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ANALYZING THE ROLE OF SOCIAL MEDIA IN ADDRESSING PUBLIC HEALTH DEVELOPMENT IN INDIA THROUGH A MULTI-CRITERIA DECISION-MAKING APPROACH

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Abstract. Nowadays, social media plays a vital role in managing public health developments. This research study has analyzed the factors of social media enhancing public health development. The analytic hierarchy process (AHP) is used to rank the factors, and the Decision-making trial and evaluation laboratory (DEMATEL) is used to find out the network relationship map of the role of social media in public health development. Results of AHP revealed that social media enhances public engagement and participation, collaboration of health professionals worldwide, and helps in remote monitoring of patients. Results of DEMATEL show that the development of health policies, repository of public health-related information, and prevention of health-related misinformation and fake news are classified as the topmost causal factors. Real-time monitoring of health conditions is the factor with the most significant impact on other factors. Policymakers and stakeholders should focus on improving public health through social media. Social media enhances collaboration among health professionals worldwide, and various stakeholders use it to address public health issues in the case of COVID-19.

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1. Introduction

With the expansion of human civilization, humankind has witnessed multiple health problems. The change in climate, water conditions, and the mixture of numerous hazardous chemicals in the air resulted in many diseases and health problems [1]. Thus, developing various policies and strategies to ensure sound public health solutions to manage problems is imperative. Community and stakeholders such as the government and civil society play an essential role in building a good health system for the public and creating responsive behavior toward achieving the goal [47,49]. On the other hand, social media (SM) platforms are considered critical tools to address public health issues and transform the information to the right audience with lucidity and accuracy [32]. Narang [42] opined that public perception is imperative for enhancing the country's health system. It enables us to understand the areas that require immediate attention and concern. The increase in digital platforms and SM usage paved the way for rapid digital surveillance, disease mapping, and information sharing, helping address

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the health sector's challenges [14,35,63]. Considering the United Nations (UN), Sustainable Development Goals (SDGs), Pereira & Marques [46] "proposed a sustainable public health index framework, based on the 13 targets of the UN's SDG 3 between 2016 and 2020".

Selerio *et al.* [53] pointed out that SM facilitates information management, public behavior, and response. O'Connor *et al.* [45] analyzed the relevance of digital complexity and advocated that proper knowledge of digital tools can enable access to and process information. Wang *et al.* [62] discussed the application of digital healthcare in fighting against the COVID-19 pandemic. They stated that digital technologies application-managed data delay, data fragmentation, data security, and accuracy and observed the relevance of the technology in present conditions. Nowadays, digital technology is considered one of the crucial ways of disseminating information and addressing public health-related issues [37]. Among those, SM has revolutionized the information handling process and become a powerful platform for expressing an opinion [7]. Yuan and Li [67] stated that digital health practices led to digital protection and regulation that can be a yardstick for policymakers and develop strategic decisions. SM is one of the imperative sources most people leverage. However, the government should still create a proper understanding among the public to leverage the platform to pass information, focus on emergency preparedness, and focus on public health development (PHD) measures.

Considering the primary healthcare sector, Pereira *et al.* [47] emphasized the importance of understanding the incentives driving institutional interventions and their alignment with health policies to achieve successful reform. To assess the alignment of institutional interventions in the primary healthcare sector from an incentive-based perspective, a framework was developed through a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis in collaboration with decision-makers from the Portuguese Ministry of Health. The resulting study provides potential policy implications and strategies for future reforms.

Various research studies identified SM's diverse roles in public health management and development. Finset *et al.* [20] discussed the essential factors for fighting the COVID-19 pandemic, where they recognized the input of SM as an active communication medium. Still, there were limited discussions about its role in emergency preparedness during the pandemic. A similar study was conducted by Schillinger *et al.* [52] to examine SM's role in healthcare management. Thakur *et al.* [60] extended the discussion on the involvement of design thinking in developing health measures to deal with the pandemic. However, the transformation requires rigorous efforts and monitoring for sustenance.

Thus, the existing research studies are limited in scope, which may not be adequate from a general viewpoint as the framing of the framework is highly dependent on the authors' interpretations. Various studies have been found related to the role of SM in addressing a particular disease. Still, there is a lack of comprehensive examinations for analyzing the role of SM factors in addressing PHD. Few research studies have used multi-criteria decision-making (MCDM) techniques to analyze SM factors in PHD. Thus, developing a deeper understanding of SM roles in developing public health measures is essential, leading to identifying appropriate intervention strategies. These gaps became the primary motivation for this work. This research examines how SM enables the development of public health measures. This research study answers the following questions:

RQ1. What are the factors of SM affecting PHD?
RQ2. What is the importance of the factors of SM impacting PHD?
RQ3. What are the causal inter-relationships among the factors of SM affecting PHD?

This work utilizes a decision-making trial and evaluation laboratory (DEMATEL) and analytic hierarchy process (AHP) to answer the above research questions. First, this study has identified the factors of SM that enhance healthcare management from the extant literature and experts' opinions. Secondly, identified factors will be prioritized for the relative importance of one factor over the other using AHP. Third, a causal relationship among the identified factors is established through the DEMATEL technique. Lastly, the study develops a framework that considers the role of SM in PHD in the Indian context and provides managerial insights. The consecutive sections of this study are organized as follows: section two discussed SM roles from a wide-ranging literature search. Section three discussed the steps used in the DEMATEL and the AHP technique. Section four

presents the results and discussions. Lastly, section five offers the concluding remarks of this research study and suggestions for future research.

2. Literature review

SM has been recognized as an essential part of public health strategy in improving public health. SM played an important role in bringing active public involvement and engagement, as shown by Chinese citizens expressing "care and solidarity, engaged in claim-making and resistance, and negotiated with authorities" during the recent COVID-19 pandemic [9]. Das and Zhang [13] highlighted that while dealing with the pandemic and building a resilient and intelligent Singapore, other than the initiatives taken by the government, engagement of public and digital solutions was also found to play an essential role in improving health. A similar study in Vietnam recognized community engagement's role in enhancing public health [23].

SM also played an essential role in bringing worldwide health professionals and multidisciplinary experts together. These collaborations help to provide better and improved services in society at a faster pace. Gross *et al.* [22] initiated a study highlighting the critical role of digital health services in patient-centered care and empowerment in clinical care with a specific focus on dementia care. In Germany, a model has been developed to highlight the economic benefits of integrated health care. The authors opined that other than the cost benefits and savings for the collaborators, better health results can be derived for the public due to the integrated healthcare model [28]. A study was undertaken in Brazil to understand the collaboration trends between health professionals and experts. The findings indicate an increasing trend in collaboration growth, which positively impacts the "participation and increasing interest initiatives" undertaken in telehealth in Brazil [16].

SM and newspapers have played a vital role in providing critical information to the public, which further helped in designing effective public health policies; for instance, scientists used Facebook frequently to disseminate scientific knowledge for the community's well-being [33]. Policymakers could refer to this SM data to know the course of action to deal with a health challenge and design the policies to mitigate the health issue. In the US, during the 2015–2016 outbreak of the Zika virus, the use of SM, *e.g.*, Twitter, helped to communicate valid information in conditions of crisis; the study highlighted the "development of effective SM strategies during natural disasters and public health emergencies" to share accurate information to the various communities [24]. During the COVID-19 pandemic, communication strategies at a national health system in Brazil were analyzed, covering 35 strategies ranging from Facebook, Websites, press conferences, Twitter, apps, YouTube, epidemiological bulletins, and Instagram; the study highlighted a gap in communication strategies in terms of health, care, education and promotion and surveillance [17].

Worldwide, students have used digital tools for their mental health and well-being; however, they have faced challenges regarding the reliability and trustworthiness of shared information and handling sensitive data [41]. During COVID-19, much information was available on SM, but the challenge was dealing with health-related misinformation and fake news. To counter the fake news [34], SM platforms were initiated to direct people to accurate information articles and reject ads comprising "harmful misinformation" about COVID-19. Other initiatives to deal with misinformation include "identifying the emerging trends and prevalence of health misinformation, evaluating its influence on health, and finally developing interventions to fight it" [12].

With the updates in information on SM platforms, public behavior and response changes were recorded. During the pandemic, any new information regarding the virus was influencing the behavior and opinion of the public [25]. A study was conducted to study the changes in individual behavior about infectious diseases of A/H1N1 and Ebola; it was found that media played an essential role in changing the behavior and the response of the public and thus mitigated the risk of the spread of infectious diseases [64].

During the pandemic, patients with mild symptoms were quarantined, or people facing other health issues used SM for consultation with the respective health practitioner and thus helped the health practitioners in effective remote monitoring or diagnosis of patients to deal with the challenge of risk of contagion [4, 48]. To manage "electronic medical records, internet of things (IoT) and supply chain monitoring", authors highlighted the use of blockchain in the remote monitoring of patients [44]. Increased use of digital technologies has been

witnessed in gathering information [18]. SM helps spread awareness and educate the masses about diseases, viruses, and other health-related problems. The government can use SM platforms to inform people about the policies related to health care benefits and take feedback about the schemes and policies.

The advent of SM has resulted in many health information updates to the public. These updates helped the communities to get the know-how of dealing with the crisis in terms of prevention and cure and further guided the health communities to have real-time monitoring of health conditions prevailing in the country and take corrective actions to mitigate its impact. This early communication further helped the government design effective health policies for the nation's well-being [34]. With the SM route, the distribution of goods and services required in PHD has become faster. SM provides a platform where buyers and suppliers can collaborate to do transactions. Su *et al.* [59] highlight the business model for intelligent healthcare through "service exchange and resource integration" in the healthcare sector.

During the pandemic, many countries faced problems in the "manufacturing and supply chain" of personal protective equipment [62]. Blockchain-based infrastructure will help deal with the supply chain shortage by providing "reliable drug supply, decentralized record-keeping, claim processes, cost-effective systems, and health data exchange" [65]. The recent COVID-19 pandemic is a live experience to know the role of SM in dealing with the health crisis. During the COVID-19 pandemic, SM was vital in bringing various global economies together. The multiple updates shared on the virtual platforms helped the public know how to prevent and cure themselves in quarantine or public places. SM allowed researchers to access data about various countries and helped the government formulate policies and change the response of general behavior by sharing accurate information on digital media. The critical role of SM in pandemic crisis management has been highlighted by various studies [1, 53].

A comprehensive literature review was performed to unearth the role of SM in PHD. Articles were identified from the Scopus database using a keyword search about "Social Media" AND "Public Health Development". The highly relevant and highly cited papers were shortlisted and reviewed to obtain the factors depicting the role of SM in PHD. Based on a rigorous literature review and expert opinions, the authors identified sixteen factors of SM in PHD. Thus, the authors tried to give meaning to the identified factors, as depicted in Table 1.

Various methods have been utilized to analyze factors of SM's role in managing healthcare. However, a few studies have adopted an MCDM technique. Some important literature related to the position of SM in PHD and their finding is shown in Table 2 below.

In this section, we have discussed the literature related to the role of SM in PHD and identified sixteen factors of SM in PHD. Some authors have used an MCDM methodology for analyzing SM factors in addressing a specific disease. Still, there is a lack of comprehensive studies examining the SM factor's role in addressing public health and the relationship among SM factors. These gaps became the primary motivation for this work. This research examines how SM enables the development of public health measures. A detailed discussion of methodologies used in the research work is presented in the next section.

3. Methodology

This section highlights the stages in which the study is performed. The study's objective is to rank the factors of using social media (SM) for public health development (PHD) in India and build a network relationship map (NRM) depicting the cause-and-effect relationship among the factors. Existing literature on "social media" AND "public health development" in the Indian context is comprehensively reviewed to explore the possible factors. The sixteen factors identified are shown in Section 2, Literature Review. A questionnaire is developed to measure the preferences among the factors and the influence of a factor on others. The data is collected using a pairwise comparison method: (i) For preference: the 1 to 9 scale where 1 is "equal importance" and 9 is "extreme importance"; (ii) For influence: the 0 to 4 scale where 0 is "no influence" and 4 is "very high influence". The data is gathered from experts from industry and academics. Two methods are used to achieve the objectives of the study: AHP and DEMATEL. The results of the analyses are the priorities or weights of the factors and an

TABLE 1. Factors of SM's role in PHD.

S.No.	Factors	Description	References
1	Public engagement and participation	Active involvement of citizens during a health issue through give and take of necessary information between public and respective health authorities.	[2,9,23,36,45,57]
2	Collaboration of health professionals and multidisciplinary experts worldwide	SM helped bring health professionals, medical students, scientists, and government authorities together to deal with a health crisis.	[6,16,19]
3	Development of health policies	The fast movement of information due to public participation and a multidisciplinary team of experts helped the government and respective authorities formulate effective policies for the health crisis.	[10,33]
4	Effective health communication	The dissemination and sharing of information through SM help the public respond immediately to prevent and manage health pandemics.	[11,21,30,61]
5	Research in public health	SM supports data collection, scholarly collaboration, and engagement of study respondents.	[53]
6	Repository of public health-related information	The data collected on digital platforms such as Facebook, Twitter, and Instagram allowed for further analysis of data and provided the latest and updated information on public perception.	[8,9,54,57]
7	Prevention of health-related misinformation and fake news	SM helped to deal with misinformation by redirecting users to web pages with accurate information and rejecting access to harmful posts.	[8–10,12]
8	Influence public behavior and response.	SM generates new information, which helps to influence the response and behavior of the public.	[1,26,66]
9	Tele-healthcare	SM helps to continue safe care and communication between health providers and patients through virtual consultation.	[29,45]
10	Helps in remote monitoring of patient	A connection between patients and their physicians to monitor the patients through virtual communication technologies without an in-patient consultation.	[1,35,56]
11	Public health education	SM helps to spread awareness and educate the masses about diseases, viruses, and other health-related problems.	[53]
12	Effective national health-related campaigns	The government can use SM platforms to inform people about the policies related to health care benefits and take feedback about the schemes and policies.	[53]
13	Real-time monitoring of health conditions	The accurate and updated information on SM platforms helped the public know how to prevent and cure a health concern.	[35,43,57]
14	Supply goods and services by online platform	SM helps to link the customer and supplier of goods and services through digital platforms.	[39,51,59]
15	Healthcare supply chain resilience	The virtual presence of suppliers and customers helped meet the challenges in the supply chain.	[38,65]
16	COVID-19 pandemic management	SM is frequently viewed as a quick and effective platform for finding, sharing, and disseminating real-time health information among the public during pandemics.	[1,5,53]

TABLE 2. Summary of some important articles.

Author(s)	Method	Problem identified	Findings
Hemant *et al.* [27]	ISM	Identified the enablers of Collaborative Planning, Forecasting, and Replenishment (CPFR)	Investing considerable effort in these pivotal enablers to strengthen businesses and their supply chains against vulnerabilities and lower their susceptibility to disruption is possible.
Ahmad *et al.* [3]	Best Worst Method	They prioritized the strategies of PHD in the case of COVID-19.	The unavailability of ventilators, PPE kits, and medical professionals should be the most critical measure against the COVID-19 outbreak.
Kumar *et al.* [32]	Delphi and DEMATEL	Explored the role of media in polio prevention.	Stakeholders should use SM platforms to spread awareness to the masses.
Selerio *et al.* [53]	Fuzzy DEMATEL and ANP	Investigate the role of SM in COVID-19.	SM's top influencing factors are policy development, misinformation spread, and public behavior management.
Mishra *et al.* [40]	Literature review	Healthcare management in the pandemic	The adoption of technology in healthcare management can better tackle the pandemic situation.
Narang [42]	Empirical Study	Investigated the service quality in rural India.	The unavailability of doctors, practitioners, and medical equipment affects the quality of the service in rural India.
Ramani and Mavalankar [49]	Literature review	Identified the opportunities and challenges in the Indian health system.	Government initiatives can increase the performance of the healthcare sector.
Wang *et al.* [62]	Literature review	It explored the impact of integrating technology and PHD in addressing COVID-19.	Artificial intelligence, blockchain technology, and digitalization can be powerful tools in healthcare management.
Yuan and Li [67]	Empirical Study	Identified the role of digitalization in health management.	General Data Protection Regulation (GDPR) has increased financial support.
Abbas *et al.* [1]	Empirical Study	Identified the role of SM in managing the COVID-19 situation.	SM is an essential tool in managing information related to pandemics.
O'Connor *et al.* [45]	Systematic Literature Review	They analyzed the factors affecting public health through digital platform interventions.	SM can enhance personal life, engagement, quality of life, and values in life.

NRM depicting the cause-and-effect relations among the factors. The research process framework is presented in Figure 1.

3.1. AHP method

AHP was developed by the Saaty in 1980. AHP is an MCDM technique used for ranking the factors, giving the relative importance of one factor over the other. It models and ranks factors in management, engineering, industry, manufacturing, etc. Managers and researchers widely use it to solve complex problems.

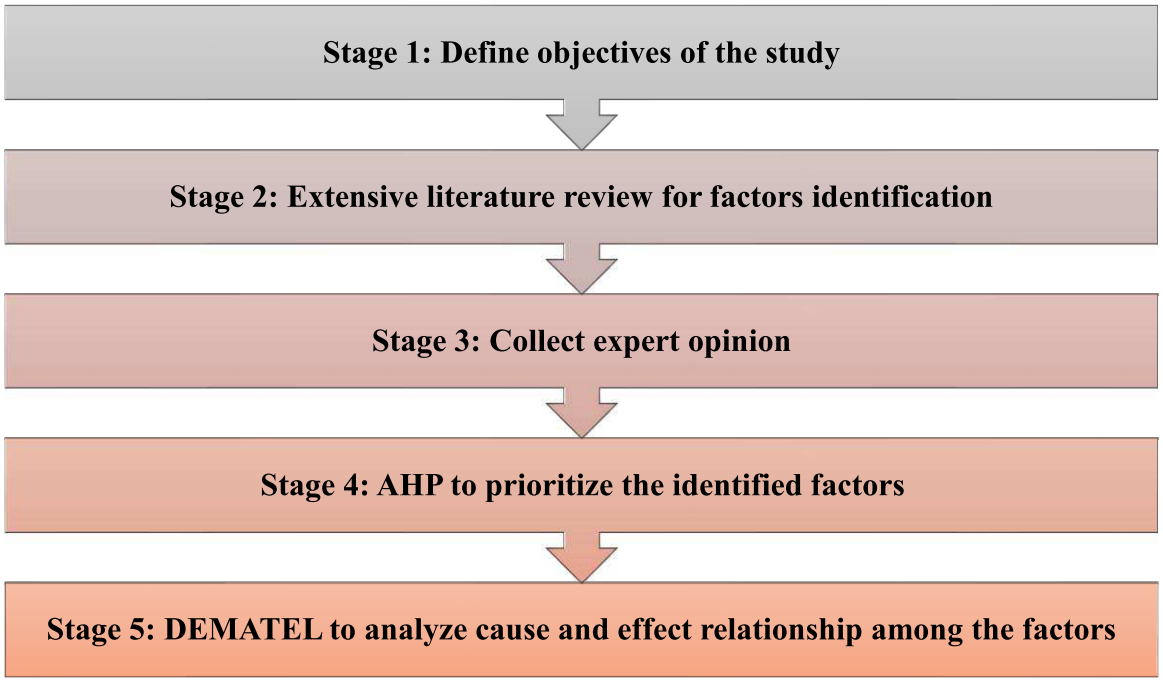

FIGURE 1. Research process framework.

TABLE 3. Scales in pairwise comparisons [50].

Score	Definition
1	Equal importance of both factors
3	Low importance of one factor over another
5	Strong importance of one factor over another
7	Very strong importance of one factor over another
9	The extreme importance of one factor over another
2, 4, 6, 8	An intermediate value between two close judgments'

A survey has been conducted for the collection of data. The responses have been collected from SM researchers, media managers, hospital doctors and staff, COVID-19 task force staff, and medical technologists. The questionnaire survey comprises three sections. The first section covers the general information about the respondents, and section two covers selecting the most suitable SM factors in public health management and explores their significance in the Indian PHD. Section three helps in finding the ranking of the factors. The expert has validated the results.

The steps involved in the AHP application are as follows [55].

(a) Selection of the factors from the existing literature and finalization of the factors through experts' opinions like practitioners, researchers, and hospital personnel. Table 3 shows the scale used for the pairwise comparisons.
(b) In this research, fifteen experts were contacted to take the responses, and ten agreed to give the answers. The pairwise evaluation matrix was constructed to determine the ranking of the identified factors. The ranking and weights of all the factors are shown in Table 4.

TABLE 4. Weight and ranking of all factors.

S. No.	Factors (Code)	Priority weight	Ranking
1	Public engagement and participation ($F1$)	8.6	1
2	Collaboration of health professionals worldwide (and multidisciplinary experts) ($F2$)	7.4	2
3	Development of health policies ($F3$)	6.9	6
4	Effective health communication ($F4$)	7.0	5
5	Research in public health ($F5$)	5.1	15
6	Repository of public health-related information ($F6$)	5.4	14
7	Prevention of health-related misinformation and fake news ($F7$)	5.6	11
8	Influence public behavior and response ($F8$)	5.8	9
9	Tele-healthcare ($F9$)	5.5	12
10	Helps in remote monitoring of patients ($F10$)	7.2	3
11	COVID-19 pandemic management ($F11$)	7.1	4
12	Public health education ($F12$)	4.4	16
13	Effective national health-related campaigns ($F13$)	5.5	13
14	Real-time monitoring of health conditions ($F14$)	6.6	7
15	Supply goods and services by online platform ($F15$)	5.8	10
16	Healthcare supply chain resilience ($F16$)	6.1	8

(c) To check the consistency of the results, determine the consistency index (CI) by using the relation:

$$\mathrm{CI} = \frac{\lambda_{\max} - n}{n - 1} \tag{1}$$

where, $\lambda_{\max}$. It is the maximum eigenvalue of the matrix, and n is the number of factors/barriers.

(d) Now, find the value of the consistency ratio (CR), which is calculated as CI/RI, where RI is the random consistency index. The above expression calculates the value of CI, and the RI value depends upon n. The final value of CR in the analysis is 05, which means the results are acceptable.

3.2. DEMATEL method

The DEMATEL method applies the study to identify the most crucial cause of the problem and the hierarchy of possible solutions on "the role of SM for PHD in India". The method also determines the interdependence among the identified factors through network relationship map (NRM). The procedure of the DEMATEL approach is presented in Figure 2 below:

Step 1. Compute the expert matrix for each respondent. Experts were asked to rate the direct influence between any two factors by a score ranging from 0, 1, 2, 3, and 4, representing "no influence", "low influence", "medium influence", "high influence", and "very high influence" respectively. The scores or responses of each respondent are converted into a matrix with diagonal elements set to zero.

Step 2. Construct the average matrix A from all the expert matrices.

Step 3. Calculate the normalized matrix D as follows:

$$D = m \times A \tag{2}$$

$$\text{where, } \min\left[\frac{1}{\max(\text{row total of } A)}, \frac{1}{\max(\text{column total of } A)}\right]. \tag{3}$$

Step 4. Calculate the total influence matrix T (t_{ij}). Using equation (3), where I is the identity matrix.

$$T = D(I - D)^{-1}. \tag{4}$$

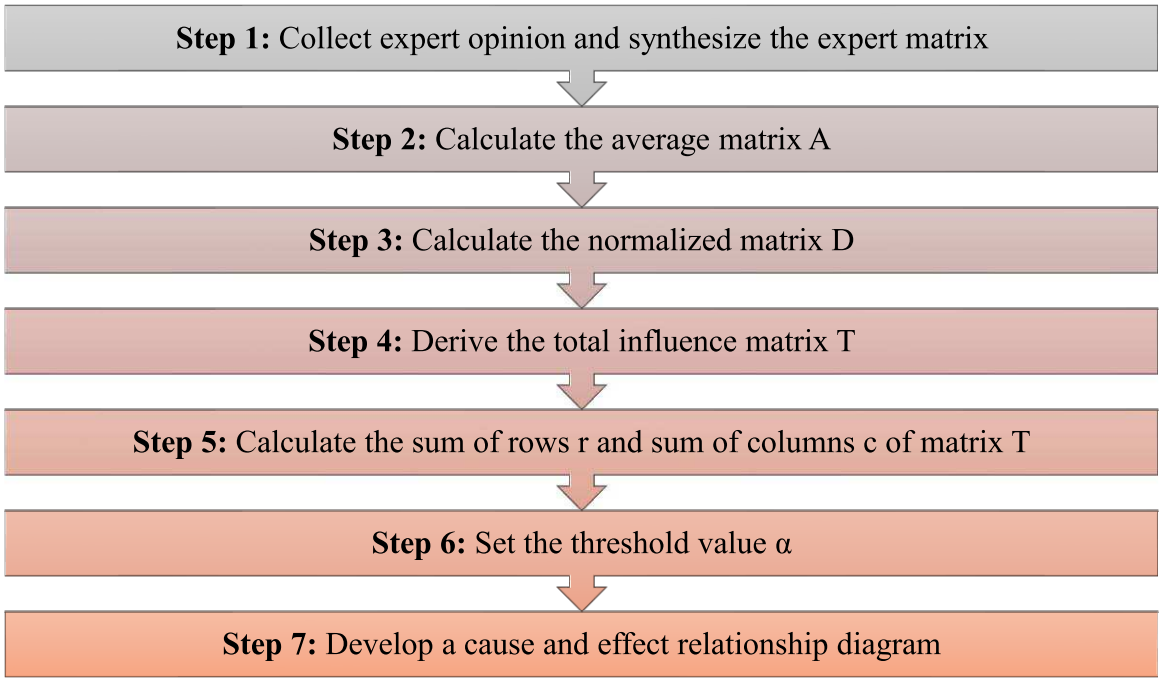

FIGURE 2. The procedure of the DEMATEL approach.

Step 5. Calculate the sum of rows (matrix r_i) and the sum of columns (matrix c_j) of the total relation matrix T. Value of r_i A factor is the effects given by the factor to other factors. The value of c_j A factor is the effects received by the factor from other factors. The sum $(r_i + c_j)$ for a factor, it shows the effects given and received by the factor. Thus, $(r_i + c_j)$ indicates the net effect of the factor, and these values are used to calculate the ranks of the factors. The difference $(r_i - c_j)$ A factor indicates the impact of the factor. If $(r_i - c_j)$ is positive, the factor is a cause, and if $(r_i - c_j)$ is negative, the factor is a receiver or result.

Step 6. Set a threshold value α to obtain the cause-and-effect relationship diagram. The threshold value α is computed as the average of elements in matrix T, as calculated in equation (3). Since matrix T provides information on the influence of one factor on another, the threshold value is set up to eliminate some minor effects elements from the matrix T. Finally, only the results more significant than the threshold value are shown in the NRM.

Step 7. Build the cause-and-effect digraph. Plot the factors by taking. $(r_i + c_j)$ values on x axis and $(r_i - c_j)$ values on the axis. Draw the arrows indicating the relationship among the factors as per the matrix $T(t_{ij}$ greater than $\alpha)$, $(r_i + c_j)$ and $(r_i - c_j)$ values of the factors.

4. Results and discussion

Results obtained by AHP and DEMATEL methodology are discussed in this section. First, to identify the relative importance of factors enhancing the role of SM in addressing the PHD issues in the Indian context through AHP, and second, to establish the causal relationship among the factors through the DEMATEL technique.

4.1. AHP findings

SM plays a vital role in addressing PHD issues globally. This research study has identified sixteen factors from the extant literature review and expert opinions. Ranking of all the factors in decreasing order as per the weights are $F1 > F2 > F10 > F11 > F4 > F3 > F14 > F16 > F8 > F15 > F7 > F9 > F13 > F6 > F5 > F12$ as shown in Table 4. Results of AHP revealed that the top five factors out of sixteen factors are public engagement and participation ($F1$), collaboration of health professionals worldwide ($F2$), helping in remote monitoring of patients ($F10$), COVID-19 pandemic management ($F11$), and effective health communication ($F4$) respectively.

It is clear from the results that public engagement and participation ($F1$) ranked first among all factors. Citizens expressed care and sympathy, were involved in claim-making and dissent, and spurred negotiations with authorities on SM platforms, which became sites of active public involvement. In this context, SM has provided a forum for discussion about balancing safeguarding public health and ensuring individual liberties, which is an essential input in forming public policy. Schillinger *et al.* [52] identified SM as a possible engine helping the community to build a common cause, advocate for, and execute health development measures. For example, In the COVID-19 situation, SM increases citizen engagement.

Collaboration of health professionals worldwide ($F2$) ranked second among the factors. As a worldwide communication tool, SM is critical for connecting multidisciplinary teams and healthcare professionals globally [15,31]. SM is used to conduct a virtual hackathon that brings medical students, doctors, scientists, and engineers together to develop health solutions and make suggestions to organizations. According to Stokel-Walker [58], SM allows health specialists from different nations to collaborate quickly to develop treatment guidelines, document treatment alternatives, and provide and distribute information.

COVID-19 pandemic management ($F11$) is ranked fourth among the roles of SM in public health management. According to Finset *et al.* [20], SM is frequently viewed as a quick and effective platform for finding, sharing, and disseminating real-time health information among the public. Health practitioners can use SM to provide accurate information to patients and the general public and promote accessible mental resources.

Increased SM presence generates environments for readily available knowledge, data, and guidance, as well as, more inconveniently, disinformation, prediction, and conspiracy. Steps have been taken to combat health-related misconceptions about COVID-19 on SM. Identifying new trends and the prevalence of health information, analyzing its impact on health, and devising strategies to combat it are only a few of these initiatives. Large SM platforms, in particular, have been adopting artificial technology to disseminate credible information. Public health education ($F12$) ranked last among the identified factors.

4.2. DEMATEL findings

The values of $r_i + c_j$ and $r_i - c_j$ of the sixteen identified factors calculated from the total relation matrix, T is shown in Table 5.

The threshold value α is computed as 0.6131. The T matrix is calculated using equation (3). The values t_{ij} in the T matrix, which is greater than α (0.6131) are shown as t^*_{ij}, which represents the direction of the arrow among the factors in the cause-and-effect diagram. The cause-and-effect diagram of the sixteen factors is shown in Figure 3.

The importance of the factors (or dimensions) is determined by $r + c$ values. Influence public behavior and response ($F8$) is the most crucial dimension with the most considerable $r+c$ value (20.2151), whereas supplying goods and services by online platform ($F15$) is the least essential dimension with the smallest $r + c$ value (17.9082). As per the $r + c$ values, the prioritization of the sixteen factors of SM in public health management is $F8 > F2 > F4 > F11 > F10 > F14 > F16 > F3 > F7 > F1 > F12 > F13 > F6 > F9 > F5 > F15$.

Based on the $r - c$ values, the sixteen factors are divided into (i) cause group and (ii) effect group. Development of health policies ($F3$), repository of public health-related information ($F6$), prevention of health-related misinformation and fake news ($F7$), influence general behavior and response ($F8$), tele-healthcare ($F9$), helps in remote monitoring of patients ($F10$), effective national health-related campaigns ($F13$), real-time tracking of health conditions ($F14$), supply goods and services by online platform ($F15$), and healthcare supply chain

TABLE 5. Rank and impact of the sixteen factors.

Factors	r_i	c_j	$r_i + c_j$	Rank	$r_i - c_j$	Impact
F1	9.16106	9.350424	18.51148	10	−0.18936	Effect
F2	9.645166	10.2665	19.91166	2	−0.62133	Effect
F3	9.34166	9.253094	18.59475	8	0.088566	Cause
F4	9.508442	10.15411	19.66256	3	−0.64567	Effect
F5	8.52712	9.518626	18.04575	15	−0.99151	Effect
F6	9.295608	8.894694	18.1903	13	0.400914	Cause
F7	9.427084	9.145376	18.57246	9	0.281708	Cause
F8	10.2657	9.949399	20.2151	1	0.316305	Cause
F9	9.176505	8.922988	18.09949	14	0.253516	Cause
F10	9.497068	9.407149	18.90422	5	0.089918	Cause
F11	9.348576	10.23298	19.58156	4	−0.88441	Effect
F12	9.188336	9.266557	18.45489	11	−0.07822	Effect
F13	9.340726	9.040529	18.38126	12	0.300197	Cause
F14	9.842874	8.937277	18.78015	6	0.905596	Cause
F15	9.080644	8.827601	17.90825	16	0.253044	Cause
F16	9.72163	8.956059	18.67769	7	0.765571	Cause

resilience ($F16$) are classified in the cause group with $r - c$ values of 0.0885, 0.4009, 0.2817, 0.3163, 0.2535, 0.0899, 0.3001, 0.9055, 0.2530, and 0.7655 respectively. Real-time monitoring of health conditions ($F14$) is the factor with the most significant impact on other factors, followed by healthcare supply chain resilience ($F16$), repository of public health-related information ($F6$), influence general behavior and response ($F8$), and effective national health-related campaigns ($F13$). Public engagement and participation ($F1$), collaboration of health professionals worldwide ($F2$), effective health communication ($F4$), research in public health ($F5$), COVID-19 pandemic management ($F11$), and public health education ($F12$) are categorized in the effect group with $r - c$ values of −0.1893, −0.6213, −0.6456, −0.9915, −0.8844, and −0.0782 respectively. Research in public health ($F5$) is the most affected by other factors.

The policymakers should focus on the following initiatives for improving Indian public health through SM: (i) use SM to influence public behavior and response, (ii) use SM for collaboration of health professionals worldwide, (iii) use SM for effective health communication, (iv) use SM for COVID-19 pandemic management, and (v) use SM for remote monitoring of patients.

Policymakers and the health industry can explore the interactions among the dimensions shown in the network relationship map (NRM) for developing Indian public health through SM. The exchanges are concentrated on the right side of the map, which indicates that the focus should be on (i) the use of SM as a repository of public health related information, (ii) the use of SM for the prevention of health-related misinformation and fake news, (iii) use of SM for healthcare supply chain resilience, (iv) use of SM for real-time monitoring of health conditions, (v) use of SM for remote monitoring of patients, (vi) use of SM to influence public behavior and response, (vii) use of SM the development of health policies, (viii) use of SM for COVID-19 pandemic management, (ix) use of SM for effective health communication and (x) use of SM for collaboration of health professionals worldwide.

5. Conclusion and implications

This paper investigates the role of SM in PHD or health care management. First, this study has identified the part of SM in PHD, ranked the factors of SM through AHP, and analyzed the factors for the causal relationship among them through the DEMATEL approach. Policymakers and the health industry can explore the interactions among the dimensions shown in the network relationship map for developing Indian public

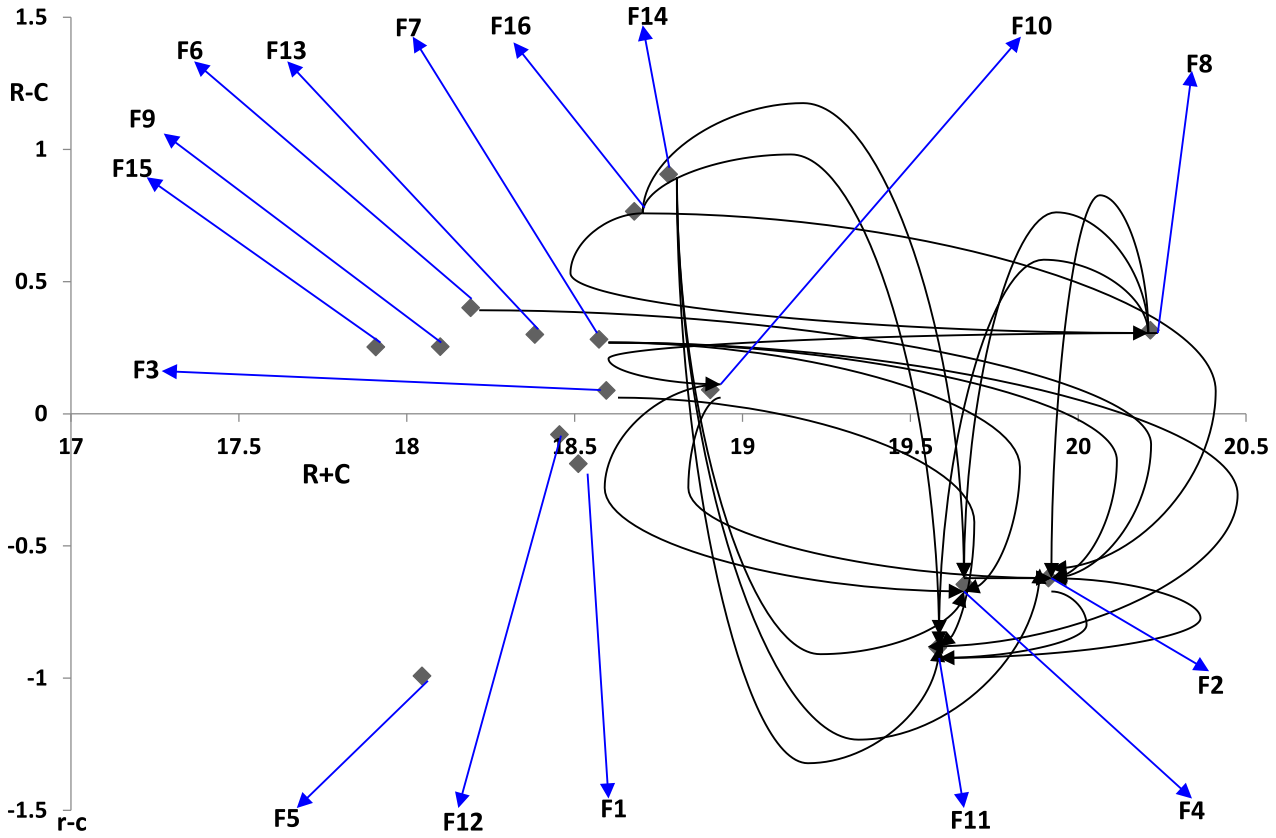

FIGURE 3. NRM of SM and PHD in India dimensions.

health through SM. Results of AHP revealed the importance of one factor over the others. The results of DEMATEL showed that ten factors were found as casual barriers, whereas six were effect barriers.

5.1. Practical implications

The role of SM in PHD has become increasingly important in recent years. SM platforms such as Twitter, Facebook, and Instagram have the potential to reach a vast audience and engage individuals in health promotion and disease prevention.

One practical implication of the role of SM in PHD is the need to develop effective strategies for using SM platforms to promote health. Healthcare professionals and public health organizations should leverage SM to disseminate evidence-based health information, educate the public about disease prevention, and encourage healthy behaviors.

Another practical implication is the need to address the issue of misinformation on SM. For example, SM platforms have been used to spread false information about vaccines, which can harm public health. Healthcare professionals and public health organizations must work to combat misinformation by providing accurate and reliable health information to the public. Furthermore, SM can monitor and respond to public health emergencies. Real-time monitoring of SM can help identify outbreaks of infectious diseases and other health threats, allowing healthcare professionals to respond quickly and efficiently.

5.2. Policy implications

Some policy suggestions based on the role of SM in improving public health:

- *Make rules about how to use SM for public health:* policymakers should make rules about how to use SM for public health that cover privacy, accuracy, and ethics. The guidelines should be updated often to reflect new technologies and health risks.
- *Work with SM companies:* public health organizations should work with SM companies to find and remove false health information and promote accurate and reliable health information. People should also be told to ask SM companies to make tools that let users spot and report incorrect health information.
- *Teach people how to use SM responsibly:* policymakers and public health organizations should encourage responsible use of SM by teaching people how to find reliable health information and avoid sharing false health information.
- *Use SM to promote health:* public health organizations should use SM platforms to promote health and keep people from getting sick. They can use SM to share health information backed up by evidence, teach people how to avoid getting sick, and encourage healthy behaviors.
- *Monitor SM for public health emergencies:* public health organizations should monitor SM platforms for early warning signs of public health emergencies, like disease outbreaks. During emergencies, they can use SM to talk to the public and give real-time updates.

Overall, these policy suggestions can help PHD make the most of the benefits of SM while minimizing the risks and problems that may arise.

5.3. Future research scope and limitations of the study

This study has certain limitations that must be addressed in future research. The findings rely on expert opinions and thus require empirical validation to be confirmed. Therefore, a subsequent study could evaluate the strategies derived from this work's results. Moreover, as the study was conducted in a specific case, the findings may be subject to the conditions of that case, such as cultural, social, and bureaucratic factors. In the future, statistical modeling could be employed to verify the structural relationships found in this paper. More factors can be included in the decision-making, and expert opinions can be recorded for the analysis to enhance the accuracy of the results. In the future, other MCDM techniques can be used to analyze and compare results.

In conclusion, the role of SM in PHD has both challenges and opportunities. Effective use of SM platforms can promote health, but it also requires careful consideration of the potential risks and challenges, such as the spread of misinformation. Healthcare professionals and public health organizations must continue to explore SM's potential while addressing its challenges to improve public health outcomes.

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