 2012 Nov;166(11):1037–44. https://doi.org/10.1001/archpediatrics.2012.1181. PMID: 22986783; PMCID: PMC4648282.

Handwashing with soap, critical in the fight against coronavirus, is ‘out of reach’ for billions – UNICEF. Available from: https://www.unicef.org/eap/press-releases/handwashing-soap-critical-fight-against-coronavirus-out-reach-billions-unicef; 2020.

Clark J, Henk JK, Crandall PG, Crandall MA, O’Bryan CA. An observational study of handwashing compliance in a child care facility. Am J Infect Control 2016 Dec 1;44(12):1469–74. https://doi.org/10.1016/j.ajic.2016.08.006. PMID: 27908434.

Smith L, Butler L, Tully MA, Jacob L, Barnett Y, Lopez-Sanchez GF, et al. Handwashing practices among adolescents aged 12-15 Years from 80 countries. Int J Environ Res Publ Health 2020 Dec; 27(18):1-33. https://doi.org/10.3390/ijerph18010138. PMID: 33375506; PMCID: PMC7794697.

There was no funding for this study.

Not commissioned; externally peer reviewed.

Funding

References
Jatrana S, Hasan MM, Mamun AA, Fatima Y. Global variation in hand hygiene practices among adolescents: the role of family and school-level factors. Int J Environ Res Public Health 2021; 18(9):4984. https://doi.org/10.3390/ijerph18094984. Published 2021 May 7.

Lopez-Quintero C, Freeman P, Neumark Y. Hand washing among school children in Bogotá, Colombia. Am J Publ Health 2009 Jan;99(1):94–101. https://doi.org/10.2105/AJPH.2007.129759. Epub 2008 Nov 13. PMID: 19008513; PMCID: PMC2636611.

Maude RR, Jongdeepaisal M, Skuntaniyom S, Muntajit T, Englewood Cliffs, NJ: Learning; 1994. 1993;71(1):23-45. doi:10.1093/101.2196/26392. PMID: 33523823; PMCID: PMC7886372.

Basch CH, Fera J, Quinones N. A content analysis of direct-to-consumer DNA testing on TikTok. J Community Genet 2021 Apr 15. https://doi.org/10.1007/s12687-021-00526-3. Epub ahead of print. PMID: 33860464.

Basch CH, Meleo-Erwin Z, Fera J, Jaime C, Basch CE. A global pandemic in the time of viral memes: COVID-19 vaccine misinformation and disinformation on TikTok. Hum Vaccines Immunother 2021 Mar 25;1–5. https://doi.org/10.1080/21645515.2021.1894896. Epub ahead of print. PMID: 33764283.

TikTok. #SafeguardSplash videos on TikTok. Available from: https://www.tiktok.com/tag/SafeguardSplash; 2021.

Brame CJ. Effective educational videos. Available from: https://cft.vanderbilt.edu/guides-sub-pages/effective-educational-videos/; 2015.

Basch CE, Basch CH, Hillyer GC, Jaime C. The role of YouTube and the entertainment industry in saving lives by educating and mobilizing the public to adopt behaviors for community mitigation of COVID-19: successive sampling design study. JMI. Public Health Surveill 2020 Apr 21;6(2):e19145. https://doi.org/10.19161/jmiphs.2020.19145. PMID: 32297593; PMCID: PMC1715786.

Basch CH, Hillyer GC, Meleo-Erwin ZC, Jaime C, Mohlman J, Basch CE. Preventive behaviors conveyed on YouTube to mitigate transmission of COVID-19: cross-sectional study. JMIR Public Health Surveill 2020 Apr 2;6(2):e18807. https://doi.org/10.19161/jmiphs.2020.18807. Erratum in: JMIR Public Health Surveill. 2020 May 6;6(2):e19601. PMID: 32240096; PMCID: PMC7124952.

Ortiz-Martinez Y, Aristizábal-Agudelo A, Arroyo-Nisperuza Y, Niño-Mendoza J, Sotomayor-Hernández A, Moreno-Uparela S, et al. Evaluation of educational content of YouTube videos focused on hand hygiene: the need for professional communication. J Hosp Infect 2019 Nov;103(3):356. https://doi.org/10.1016/j.jhin.2019.03.016. Epub 2019 Apr 3. PMID: 30953680.

Zhang SX, Graf-Vlachy L, Looi KH, Su R, Li J. Social media use as a predictor of handwashing during a pandemic: evidence from COVID-19 in Malaysia. Epidemiol Infect 2020 Oct 23;148:e261. https://doi.org/10.1017/S0950268820002575. PMID: 33092675; PMCID: PMC7653491.

Martischang R, Tartari E, Kilpatrick C, Mackenzie G, Carter V, Castro-Sánchez E, et al. Enhancing engagement beyond the conference walls: analysis of Twitter use at #ICPIC2019 infection prevention and control conference. Antimicrob Resist Infect Control 2021 Jan 25;10(1):20. https://doi.org/10.1186/s13756-021-00891-1. PMID: 33494810; PMCID: PMC7830043.

Jang H, Rempel E, Roth D, Carenini G, Janjua NZ. Tracking COVID-19 discourse on twitter in North America: infodemiology study using topic modeling and aspect-based sentiment analysis. J Med Internet Res 2021 Feb 10;23(2):e25431. https://doi.org/10.2196/25431. PMID: 33497352; PMCID: PMC7879725.