CASE STUDY

Exploring nurses' online perspectives and social networks during a global pandemic COVID-19

Lisa O'Leary BA, MA, PhD Lecturer[1] | Sonja Erikainen PhD Research Fellow[2] |
Laura-Maria Peltonen PhD, MNSc, RN Clinical Lecturer[3] | Wasim Ahmed BA, MSc, PhD
Senior Lecturer in Digital Business[4] | Mike Thelwall BSc, PhD Professor[5] |
Siobhan O'Connor BSc, RGN, PhD Lecturer[6]

[1] School of Health and Social Care, Edinburgh Napier University, Edinburgh, UK

[2] Centre for Biomedicine, Self and Society, Usher InstituteThe Edinburgh of University, Edinburgh, UK

[3] Department of Nursing Science, University of Turku, Turku, Finland

[4] Business School, University of Stirling, Stirling, UK

[5] Faculty of Science and Engineering, University of Wolverhampton, Wolverhampton, UK

[6] School of Nursing and Midwifery, National University of Ireland Galway, Galway, Ireland

Correspondence
Siobhan O'Connor, School of Nursing and Midwifery, National University of Ireland Galway, Moyola Building, Upper Newcastle, Galway, Ireland.
Email: s.oconnor@nuigalway.ie

Abstract

Objectives: Examine the online interactions, social networks, and perspectives of nursing actors on COVID-19 from conversations on Twitter to understand how the profession responded to this global pandemic.

Design: Mixed methods.

Sample: Ten-thousand five-hundred and seventy-four tweets by 2790 individuals and organizations.

Measurements: NodeXL software was used for social network analysis to produce a network visualization. The betweenness centrality algorithm identified key users who were influential in COVID-19 related conversations on Twitter. Inductive content analysis enabled exploration of tweet content. A communicative figurations framework guided the study.

Results: Nursing actors formed different social groupings, and communicated with one another across groups. Tweets covered four themes; (1) outbreak and clinical management of the infectious disease, (2) education and information sharing, (3) social, economic, and political context, and (4) working together and supporting each other.

Conclusion: In addition to spreading knowledge, nurses tried to reach out through social media to political and healthcare leaders to advocate for improvements needed to address COVID-19. However, they primarily conversed within their own professional community. Action is needed to better understand how social media is and can be used by nurses for health communication, and to improve their preparedness to be influential on social media beyond the nursing community.

KEYWORDS
communicable diseases, coronavirus, COVID-19, infectious disease, nursing, pandemics, social media, Twitter

1 | INTRODUCTION

Infectious diseases pose a serious threat to human health. The SARS-CoV-2 virus, commonly known as COVID-19, was identified in China towards the end of 2019 (Wang et al., 2020). A pandemic was declared by the World Health Organization (WHO) on March 11, 2020. As of June 8, 2021, over 172 million cases of the infection have been reported, with more than 3.7 million deaths worldwide (World Health Organization, 2021). Public health measures such as testing, contact tracing, and travel restrictions were introduced to control the disease and minimize its impact on population health, the economy, and wider society (Heymann & Shindo, 2020). Mass vaccination programs to protect the public are now underway. However, low- and middle-income countries are lagging behind due to a lack of investment and infrastructure (Thanh Le et al., 2020).

The public health crisis led to significant challenges with healthcare systems globally. This included a shortage of Personal Protective Equipment (PPE) that endangered healthcare workers such as nurses (World Health Organization, 2020), and additional stress and anxiety leading to burnout among nurses from working in hazardous conditions (Gennaro, 2020; Jun et al., 2020). Nurses working in community settings also experienced verbal and physical abuse from people who saw them as a virus-spreading threat (Gilroy, 2020). Furthermore, many healthcare workers were infected with and lost their lives from COVID-19 (Erdem & Lucey, 2021). These challenges were especially acute during the early stages of the pandemic, which was characterized by scientific, governmental, and social uncertainty. Studies have looked at specific aspects of nursing during COVID-19 such as working in palliative care (Kates et al., 2021), preventing delirium in critically ill patients with the virus (Ozga et al., 2020), or reacting to hero narratives attributed to nurses during the pandemic (Halberg et al., 2021). Yet, none have taken a comprehensive overview of the challenges faced by the nursing profession and how it responded to this public health emergency.

1.1 | Communication in nursing

Nursing communication has traditionally focused on face-to-face interactions with patients, families, and other healthcare professionals or written forms of communication documented in patient notes or electronic medical records (McCabe, 2013). Numerous conceptual models and theories explaining these processes exist such as Peplau's Theory of Interpersonal Relations (Peplau, 1991), the Humanistic Nursing Theory (Paterson & Zderad, 1976), and more recently the Contac-d model (van Manen et al., 2021). As contemporary society embraces digital technologies, ways in which nurses communicate using digital media are being proposed. Nonetheless, this tends to focus on conventional stakeholders, that is, patients and healthcare professionals (Wagg et al., 2018). Alternative models of communication may be necessary when nurses need to reach out to influence patients, the public, or policy makers, particularly in times of crisis when the situation is changing fast, and information is rapidly evolving. Nurses are increasingly using digital media for real-time health communication and promotion (Gabarron & Wynn, 2016). Hence, communication theories and frameworks from other disciplines may be useful to employ to understand the complexities of this process.

1.2 | Communicative figurations framework

Hasebrink and Hepp (Hasebrink & Hepp, 2017) proposed a new conceptual framework called *communicative figurations*, to further our understanding of the relationship between media-related communicative practices as an individual and as a collective configuration of actors within a particular social domain. This is explored through three concepts. Firstly, the "constellation of actors" which is the network of individuals who communicate with each other about a related interest. Secondly, the "relevance frames" which defines the topic of interest and the characteristics of this social domain. Thirdly, the "communicative practices" are the tools and techniques, intertwined with other social practices, that form the basis of generating and sharing information about the social domain. This framework allows for a more holistic appreciation of mediatization theory which argues that the media, particularly mass media, can shape the processes and dialogues of political and social communication that influence present-day society (Corner, 2018). It is particularly useful when examining social media, where both individual and collective communicative practices converge in digital spaces. Here, communities of users create, share, and engage with media content to make sense of and take action on various issues (Lutkenhaus et al., 2019), but the communicative figurations framework has yet to be employed in nursing. The term nursing "actor" is utilized in this study to refer to the various stakeholder groups within the profession that perform distinct roles in clinical practice, education, research, policy, and regulation, and therefore have unique perspectives on nursing.

1.3 | Research aims

The online perspectives of nurses from around the world, and with varying professional backgrounds, could provide valuable insights into nurses' social media behavior, the challenges faced during the early stages of COVID-19, and how the nursing profession responded to this global pandemic. Furthermore, understanding how nurses communicate online could inform how the profession might utilize social media in the future to respond quickly to outbreaks of infectious disease and other public health crises. This may assist nurses to better engage with the public, support nursing education, research, and professional practice, and influence policy via these digital platforms. This study, guided by the communicative figurations framework and its three core concepts, aims to:

1. Examine nursing actors' online interactions and social networks during COVID-19 related conversations on Twitter during the early stages of the pandemic.
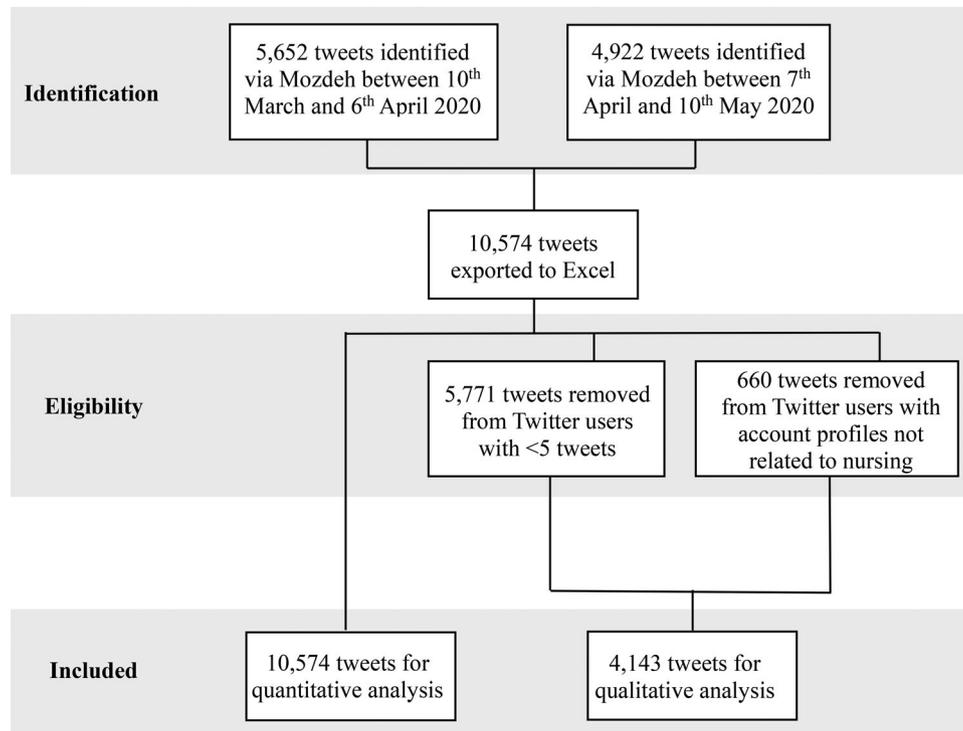
FIGURE 1 Flow chart of the tweet sampling process

2. Explore the perspectives of nursing actors on the early stages of COVID-19 via tweets posted online.

2 | METHODS

2.1 | Design and sample

A mixed methods study utilizing a sequential explanatory design was employed (Bowen et al., 2017). This comprised two phases: (1) a quantitative analysis of Twitter data about COVID-19 posted by nursing actors, and (2) a qualitative exploration of tweets related to COVID-19 made by the nursing profession. The qualitative phase elaborated on the quantitative data by providing a more detailed analysis of the most common topics and perspectives discussed by nursing actors in the early stages of the pandemic. The sample was drawn from English language tweets, posted from March 10, 2020 to May 10, 2020, to reflect how nursing actors used social media as a new means of communicative practice to rapidly respond to a public health emergency in its early stages.

2.2 | Data collection

A software program called Mozdeh (http://mozdeh.wlv.ac.uk) was used to access the Twitter application program interface to collect English-language tweets using four keywords (coronavirus, "corona virus",

Covid-19, and Covid19). These were filtered to remove duplicates and near-duplicates, giving 7,427,918 unique English-language COVID-19 tweets. The tweets were processed to identify those containing the words "nurse" or "nurses". The term "nursing" was not included because it is often used to refer to activities not by nurses, for example, nursing a hangover, baby, or cold. This subset of data was searched for the term "nurs" in the Twitter username, as it was more likely these accounts were related to people that self-identified as nurses or nursing related organizations. This final dataset comprised 10,574 tweets which were exported to Microsoft Excel (http://www.microsoft.com) for further screening (see Figure 1).

Twitter usernames were sorted and associated tweets counted. Those with less than five tweets were removed (n = 5771) for the qualitative study, as it was hypothesized these were less likely to be nurses or nursing organizations and the quality of the online content posted could be less relevant. In addition, the resources available for qualitative coding were limited, so a pragmatic decision was taken to focus on what was perceived to be the best quality Twitter data. This subset of data contained a manageable number of unique usernames. These were cross-checked manually against the Twitter account profile to determine the geographic location of each user and gauge the type of nursing actor. In some cases, the geographic region was not listed. In others, the Twitter profile descriptions were too vague to allocate them to a specific nursing actor role and so these tweets (n = 660) were also removed. Therefore, the final dataset for qualitative analysis comprised 4143 tweets (39%).

2.3 | Data analysis

For the initial quantitative phase, the full Twitter dataset (10,574 tweets) was imported into the professional version of NodeXL (https://nodexl.com/, release code: +1.0.1.428+) (Ahmed & Lugovic, 2019). Social network analysis was performed to produce a network visualization. The users were grouped using the Clauset-Newman-Moore algorithm (Clauset et al., 2004) which shows clusters of users who communicate with each other frequently, forming a unique group within a network. The betweenness centrality algorithm (White & Borgatti, 1994) was also used. This is a measure from graph theory that indicates a person's role in enabling information to pass from one part of a network to another via the shortest path. This allowed for the identification of key nursing actors in the social media network who were influential in COVID-19 related conversations on Twitter. The most frequently occurring hashtags were also examined.

For the qualitative phase, inductive content analysis was used on tweets posted online to explore the perspectives of nursing actors on COVID-19. The three phases of preparing, organizing, and reporting were followed. Only manifest content was used given the challenges of interpreting latent content [hidden meanings] from social media data (Elo & Kyngäs, 2008). The unit of analysis was any term related to COVID-19. Detailed reading of the tweets was undertaken by four authors (L.O., S.E., L.P., S.O.) to classify the data into content and then higher order categories (see Appendix A). N-Vivo 10.0 and Microsoft Excel were employed to facilitate the analyses.

2.4 | Rigor and reflexivity

Screening and analysis of the quantitative social network data was undertaken by WA using NodeXL. This was checked and validated by SO and LO. NodeXL is used extensively in health research and clearly discloses the algorithms, assumptions, and techniques it uses to analyze data (Ahmed & Lugovic, 2019; Probst & Peng, 2019; Riddell et al., 2017). The four dimensions of qualitative rigor (i.e., trustworthiness) were adhered to (Lincoln & Guba, 1985; Noble & Smith, 2015). Robust data collection and analysis methods, examination of negative data, and periodic peer debriefing were used. Coding clinics were also held to cross-check the qualitative analysis. Data were triangulated via different types of nurses and nursing organizations discussing COVID-19 on Twitter. Open social media datasets and freely available software programs also enhanced the study's rigor. Researcher reflexivity was heightened as data analysis was undertaken, discussed, and cross-checked by multiple authors from different scientific disciplines (Palaganas et al., 2017).

2.5 | Ethical considerations

Ethical guidance specific to social media research was followed (Townsend & Wallace, 2016). Favorable ethical opinion was obtained from a university ethics committee (reference ID: Staff179).

3 | RESULTS

3.1 | Phase one: Social media networks and interactions

A total of 10,574 tweets on COVID-19 posted by 2790 individuals or organizations were extracted from Twitter. The network visualization in Figure 2 represents nursing actors that were tweeting about the infectious disease. Each colored circle represents a unique Twitter user within the social network, and the lines connecting users indicate interactions such as a reply or mention. This shows nurses formed several different groups, and communicated with one another across groups. Twitter users, and their top tweets, words, and word pairs, who were most influential in the early stages of COVID-19 conversations amongst nursing actors are illustrated in Table 1, ranked by betweenness centrality. Individuals who ranked highly, such as those located in the United States or the United Kingdom, with some representation from Switzerland, Australia and Nigeria, may be information gatekeepers in the social network. National and international nursing organizations were highly represented along with nurse leaders, educators, and a learning disability nurse as some of the most influential users. The top hashtags across all Twitter users, excluding target hashtags (#covid19, #covid_19, #covid, #pandemic, #nurses, and #nursing), were "#ppe" (25 tweets), "#protectnurses" (30 tweets), and "#getmeppe" (25 tweets).

### 3.2 | Phase two: Sample characteristics

The qualitative phase analyzed 4143 tweets (39%). The majority came from individuals or organizations positioned in the United States (53.1%) and the United Kingdom (22.4%) (see Table 2). Almost one-third of the tweets analyzed were posted by Twitter users self-reported to be registered nurses (30.1%), another third by nurse and patient organizations (14.3%), nurse specialists and consultancy services (11.7%), and informal nursing networks (10.4%).

3.3 | Phase two: Key COVID-19 related themes

Four overarching themes emerged from the discussions that nursing actors had on Twitter about COVID-19. These were: (1) outbreak and clinical management of the infectious disease, (2) education and information sharing, (3) social, economic, and political context, and (4) working together and supporting each other. Each theme had a number of sub-themes, detailed below. Tweets to support each theme and sub-theme can be found in Table 3.

3.3.1 | Outbreak and clinical management of the infectious disease

Here, three sub-themes emerged: (a) prevalence and spread, (b) testing for, and (c) clinical disease management of COVID-19 infections. Many tweets focused on sharing statistical information on regional
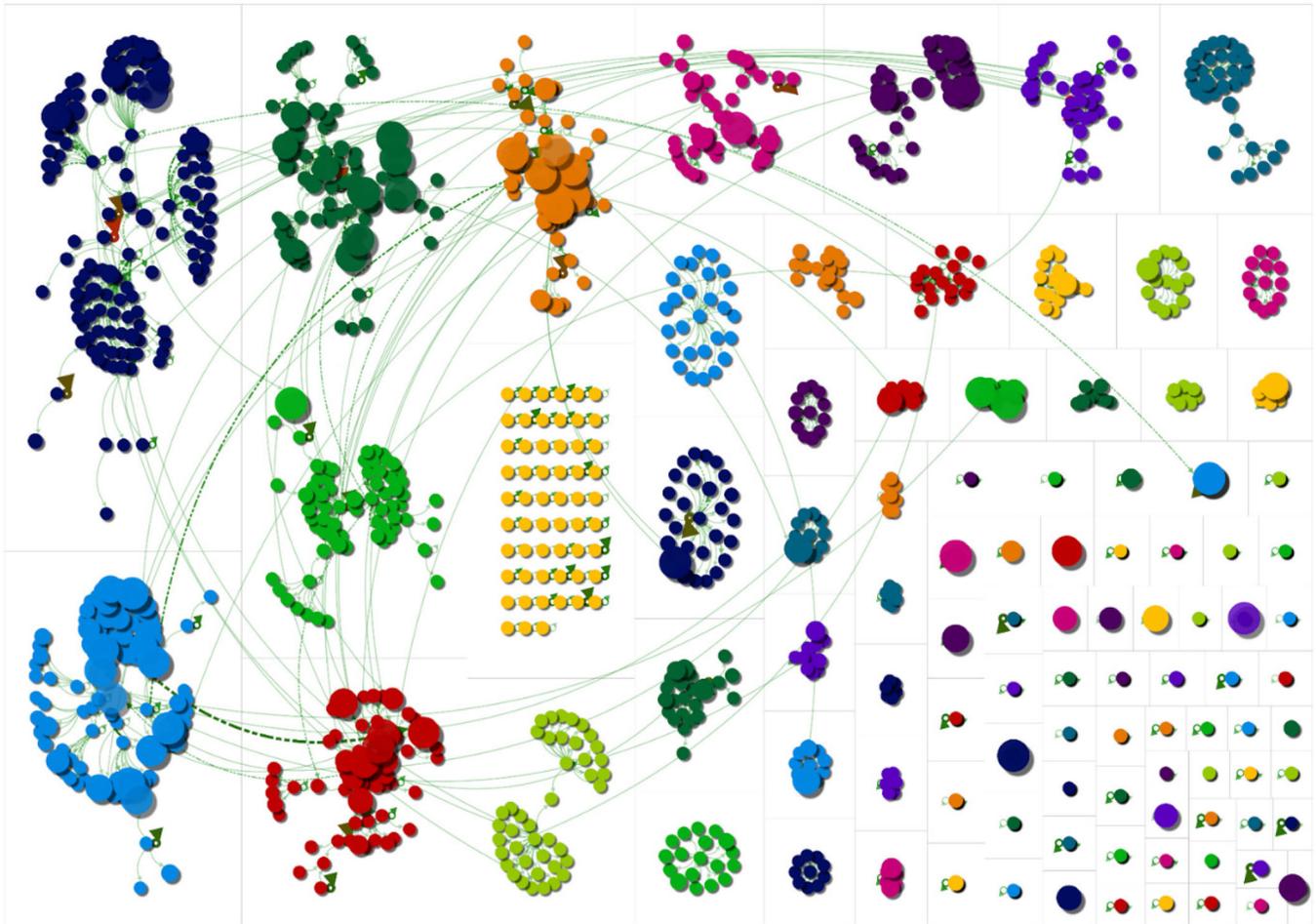
FIGURE 2 Network visualization of nursing actors tweeting about COVID-19

prevalence of cases and deaths connected with COVID-19. Tweets about the international spread of the virus were accompanied with commentaries on controlling its transmission via social distancing, staying at home, and washing one's hands.

The development and implementation of COVID-19 testing, including the progress and delivery of public testing programs, in different national contexts were discussed. Many tweets expressed concerns about testing effectiveness. Tweets relating to strategies for prevention, treatment, cure, and management of COVID-19 symptoms and patient outcomes were also posted. The impact of the infectious disease on hospitalizations, morbidity, and mortality was expressed, as was the need to provide holistic care, and the right to be treated with dignity and die with comfort.

Many tweets concerned generic changes to care delivery that were provoked by the global pandemic. This included nurses adapting their practice to meet patients' needs and work in more challenging environments. For instance, managing relationships between healthcare professionals, patients, and their families where close physical contact and social interaction was identified as high risk. The move to more digital forms of healthcare was another notable change. Digital platforms such as mobile apps, social media, telehealth, and virtual clinics were rec-

ognized as potentially beneficial to healthcare delivery and the patient experience during COVID-19.

3.3.2 | Education and information sharing

This theme had two subthemes: (a) sharing information and resources, and (b) nursing education and students. The quality of information shared about COVID-19 varied from evidence-based knowledge from authoritative sources such as nursing associations, public health organizations, and published scientific articles, to personal experiences. An array of information on research developments, to practical guidance around managing different aspects of the virus was shared. Nurses actively encouraged others to share information on social media to enable wider dissemination. Some nursing actors shared perspectives that declared COVID-19 to be a fake pandemic or framed it as being made and released by the Chinese government, while others focused on challenging misinformation and conspiracy theories. It was mentioned how nurses and nursing students should have access to evidence based and credible sources of information to inform their response to the pandemic.

TABLE 1 Accounts of the most influential Twitter users (betweenness centrality)

Account type/user	Location	Followers	Account tweets	Top hash tags in tweets	Top words in tweets	Top pair words in tweets	
International Nursing Network	Switzerland	18,931	3,576	covid19, nurses, coronavirus, nursing, personal protective equipment, coronavirus, healthcareworkers, virus, ppe, africa	#covid19, icn, #nurses, more, ceo, [icn ceo name], webinar, national, president, together	ceo,[icn ceo name] icn,ceo president,[icn president name] https,t t,co icn,president	lack, #personal protective equipment #covid19, infection infection, rates rates, deaths
National Professional Nursing Association	USA	113,382	13,227	covid19, nurses, getmeppe, thanksnurses, ppe, anacovid19chat, caresact, covid19pandemic, heroesshinebright, epwchat	#covid19, nurses, #nurses, pandemic, workplace, thanks, foundation, workers, critical, ppe	#covid19, pandemic american, nurses nurses, foundation foundation, coronavirus #nurses, frontlines	frontlines, #covid19 spread, #covid19 #covid19, #getmeppe fear, retaliation right, report
Professor of Nursing	Australia	11,144	74,918	Covid, covid19, covid_19, children, immunity, nursinginacrisis, nationalism, populism, othering, collaboration,	covid19, covid, covid_19, children, immunity, nursinginacri-sis, nationalism, populism othering, collaboration	#covid,19 covid,19 via, hubjhu 19, via via, youtube	via, conversationedu such, amazing amaz-ing,colleagues colleagues, working working, hard
Nursing Magazine	UK	75,536	34,145	covid19, covid_19, covid, nhs, covid19pandemic, ppe, bame, covid19uk	Nurses, 19, nursing, covid, #covid19, pandemic, care, nurse, free, during	covid, 19 nurs-ing,[magazine name] nursing, [magazine name] mental, health find, out	19, pandemic critical, care free, #covid19 during, covid well, being
Nurse Educa-tor/Consultant	USA	6,359	77,840	covid19, medtwitter, covid, coronavirus, hospital, nursing, fail, free, healthcare	#covid19, #medtwitter, #covid, 19, via, u patients, #coronavirus, #hospital	#covid, 19 #medtwitter, #covid19 outdoor, shoes re, #covid19 mtnmd, jgillenwatermd	rapid, tests #covid19, patients #scholastic, releases releases, #free #free, daily
Learning Disability Nurse	UK	1,936	10,443	covid19, pandemic, studentnurses, ldnursing, studentnurse, nursing, publichealth, healthpolicy, student, medics	#covid19, people, health, #pandemic, pandemic, need, westu-dentnurse, weldnurses, more, support	#covid19, #pandemic #covid19, pandemic during, #covid19 response, #covid19 graduate, entry	entry, profession #studentnurse, #covid19 public, health don,t #studentnurses, enter
Nursing Union and Professional Body	UK	4,377	129,195	covid19, covid, itcantwait, covid_19, [prime minister name], coronavirus, nursesweek, nurseproud, vaccine	#covid19, 19, coronavirus, covid, #covid, more, health, s, now, nursing	covid, 19 total, cases #covid19, #nurses frontline, workers sadly, died	health, social care, workers #covid19, #coronavirus #nurse, #healthcare

TABLE 1 (Continued)

Account type/user	Location	Followers	Account tweets	Top hash tags in tweets	Top words in tweets	Top pair words in tweets	
Professor of Nursing	USA	705	5,088	Resilience	covid19, [dean of school of nursing name], pandemic, protection, practice, based, panic, amid, [school of nursing name], good	amid,covid19 covid19, pandemic nurse,leaders preven- tion,protection protec- tion,preparation	preparation, practice practice, science science, based based, interventions interventions, panic
Nurse Educator	USA	313	7,424	covid19, coronavirus, wallofshame, racist, politicalpoints, tds, corona, wuhanvirus, sarsvirus, victorygardens	S, #covid19, now, via, youtube, Chinese, cases, realdon- aldtrump, treatment, italy	#covid19, pandemic died, covid mortality, rate teamtrump, foxnews #covid_19, #coronavirus	care, workers #studentnurse, #covid registered, nurse task, force care, during
Professional and Social Networking Site for Nurses	Nigeria	12,514	34,044	covid19, covid19nigeria, clap, coronavirus, covid-19, covid, nurses, ppe, prayer, staysafe	19, covid, coronavirus, nurses, #covid19, Nigeria, state workers, test, healthy	covid, 19 19,nigeria health, workers positive, coronavirus frontline, workers	19, ncdc fight, against april, 2020 response, novel novel, covid

TABLE 2 Sample characteristics of tweets from the qualitative phase

Country	N	%	Reported role	N	%
USA	2198	53.1	Registered nurse	1246	30.1
UK	928	22.4	Nursing and patient organization	590	14.3
Canada	391	9.4	Nurse specialists and consultants	482	11.7
Nigeria	218	5.3	Nursing network (informal)	429	10.4
Australia	96	2.3	Nursing journal or library services	328	7.9
Ireland	90	2.2	Nursing student	264	6.4
Switzerland	32	0.8	School of nursing	176	4.3
New Zealand	24	0.6	Professor	172	4.2
France	22	0.5	Nurse scientist	148	3.6
India	22	0.5	Retired nurse	126	3.0
South Africa	18	0.4	Patient safety advocate	94	2.3
Information not available	104	2.5	Private home care and third sector	62	1.5
			Regulator	20	0.5
			Information not available	6	

The impact of the pandemic on higher education and the organization of nursing education was notable in discussions on Twitter. Tweets focused on preparing nurses to transition to digital models of healthcare and emphasizing the need for more specialist knowledge and skills in critical care. Nursing students' also expressed concerns about their university studies, graduating, and going into clinical practice.

3.3.3 | Social, economic, and political context

Three sub-themes were evident here: (a) politicization and leadership, (b) resource use and shortages in healthcare, and (c) the pandemic's social impact. Many tweets from nursing actors indicated a critical approach to local and national leadership during the pandemic. There

TABLE 3 Tweets about COVID-19 from nursing actors

Theme 1. Outbreak and clinical management of the diseaseSubtheme 1.1: Prevalence and spread of the virus

"#COVID19 cases increase exponentially. #China 1/23: 444 cases 1/30: 4,903 2/6: 22,112 #Italy 2/22: 62 2/29: 888 3/6" **(Registered nurse, USA)**
"Ontario has just announced 100 new positive #coronavirus tests and 1 additional death. That makes it 688 cases for the province and 9 deaths. Canada's total stands at 2,892" **(Nursing network, Canada)**
"Taiwan sets example for world on how to fight coronavirus" (Registered nurse, Canada)
"Excellent move by Government to help #FlattenTheCurve and #Stopthespread of #covid19" **(Nursing network, New Zealand)**

Subtheme 1.2: Testing for the virus

"We should be testing for #COVID19 just as commonly as we test for the flu and strep" **(Registered nurse, USA)**
"there are further calls to step up testing so health workers who are clear of the coronavirus can get back to work" **(Registered nurse, UK)**

Subtheme 1.3: Clinical disease management of COVID-19 infections

"It's important to remember that people are still people, not just #COVID19 cases or patients. People, surrounded by other people, and all that comes with it! People-first language still matters." **(Registered nurse, UK)**
"Covid out there reinforcing how important it is to have those hard conversations with loved ones about resuscitation and end of life care choices #DontWait" **(Nursing student – PhD, USA)**
"the role of palliative care had to brutally be adapted … there is no relationship with the patient and his family … all hospitalized patients die and these deaths are linked to a traumatic and startling psychological experience" **(Nursing student, New Zealand)**

Theme 2. Education and information sharingSubtheme 2.1: Sharing information and resources

"#ChineseVirus [that] was made and released by the government of China." (Registered nurse, USA)
"Our guide addresses risk assessment, public education about the virus (including #COVID19 mythbusting and misinformation) (Registered nurse, USA)
"Great resource for seniors and for those who would like to play a part in supporting them during this #COVID19 pandemic" (Professor, Canada)

Subtheme 2.2: Nursing education and students

"September 1892, 1st graduating nursing class. Fast forward to 2020, we are delivering compelling virtual content. Long tradition of quality education moves forward." (Professor, USA)
"It has become apparent that there is a significant lack of understanding about critical care in general and the issues facing critical care nurses, says the chair of the British Association of Critical Care Nurses. #covid19" (Nursing journal or library services, UK)
"It's hard to not talk about this but we feel that the impact it is having on uni/placement should be highlighted" (Nursing student, USA)

Theme 3. Social, economic, and political contextSubtheme 3.1: Politicisation and leadership

"From the start of the crisis (nursing organisation) has been calling for govts to prioritise the support", Our nurses are reporting to work every day knowing that their lives are at risk because federal agencies gave the green light to substandard protection" (Nursing and patient organisation, USA)
"We should've embraced humanity after Hitler. Instead, #COVID19 is the ruthless guard, & the lack of vents is a death chamber march. No disrespect meant. We learned NOTHING" (Registered nurse, USA)
"The preventive measures about #COVID19 is quite low, by now they should have imposed a travel ban." (Nursing network, Nigeria)
"Yesterday I wrote to .. to ask @… to share some ventilators with NY and 140 were sent today. So proud to live in a caring state, where we look out for our fellow humans. Thank you …for your leadership" (Registered nurse, USA)

Subtheme 3.2: Resource use and shortages in healthcare

"tell President Trump: Healthcare Workers Need PPE NOW." (Nursing and patient organisation, USA)
"the impossible choices we will be faced with when there are two #COVID19 patients in our care who need ventilators, but there's only one ventilator" (Registered nurse, USA)
"As#Nurses we're shocked to find out that any #NHS Trust is refusing to pay their outsourced workers sick leave and is putting #PatientSafety at risk" (Nursing and patient organisation, UK)
"It is outrageous for the (name of organisation) to tell hospitals that nurses and other health care workers don't need the maximum protective gear to prevent them from getting sick during this pandemic" (Nursing and patient organisation, USA)
"Unfortunately, the employer has decided to continue disregarding basic health and safety precautions" (Nursing and patient organisation, Canada)

Subtheme 3.3: Pandemics' social impact

"The Covid-19 pandemic is thought to have caused the largest sudden rise in the number of unemployed in the history of the state" **(Registered nurse, Ireland)**
"Paying hospitals to care for the uninsured based on Medicare infrastructure? The Administration is waking up to urgent need" **(Professor, USA)**
"This looks promising. But just a reminder: it does nothing for those who can't afford or can't access internet." **(Nursing student - MSc, Canada)**

Theme 4. Working together and supporting each otherSubtheme 4.1: Strategies for building resilience and coping skills

"In these unusual times, it's easy to feel helpless. But you're not. Here are 10 specific things you can do to help" **(School of Nursing, USA)**
"Here are some great tools & resources for everyone related to anxiety #self-isolation #self care" (Registered nurse, Australia)
"We use iPads to help families connect with patients in our older adult unit ..FaceTime and Family videos can be utilized for emotional support and reduce risk" **(Assistant Professor, Canada)**

(Continues)

TABLE 3 (Continued)

Subtheme 4.2: A sense of "we're all in this together"
"Covid19 knows no boundaries as we are all in this together as we battle this pandemic" (Nursing network, Nigeria)
"To all the healthcare workers putting service above self, I thank you, your patients thank you, the whole world thanks" (Nurse specialists and consultants, France)
"From the health care workers and first responders at the forefront of #COVID19,,,care to all of those staying home to save lives, we thank you. Together we're dedicated to getting through this global health crisis." (School of Nursing, USA)
"Thanks to all the nurses who have reached out to help with the #COVID19 pandemic" (Regulator, Canada)
"President (name of organisation) urges the world to listen to our #nurses on the frontline and follow @Dr..' advice to fight, unite and ignite. Together we will beat #cornavirus!" (Nursing Organisation, Switzerland)

Theme 4. Working together and supporting each otherSubtheme 4.3: Healthcare volunteering and donations
"More than 7,000 ex nurses answer Covid-19 call to return to service" (Nursing journal of library services, UK)
"I've signed up to do an extended 6-month placement, to help with the COVID19 outbreak, for the duration of my degree." (Nursing student society, UK)
"Coronavirus crisis sees a volunteer army of thousands offer help to healthcare workers and the elderly" (Private home care and third sector, India)

were requests for a better response by government and healthcare organizations in the struggle against COVID-19. There were less comments that praised leaders, although some mentioned a compassionate approach from those that shared healthcare supplies.

The shortage of equipment and other resources focused predominantly on taking action to increase access to PPE by manufacturing more masks and gowns. Nurses were forced to create alternatives in the absence of standardized PPE such as using bandanas, toy glasses, bin liners, and recycled masks. Health professionals getting fired or suspended without pay for wearing their own PPE, despite having underlying medical conditions, was also mentioned. Furthermore, there were expressions of fear at the implications of speaking out against an employer for not providing enough protection for nurses. Some organizations were advocating for healthcare workers and frequently mentioned #WeNeedPPE.

Nursing actors also commented on shortages of ventilators and intensive care beds, with some raising the ethical dilemmas this caused. There were mentions of how the health system focused on profit over people, referring to nurses' deaths or sickness, or instilling fear, and limiting nurses' capacity to tackle the virus. The deployment of nursing students, retired nurses or others who had left the profession was noted as an organizational strategy to overcome resource limitations. However, some strategies conflicted with employment rights and health and safety standards such as nurses being expected to work during annual leave and unpaid overtime. In addition, tweets mentioned employers disregarding basic health and safety precautions in certain countries and that sometimes nurses were expected to relinquish their rights to follow clinical guidelines during the pandemic.

Nursing actors also discussed how COVID-19 exacerbated existing social inequalities such as the inability of homeless people to follow shelter at home mandates, putting them at a disadvantage. The lack of equitable access to new and emerging healthcare treatments and digital platforms was also identified.

3.3.4 | Working together and supporting each other

The final theme included three sub-themes: (a) strategies for building resilience and coping skills, (b) a sense of "we're all in this together",

and (c) healthcare volunteering and donations. Strategies for building resilience and coping with the pandemic encompassed the practical and emotional challenges of providing care to patients and families. Tweets provided explanations on normal emotions, stress, and how to cope with these. Staff retention and suicide was also recognized as an issue within the nursing profession during COVID-19.

The courage of frontline healthcare workers and the importance of auxiliary staff in care provision was acknowledged in tweets. There were calls for more financial reward and recognition for them. Healthcare workers were labelled as "warriors" and "unsung heroes". The clap for carers tradition and tokens such as free parking, free meals, and other personal and collective gestures were used to applaud health professionals for their work. Tweets endorsing the view of "we're all in this together" and calls for "all hands-on deck" were dominant, voicing empowerment by sharing the burden of the pandemic. The loss of nursing and other colleagues due to the virus was also acknowledged online.

Nursing actors shared tweets on fundraising for healthcare equipment or advertised vacancies for health professionals, volunteering, and donations to support the healthcare workforce such as providing money, PPE, and other supplies. In particular, nurses tweeted calls for masks and hand sanitizer to be donated to hospitals and frontline workers. Many also reported contributions by private businesses who gave money, PPE, and equipment such as ventilators.

4 | DISCUSSION

4.1 | Principal findings

This study showed the social networks and interactions of nursing actors on Twitter during the early months of COVID-19. It highlighted discussion hubs, containing nine of the most influential users in the network, as well as smaller more disconnected groups. A number of key perspectives on COVID-19 from nursing actors were also revealed. Nurses recognized a lack of preparedness and control on a macro-level in terms of how governments handled the crisis, highlighting failures in contact tracing systems and lack of PPE. The capacity of healthcare

organizations to protect the safety and rights of nurses and other professionals at work was also questioned. Nursing actors reached out through social media to political and nursing leaders to advocate for change such as using more technology to identify and manage COVID-19. Nurses also critiqued the quality of information available on the global pandemic, reflecting the scientific uncertainty that characterized its early stages. They emphasized the need to distinguish between misleading information versus emerging scientific evidence to inform the public health response. Furthermore, nursing actors used Twitter to voice their pride in the profession and advocate for greater recognition of their role in responding to public health emergencies.

4.2 | Strengths and limitations

A mixed methods approach was adopted that included robust methods of data collection and analysis. Although, the quantitative and qualitative findings were not wholly integrated, the themes and subthemes that emerged in the second phase enabled a more in-depth understanding of COVID-19 related conversations and some of the interactions nursing actors participated in online identified in the first phase. The communicative figurations framework also helped frame the research questions and study design, enabling an exploration of how nursing actors communicated via an online social network and the relevant themes or characteristics that emerged related to the social domain of nursing during COVID-19. This resulted in a better understanding of how Twitter is being used as a new sphere of communicative practice for nurses. The study was conducted by an experienced research team from a variety of scientific disciplines including nursing, sociology, computer science, and social care, who discussed and agreed the interpretation of data. However, as this study focused on the early stages of the pandemic, the data are not representative of later phases or tweets outside of the English language, which may constrain the generalizability of the findings. Self-reported data in Twitter account profiles may be unreliable (Jensen, 2017), hence the categorization of nursing actors and the results should be interpreted with caution. Most Twitters users were from high-income countries whose experiences of COVID-19, digital media access, and social media culture may be different from those in low and middle-income nations.

4.3 | Comparison with existing literature

This study found a lack of preparedness on a macro and meso level by government and healthcare organizations. Hence, some nursing actors took control on a micro-level, adopting creative strategies to protect themselves against the virus such as making their own versions of PPE and calling for donations of equipment from private providers. Similar strategies were found in a study of front-line healthcare staff in the United Kingdom during COVID-19 (Hoernke et al., 2021). Previous studies also identified how limited organizational readiness can affect nurses' capacity to cope with a crisis and lead to burnout and high staff turnover (Corley et al., 2010; Fernandez et al., 2020; Hu et al., 2020;

Wood et al., 2021). These mental health concerns emerged in the current study, because suicidal ideation and a desire to leave the nursing profession were mentioned. This has been emphasized in other recent studies on this global pandemic (Hu et al., 2020; Liu et al., 2020).

The study's findings are also supported by nursing informaticians who called for nurses to embrace digital technologies during the pandemic (Atique et al., 2020). This study added insights into digital practices nurses employed during COVID-19 such as electronic medication management, remotely monitoring patients at home, and providing virtual forms of support to patients. Misinformation on social media and mass media about COVID-19 was also raised by nurses in this study, which was noted previously (Lee et al., 2020). In addition, this study highlighted that nursing actors recommended reliable sources of information and stressed the importance of generating and utilizing scientific evidence. They also encouraged others to share credible information to counteract fake or misleading claims about the virus. In keeping with the findings of this study, others have discussed the changes needed in higher education to prepare nursing students with the knowledge and skills to care for patients with COVID-19 (Dewart et al., 2020). The voices of nursing students who expressed anxiety about working in clinical practice and continuing academic studies was highlighted in this study.

4.4 | Implications for nursing

This study uncovered several implications for nursing research. Firstly, the experiences of nursing actors in low- and middle- income countries needs further exploration as their experiences of COVID-19 may be different. This could be due to prior exposure of other infectious disease outbreaks (Mboussou et al., 2019), poor healthcare infrastructure (Oleribe et al., 2019), and limited access to digital media and online forms of communication (Mutsvairo & Ragnedda, 2019). Secondly, nursing students and nurses working in care homes with older adults were underrepresented in this study. Hence, further research into their perspectives could aid our understanding of the challenges they faced, their response to COVID-19, and how they utilized social media during the pandemic. Thirdly, it could be beneficial to research later phases of the pandemic to identify how nurses responded via social media to changes in scientific evidence, the availability of vaccines (Khubchandani et al., 2021), and other social and political changes that affected the public health response (Jaffe, 2021). Finally, more research could explore how nursing actors use other social media platforms to communicate during times of crisis, as Instagram and TikTok are becoming popular avenues for online health promotion (Basch et al., 2021; Niknam et al., 2021).

While social media research and practice in nursing is gaining momentum, this study showed that nursing actors tended to remain within their professional community when communicating online. This could limit their ability to advocate for change and reach key stakeholders such as policy makers and the public. As social media platforms like Twitter are becoming an increasingly central tool for health promotion, they open up new possibilities for communicative practices that have

the potential to reach and influence large audiences (Niknam et al., 2021). Yet, the restricted scope of nurses' sphere of influence suggests that the ability of nurses to fully leverage the potential offered by social media platforms like Twitter remains limited. This has notable implications for the future of nursing as a digitally engaged health profession capable of informing and shaping public health debates and communication in the digital age (Booth et al., 2021). Thus, more research is needed to understand how nurses can or should use social media effectively and what kinds of communicative practices they should engage in to reach beyond their own professional community, to fully engage with and influence stakeholders digitally. Hence, more education that prepares nursing actors to leverage different social media platforms is necessary to ensure they have the digital and communication skills needed to be influential in healthcare (O'Connor & LaRue, 2021).

As public health nurses are closely involved with their local communities (Vessey & Betz, 2020), they could use social media to reach out to key community groups, particularly those who are vulnerable, to ensure public health advice about controlling infectious diseases such as COVID-19 is widely shared. They could also work with these groups to use various social media platforms to influence local politicians and healthcare leaders to invest in the right infrastructure and resources to limit the transmission and spread of infectious disease. National, regional, and local public health campaigns on social media may also benefit from the expertise of public health nurses, who are attuned to the needs of the different populations in their locality.

5 | CONCLUSION

This study demonstrated how social media enables global health communication and promotion, as it clearly identified how nursing actors communicated using an online platform as an international public health crisis unfolded. It also showed how a range of nursing actors used social media to urge political and nursing leaders to invest in areas of nursing education, research, and practice to help manage the infectious disease. Nurses' contribution to tackling COVID-19 were acknowledged on Twitter and tweets also offered support to the profession. However, nursing actors mainly conversed within their own community on Twitter, potentially limiting their reach and influence during the pandemic. Nurses need to take a more active role in online discussions on healthcare issues, targeting health service and political leaders to advocate for change. More education is also needed to improve nurses' knowledge and skills about how to be influential on social media to help enact positive change.

CONFLICT OF INTEREST
The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT
The raw data used in this article is freely available in the public domain on Twitter (https://twitter.com/), as it is an open, online social media platform.

ORCID
Lisa O'Leary BA, MA, PhD https://orcid.org/0000-0002-7131-2920
Siobhan O'Connor BSc, RGN, PhD https://orcid.org/0000-0001-8579-1718

REFERENCES

Ahmed, W., & Lugovic, S. (2019). Social media analytics: Analysis and visualisation of news diffusion using NodeXL. *Online Information Review*, *43*(1), 149–160. https://doi.org/10.1108/OIR-03-2018-0093

Atique, S., Bautista, J. R., Block, L. J., Lee, J. J., Lozada-Perezmitre, E., Nibber, R., O'Connor, S., Peltonen, L. M., Ronquillo, C., Tayaben, J., Thilo, F. J. S., & Topaz, M. (2020). A nursing informatics response to COVID-19: Perspectives from five regions of the world. *Journal of Advanced Nursing*, *76*(10), 2462–2468. https://doi.org/10.1111/jan.14417

Basch, C. H., Fera, J., Pierce, I., & Basch, C. E. (2021). Promoting mask use on TikTok: Descriptive, cross-sectional study. *JMIR Public Health and Surveillance*, *7*(2), e26392-e26392. https://doi.org/10.2196/26392

Booth, R. G., Strudwick, G., McBride, S., O'Connor, S., & Solano López, A. L. (2021). How the nursing profession should adapt for a digital future. *BMJ: British Medical Journal*, *373*(n1190), n1190. https://doi.org/10.1136/bmj.n1190

Bowen, P., Rose, R., & Pilkington, A. (2017). Mixed methods-theory and practice. Sequential, explanatory approach. *International Journal of Quantitative and Qualitative Research Methods*, *5*(2), 10–27.

Clauset, A., Newman, M. E. J., & Moore, C. (2004). Finding community structure in very large networks. *Physical Review. E, Statistical, Nonlinear, and Soft Matter Physics*, *70*(6 Pt 2), 066111-066111. https://doi.org/10.1103/PhysRevE.70.066111

Corley, A., Hammond, N. E., & Fraser, J. F. (2010). The experiences of health care workers employed in an Australian intensive care unit during the H1N1 Influenza pandemic of 2009: A phenomenological study. *International Journal of Nursing Studies*, *47*(5), 577–585. https://doi.org/10.1016/j.ijnurstu.2009.11.015

Corner, J. (2018). 'Mediatization': Media theory's word of the decade. *Media Theory*, *2*(2), 79–90.

Dewart, G., Corcoran, L., Thirsk, L., & Petrovic, K. (2020). Nursing education in a pandemic: Academic challenges in response to COVID-19. *Nurse Education Today*, *92*, 104471-104471. https://doi.org/10.1016/j.nedt.2020.104471

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

Erdem, H., & Lucey, D. R. (2021). Healthcare worker infections and deaths due to COVID-19: A survey from 37 nations and a call for WHO to post national data on their website. *International Journal of Infectious Diseases*, *102*, 239–241. https://doi.org/10.1016/j.ijid.2020.10.064

Eysenbach, G. (2004). Improving the quality of Web surveys: The checklist for reporting results of internet E-Surveys (CHERRIES). *Journal of Medical Internet Research*, *6*(3), e34-e34. https://doi.org/10.2196/jmir.6.3.e34

Fernandez, R., Lord, H., Halcomb, E., Moxham, L., Middleton, R., Alananzeh, I., & Ellwood, L. (2020). Implications for COVID-19: A systematic review of nurses' experiences of working in acute care hospital settings during a respiratory pandemic. *International Journal of Nursing studies*, *111*, 103637-103637. https://doi.org/10.1016/j.ijnurstu.2020.103637

Gabarron, E., & Wynn, R. (2016). Use of social media for sexual health promotion: A scoping review. *Global Health Action*, *9*(1), 32193-32193. https://doi.org/10.3402/gha.v9.32193

Gennaro, S. (2020). 2020: The Year of the Nurse as Seen Through a Coronavirus Lens. *Journal of Nursing Scholarship*,*52*, 231-232, https://doi.org/10.1111/jnu.12556

Gilroy, R. (2020). *Nurses on coronavirus frontline facing 'abhorrent' abuse from public*. Nursing Times, https://www.nursingtimes.net/news/coronavirus/nurses-fighting-coronavirus-facing-abhorrent-abuse-from-public-20-03-2020/

Halberg, N., Jensen, P. S., & Larsen, T. S. (2021). We are not heroes—The flipside of the hero narrative amidst the COVID19-pandemic: A Danish hospital ethnography. *Journal of Advanced Nursing*, *77*(5), 2429–2436. https://doi.org/10.1111/jan.14811

Hannaford, L., Cheng, X., & Kunes-Connell, M. (2021). Predicting nursing baccalaureate program graduates using machine learning models: A quantitative research study. *Nurse Education Today*, *99*, 104784-104784. https://doi.org/10.1016/j.nedt.2021.104784

Hasebrink, U., & Hepp, A. (2017). How to research cross-media practices? Investigating media repertoires and media ensembles. *Convergence (London, England)*, *23*(4), 362–377. https://doi.org/10.1177/1354856517700384

Heymann, D. L., & Shindo, N. (2020). COVID-19: What is next for public health? *The Lancet.*, *395*(10224), 542–545. https://doi.org/10.1016/S0140-6736(20)30374-3

Hoernke, K., Djellouli, N., Andrews, L., Lewis-Jackson, S., Manby, L., Martin, S., … Vindrola-Padros, C. (2021). Frontline healthcare workers' experiences with personal protective equipment during the COVID-19 pandemic in the UK: A rapid qualitative appraisal. *BMJ open*, *11*(1), e046199-e046199. https://doi.org/10.1136/bmjopen-2020-046199

Hu, D., Kong, Y., Li, W., Han, Q., Zhang, X., Zhu, L. X., … Zhu, J. (2020). Frontline nurses' burnout, anxiety, depression, and fear statuses and their associated factors during the COVID-19 outbreak in Wuhan, China: A large-scale cross-sectional study. *EClinicalMedicine*, *24*, 100424-100424. https://doi.org/10.1016/j.eclinm.2020.100424

Jaffe, S. (2021). Biden unwinds Trump health-care policies. *The Lancet (British Edition)*, *397*(10272), 362–363. https://doi.org/10.1016/S0140-6736(21)00182-3

Jensen, E. A. (2017). Putting the methodological brakes on claims to measure national happiness through Twitter: Methodological limitations in social media analytics. *Plos One*, *12*(9), e0180080-e0180080. https://doi.org/10.1371/journal.pone.0180080

Jun, J., Tucker, S., & Melnyk, B. (2020). Clinician mental health and well-being during global healthcare crises: evidence learned from prior epidemics for COVID-19 pandemic. *Worldviews on Evidence-Based Nursing*,*17*, 182–184, https://doi.org/10.1111/wvn.12439

Kates, J., Gerolamo, A., & Pogorzelska-Maziarz, M. (2021). The impact of COVID-19 on the hospice and palliative care workforce. *Public Health Nursing (Boston, Mass.)*, *38*(3), 459–463. https://doi.org/10.1111/phn.12827

Khubchandani, J., Sharma, S., Price, J. H., Wiblishauser, M. J., Sharma, M., & Webb, F. J. (2021). COVID-19 vaccination hesitancy in the United States: A rapid national assessment. *Journal of Community Health*, *46*(2), 270–277. https://doi.org/10.1007/s10900-020-00958-x

Lee, J. J., Kang, K.-A., Wang, M. P., Zhao, S. Z., Wong, J. Y. H., O'Connor, S., … Shin, S. (2020). Associations between COVID-19 misinformation exposure and belief with COVID-19 knowledge and preventive behaviors: Cross-sectional online study. *Journal of medical Internet research*, *22*(11), e22205-e22205. https://doi.org/10.2196/22205

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Liu, Y. E., Zhai, Z. C., Han, Y. H., Liu, Y. L., Liu, F. P., & Hu, D. Y. (2020). Experiences of front-line nurses combating coronavirus disease-2019 in China: A qualitative analysis. *Public Health Nursing (Boston, Mass.)*, *37*(5), 757–763. https://doi.org/10.1111/phn.12768

Lutkenhaus, R., Jansz, J., & Bouman, M. (2019). Tailoring in the digital era: Stimulating dialogues on health topics in collaboration with social media influencers. *Digital Health*, *5*, 2055207618821521-2055207618821521. https://doi.org/10.1177/2055207618821521

Mackay, M. T., Brown, R. A., Joyce-Mccoach, J. T., & Smith, K. M. (2014). The development of a model of education for casual academic staff who support nursing students in practice. *Nurse Education in Practice*, *14*(3), 281–285. https://doi.org/10.1016/j.nepr.2013.08.005

Mboussou, F., Ndumbi, P., Ngom, R., Kassamali, Z., Ogundiran, O., Beek, J. V., … Impouma, B. (2019). Infectious disease outbreaks in the African region: Overview of events reported to the World Health Organization in 2018 - ERRATUM. *Epidemiology and Infection*, *147*, e307-e307. https://doi.org/10.1017/S0950268819002061

McCabe, C. (2013). *Communication skills for nursing practice* (2nd ed.). Basingstoke: Palgrave Macmillan.

Mutsvairo, B., & Ragnedda, M. (2019). *Mapping the digital divide in Africa: A mediated analysis*. Amsterdam University Press.

Niknam, F., Samadbeik, M., Fatehi, F., Shirdel, M., Rezazadeh, M., & Bastani, P. (2021). COVID-19 on Instagram: A content analysis of selected accounts. *Health Policy and Technology*, *10*(1), 165–173. https://doi.org/10.1016/j.hlpt.2020.10.016

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing*, *18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

O'Connor, S., & LaRue, E. (2021). Integrating informatics into undergraduate nursing education: A case study using a spiral learning approach. *Nurse Education in Practice*, *50*, 102934-102934. https://doi.org/10.1016/j.nepr.2020.102934

Oleribe, O. O., Momoh, J., Uzochukwu, B. S., Mbofana, F., Adebiyi, A., Barbera, T., … Taylor-Robinson, S. D. (2019). Identifying key challenges facing healthcare systems in Africa and potential solutions. *International Journal of General Medicine*, *12*, 395–403. https://doi.org/10.2147/IJGM.S223882

Ozga, D., Krupa, S., Witt, P., & Mędrzycka-Dąbrowska, W. (2020). Nursing interventions to prevent delirium in critically ill patients in the intensive care unit during the COVID19 pandemic-narrative overview. *Healthcare (Basel)*, *8*(4), 578. https://doi.org/10.3390/healthcare8040578

Palaganas, E., Sanchez, M., Molintas, M. V., & Caricativo, R. (2017). Reflexivity in qualitative research: A journey of learning. *Qualitative Report*, *22*(2), 426. https://doi.org/10.46743/2160-3715/2017.2552

Parker, J. M., & Hill, M. N. (2017). A review of advanced practice nursing in the United States, Canada, Australia and Hong Kong Special Administrative Region (SAR), China. *International Journal of Nursing Sciences*, *4*(2), 196–204. https://doi.org/10.1016/j.ijnss.2017.01.002

Paterson, J. G., & Zderad, L. T. (1976). *Humanistic Nursing*. National League for Nursing.

Peplau, H. E. (1991). *Interpersonal relations in nursing a conceptual frame of reference for psychodynamic nursing*. New York: Springer.

Probst, Y. C., & Peng, Q. (2019). Social media in dietetics: Insights into use and user networks. *Nutrition & dietetics*, *76*(4), 414–420. https://doi.org/10.1111/1747-0080.12488

Riddell, J., Brown, A., Kovic, I., & Jauregui, J. (2017). Who are the most influential emergency physicians on Twitter? *The Western Journal of Emergency Medicine*, *18*(2), 281–287. https://doi.org/10.5811/westjem.2016.11.31299

Suominen, H., Zhou, L., Hanlen, L., & Ferraro, G. (2015). Benchmarking clinical speech recognition and information extraction: New data, methods, and evaluations. *JMIR Medical Informatics*, *3*(2), e19-e19. https://doi.org/10.2196/medinform.4321

Thanh Le, T., Andreadakis, Z., Kumar, A., Gómez Román, R., Tollefsen, S., Saville, M., & Mayhew, S. (2020). The COVID-19 vaccine development land-

scape. *Nature Reviews. Drug discovery*, *19*(5), 305–306. https://doi.org/10.1038/d41573-020-00073-5

Townsend, L., & Wallace, C. (2016). *Social media research: A guide to ethics*. University of Aberdeen. https://seenpm.org/social-media-research-guide-ethics/

van Manen, A. S., Aarts, S., Metzelthin, S. F., Verbeek, H., Hamers, J. P. H., & Zwakhalen, S. M. G. (2021). A communication model for nursing staff working in dementia care: Results of a scoping review. *International Journal of Nursing Studies*, *113*, 103776-103776. https://doi.org/10.1016/j.ijnurstu.2020.103776

Vessey, J. A., & Betz, C. L. (2020). Everything old is new again: COVID-19 and public health. *Journal of Pediatric Nursing*, *52*, A7-A8. https://doi.org/10.1016/j.pedn.2020.03.014

Wagg, A. J., Callanan, M. M., & Hassett, A. (2018). The use of computer mediated communication in providing patient support: A review of the research literature. *International Journal of Nursing Studies*, *82*, 68–78. https://doi.org/10.1016/j.ijnurstu.2018.03.010

Wang, C., Horby, P. W., Hayden, F. G., & Gao, G. F. (2020). A novel coronavirus outbreak of global health concern. *The Lancet*, *395*(10223), 470–473. https://doi.org/10.1016/S0140-6736(20)30185-9

White, D. R., & Borgatti, S. P. (1994). Betweenness centrality measures for directed graphs. *Social Networks*, *16*(4), 335–346. https://doi.org/10.1016/0378-8733(94)90015-9

Wood, E., King, R., Senek, M., Robertson, S., Taylor, B., Tod, A., & Ryan, A. (2021). UK advanced practice nurses' experiences of the COVID-19 pandemic: A mixed-methods cross-sectional study. *BMJ Open*, *11*(3), e044139-e044139. https://doi.org/10.1136/bmjopen-2020-044139

World Health Organization. (2020). *Rational use of personal protective equipment(PPE) for coronavirus disease (COVID-19): Interim guidance*. W. H. Organization. https://apps.who.int/iris/bitstream/handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf

World Health Organization. (2021). COVID - 19 weekly epidemiological update. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports

APPENDIX A: DEVELOPMENT OF CODES AND CATEGORIES

SO codes	SE codes	LO codes	LM codes	Category	Theme
Cases AND Deaths AND Location of disease AND Mortality AND Transmission of disease	Number of cases and deaths AND Death AND spread	Cases AND deaths AND infection control / contagion AND international spread of virus	Number of cases, number of deaths, spread numbers	Prevalence and spread of the virus (relates to transmission, number of cases and deaths, all statistical information, tracing of spread)	**Prevalence, spread and clinical management of the infectious disease**
Testing	Testing	Testing, tracing, and surveillance	Testing and surveillance	Testing for the virus	
Disease management AND medication AND Cure AND medication as cure AND scientific evidence AND symptoms AND treatment recovery	New medical treatments AND safety AND research AND ethical issues	Scientific expertise and research AND treatment and curative approach AND preventative measures AND treatment side effects AND symptom identification	Research and knowledge on how to clinically manage the infected including medication, nursing care	Clinical disease management and treatment of COVID-19 infections	
Guidelines AND misinformation AND patient education AND public health information AND share knowledge AND training / education	Sharing information AND misinformation AND changing practice	Signposting guidance and resources AND false, partial and hidden information Scaremongering	Information regarding personal experience of patients, relatives or professionals regarding covid experiences that guide or provide misinformation	Sharing information and resources (huge variability in quality of information shared)	**Education and information sharing**
Nursing students Training (nurses)	Nursing education AND student nurses entering workforce	Education and development of nursing role and student nurses entering workforce	Nursing student's discussion regarding studies or practice AND educational institutions reactions to pandemic	Nursing education and students (system infrastructure and structure)	
Government advice AND Lockdown AND Legislative changes AND Healthcare systems capacity AND Laying blame And reg Political choices AND political support AND political views AND Leadership AND Political lobbying	Preparedness AND Government response AND social distancing / lockdown AND healthcare funding AND closures / cancellations / activities suspended Politics / politicization AND Leadership	Lockdown restrictions lack of trust in leadership and political context distrust in employer	Lockdowns and influence on individual's social life, politicization of and COVID Feedback for politically active and leadership on different levels	Politicization and Leadership	**Social and political context (including healthcare systems capacity challenges)**
Equipment AND Equipment requests AND Equipment shortage AND staff shortage	Shortages	PPE AND masks AND resource and capacity challenges Protect health care workers advocacy and lobbying lives at risk	lack of resources (PPE and medical equipment), change management in how care is organized to suffice	Resource use and shortages in healthcare	

(Continues)

SO codes	SE codes	LO codes	LM codes	Category	Theme
Employment / jobs AND homelessness AND inequality	Social issues AND employment protections	Lack of insurance AND social justice Housing issues Inequality	Pandemic influence on employment, socio-economic and health disparities	Social impact of pandemic	
Self-care nursing stories	Calls for nurses to stay resilient	Individual and collective coping strategies	means on how to manage on individual level, professional resilience building, programs for support in crisis	Strategies for building resilience and coping skills	**Working together and supporting each other**
Public gratitude AND protect healthcare staff AND Support Healthcare staff International cooperation Nursing stories (when talk about nurses as inspiration and deserving recognition cooperation) international cooperation Public health information when referring to protection of nurses	Praise AND Together	need for nurse reward and recognition Solidarity collective response	Collective support and praise for frontline professionals AND professional and health care organizational activities to acknowledge the challenges posed to individuals and professionals	A sense of "we're all in this together"	
Funding AND volunteers	Donations AND support and volunteering	Healthcare volunteering and donations	organizations and individuals calling for support and donations for health organizations and to support workforce AND statement of given donations and support for the system	Healthcare volunteering and donations	