

# Application of the Analytical Hierarchical Process in the digital communication of public agencies during the COVID-19 pandemic

Aplicación del Proceso Analítico Jerárquico en la comunicación digital de los organismos públicos durante la pandemia de la COVID-19

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## ABSTRACT

**Introduction:** This research analyses the digital communication carried out by 21 public health institutions on the Twitter platform during the period of the COVID-19 pandemic. It focuses on examining the criteria for the success of communication strategies on this digital social network and their weighted weight in the proposed model. **Methodology:** the data was recorded using the open-access application Twitonomy, which analyses the last 3,200 Tweets from each profile. The analysis of the information is carried out by applying the Analytic Hierarchy Process (AHP) as a method for multi-criteria decision-making. Using Expert Choice software, 17 criteria corresponding to the account activity and impact clusters are studied. **Results:** The most appropriate alternative in the field of public health communication in social networks and the weight of the criteria that benefit this communication on the Twitter platform is determined. **Discussion and Conclusions:** This study confirms that it is advisable for decision-makers in digital communication to bear in mind that the impact cluster has a greater weight on the Twitter social network than account activity.

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**KEYWORDS:** public health; digital communication; Twitter; Analytic Hierarchy Process (AHP); multi-criteria decision; COVID-19; social networks; social media

## RESUMEN

**Introducción:** esta investigación analiza la comunicación digital llevada a cabo por 21 organismos públicos del ámbito sanitario en la plataforma Twitter en el periodo de la pandemia de la COVID-19. Se centra en examinar los criterios de éxito de las estrategias de comunicación en esta red social digital y en conocer su peso ponderado en el modelo propuesto. **Metodología:** el registro de los datos se ha elaborado a través de la aplicación de acceso libre Twitonomy que analiza los últimos 3.200 *Tweets* de cada perfil. El análisis de la información se realiza aplicando el *Analytic Hierarchy Process* (AHP) o Proceso de Análisis Jerárquico como método para la toma de decisiones multicriterio. A través del software Expert Choice se estudian 17 criterios correspondientes a los clústeres actividad de la cuenta e impacto. **Resultados:** se determina la alternativa más adecuada en el ámbito de la comunicación de la salud pública en redes sociales y el peso de los criterios que benefician esta comunicación en la plataforma Twitter. **Discusión y Conclusiones:** este estudio confirma que es conveniente que los responsables de la toma de decisiones en materia de comunicación digital tengan presente que el clúster impacto tiene un mayor peso en la red social Twitter que la actividad de la cuenta.

**PALABRAS CLAVE:** salud pública; comunicación digital; Twitter; Proceso de Análisis Jerárquico; decisión multicriterio; COVID-19; redes sociales

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Translation by **Paula González** (Universidad Católica Andrés Bello, Venezuela)

### 1. Introduction

In the health field, the role of the patient has evolved into an active role that participates in decision-making (Pisano et al., 2021, p. 3) and the search for health information. In Spain, 60% of the population uses the Internet to search for health information (ONTSI, 2020). In the last 10 years, its use has doubled, going from 31% in 2009 to 60% in 2019 (Eurostat, 2020). This active and empowered patient role is closely related to the need to obtain accurate information.

The pandemic produced by SARS-CoV-2 has led to confinement and physical distancing situations that “have meant a change in social relationships” (Ferrer-Serrano et al., 2020, p. 3), giving rise to new interaction habits through the Internet and also to a greater search for information in digital media and social networks (Cabrera and Clavijo, 2020, p. 130). However, the Internet has a dual facet. On the one hand, it is a great source of information, but on the other, it sometimes facilitates infoxication, giving rise to unfounded or erroneous conclusions (Navas-Martín et al., 2012, p. 155). The increase in its use as a means of information is not always accompanied by an increase in digital literacy that trains the user in the efficient use of the Internet and allows them to discern between hoaxes and verified information (Cabrera and Clavijo, 2020, p. 130). Faced with this situation, health organizations become a reference source of online information, in a close and simple way, aimed at a non-specialized public (Park et al., 2015, p. 1).

During the COVID-19 pandemic, the Twitter platform has become a relevant channel for organizations in different contexts such as government, health, or education, among others. In the educational field, the pandemic has had an impact on the use that schools and universities have made of this social network, mainly due to its collaborative nature and the possibility that this platform offers entities to show an active role (Ferrer-Serrano et al., 2020, p. 9). In this sense, research indicates that during the pandemic, Spanish universities have presented a change in their digital communication, increasing the messages that project “a cooperative and pro-social profile” of the center (Ferrer-Serrano et al., 2020, p. 10). In the sanitary and public health context, Twitter has also become a very relevant network for the population because it has facilitated immediately obtaining information (Cabrera and Clavijo, 2020, p. 130).

The entities that use digital social networks in their external communication processes have to make strategic decisions to reach the audience. Thus, in the communication strategy of the social network Twitter, it must be taken into account which communicational objectives have priority and greater relevance. This might seem, a priori, simple, however, when qualitative and quantitative aspects come into value in decision-making, the difficulty of having to give greater relevance to some criteria over others arises, giving rise to a multi-criteria decision problem (Guijarro et al., 2018, p.1415). The communication managers of the organizations that carry out their digital communication strategies on Twitter often have to face this type of dilemma.

In the communication processes in which these channels are used, it is convenient to carry out an analysis of the alternatives, evaluating the multiple-criteria decision-making (MCDM) (Osorio, 2008, p. 247; Agwa-Ejon et al., 2017). The purpose of this research is to facilitate a decision model applicable to the Twitter communication of public organizations linked to the health field, through the *Analytic Hierarchy Process* (AHP).

### **1.1. The Twitter platform as a channel for disseminating information related to health**

Spanish legislation includes the right of citizens to health information. Article 29 of Law 12/2001 of December 21<sup>st</sup>, on Health Management of the Community of Madrid, indicates the right of citizens to “clear, truthful, relevant, reliable, balanced, updated, quality information based on scientific evidence, which enables the autonomous and responsible exercise of the power of choice and active participation” (Law 12/2001). The massive use of social networks has had an impact on communication in the health field, becoming a channel for the dissemination of health messages that has allowed the scope and access to this information to be expanded (Medina, 2018, p. 215).

The use of these social networks in the health field, and more specifically in contexts of health crises such as that produced during the COVID-19 pandemic, has been the object of study in various research studies (Manfredi-Sánchez et al., 2021, p. 84; Pulido-Polo et al., 2021, p. 5; Zolbanin et al., 2021, p. 2; Bartlett et al., 2015, p. 379). The focus of interest has been on determining the potential presented by social networks such as Twitter in public health surveillance, given the amount of data it provides in real-time (Jordan et al., 2018, p. 2; Sinnenberg et al. al., 2017, p. e3); on increasing knowledge about how public health communication occurs between organizations and audiences; the messages of political leaders during these periods; the study of communication strategies that make it possible for messages to have a greater reach, or, as in the case of the research carried out by Zolbanin et al. (2021), on establishing whether messages about diseases published by users on social networks can be used to determine the list of symptoms of a disease in a short period (p. 1).

Within social networks “Twitter is, without a doubt, the most influential social network in the health field, and in which authors, scientific organizations, professionals, and patients focus most of their attention” (Barajas-Galindo and Rodríguez Carnero, 2020, p. 295). Obtaining high popularity among political leaders and citizens (Caldevilla-Domínguez et al., 2019, p.1288). Proof of this is the use that the presidents of different countries have made of digital communication through this platform to update the population on the news regarding COVID-19 (Manfredi-Sánchez et al., 2021, p. 86).

In environments of high uncertainty, such as that derived from this pandemic context, the relevance of communication and that the population is duly informed in the face of a health crisis is evident. The use of this type of social platform to carry out health communication can facilitate social participation, interaction with the audience, and informational support, empowering users in their decision-making in health matters (Centers for Disease Control and Prevention, 2011, p. 1; Myrick et al., 2016, p. 5).

Infodemiology data, understood as the profusion of information on the Internet, focused on the health field communication on Twitter, indicate that this network allows professionals to know in real-time the opinion, perception, or sensation of users (Pulido- Polo et al., 2021, p. 10; WHO, 2020; Eysenbach, 2020, p. 2; Schillinger et al., 2020, p. 1393). In this way, it is possible to obtain metrics related to the audience's attitude towards a public or private service (Eysenbach, 2011, p. S157), with the impact that the treatment of this information may lead to improvement or boost of service in a given sector. In terms of public health, Twitter has also become a useful means of obtaining information on the first symptoms of a disease in the event of a possible outbreak of a pandemic (Guo et al., 2021, p. 7). Likewise, the analyzes that refer to the sentiment of the messages that users express on their social networks are relevant in the management of a pandemic. In this sense, studies have indicated that during the start of the vaccination campaign against COVID-19, negative messages have prevailed on Twitter (Hou et al., 2021, para. 12). These types of studies offer information on the need to promote campaigns that increase the population's trust in the vaccination process.

The analysis of the publications in digital social networks in the health field facilitates the understanding of the communication between the official bodies and the rest of the participants. This knowledge can be useful in times of health crises “to guide future communication strategies for emerging global health crises” (Wang et al., 2021, p. 11). Research on pandemic management shows the relevance of being able to monitor information from the environment to obtain information that facilitates the promotion of preventive measures in the event of a possible health crisis, but, furthermore, those responsible for communication must provide information to the audience to reduce public anxiety and stress (Xifra, 2020, p. 3). Most of the messages aimed at promoting knowledge of health originate from non-profit organizations (NGOs) (49.2%) (Park et al., 2013, p. 415). Although the use of social networks is becoming generalized in the health field, their use is still not very effective, given that there is usually an absence of two-way communication; lack of interactivity, and lack of professionalism in managing accounts (Sendrá-Toset and Farré-Comá, 2016, p. 293). However, the information published on Twitter about health by government agencies is organized in a way that further facilitates public understanding (45.5%) (Park et al., 2013, pp. 415-418).

Studies on the corporate image of Spanish hospitals indicate that they should professionalize their communication on digital social networks, enhancing their presence in them and setting communication objectives (Medina, 2018, p. 222). These hospitals point out that among the main difficulties in carrying out communication through social networks is the lack of training in

communication management; updating of the contents; involvement of professionals. Likewise, there is difficulty in reaching potential users and the absence of citizen feedback (Rando and de las Heras, 2016, p. 568). The analysis of the corporate communication of Andalusian hospitals indicates that about 60% of those who use social networks to carry out their health communication seek to promote effective communication with society (Rando and de las Heras, 2016, p. 566). Most also do so to promote social projection and disseminate information. To a lesser extent, but also a relevant aspect is the objective of promoting an image of closeness to health professionals (Rando and de las Heras, 2016, p. 565). All this shows the need to approach health communication from a strategic, planned, and professional orientation, with messages adapted to the environment and the audience.

Health institutions have the challenge of knowing the interest generated in the audience by the publications they make on digital social networks. The relevance of the interaction of the public with these publications lies in knowing the key aspects that facilitate generating that interest, promote collaboration between network users, and the rapid and effective exchange of information (Sanz-Lorente et al., 2018, p. 5).

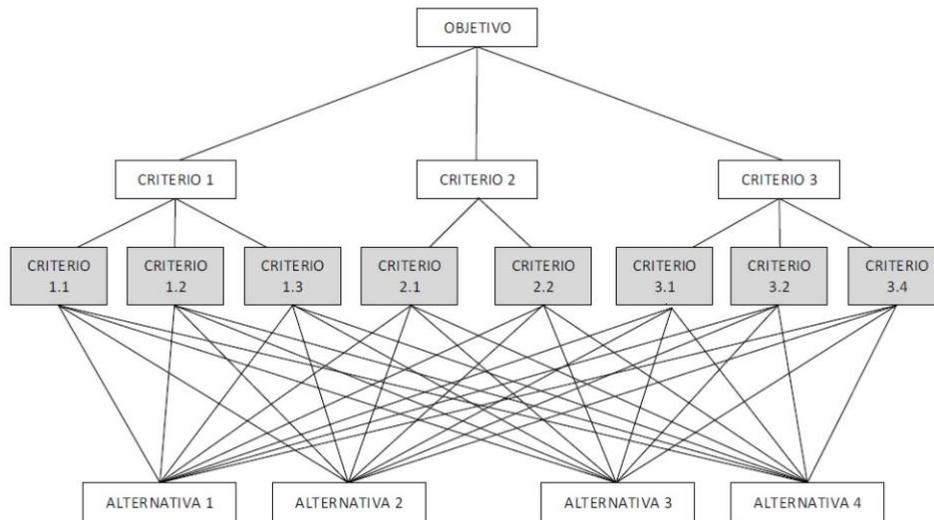
## **1.2. The Analytic Hierarchy Process in decision making**

During the 1970s, Thomas L. Saaty developed the Analytic Hierarchy Process (AHP), a method to facilitate decision-making on complex issues involving multiple criteria (Paredes, 2010, p. 96), such as qualitative aspects that are difficult to assess to determine a decision, as well as quantitative ones.

In decision-making, this process requires the evaluation of each of the criteria involved, to provide a hierarchical model of priorities for each option (Hurtado and Bruno, 2005; Lamirán-Palomares et al., 2020, p. 7). In a way, it consists of including in the decision-making the quantification or the numerical value of qualitative elements.

The AHP segments the problem so that possible solutions can be seen more clearly. Its answer is not discretionary but provides alternatives based on criteria established and ranked in advance.

It is the way to provide mathematical support to decision-making using quantitative and qualitative criteria on the same scale (Hurtado and Bruno, 2005). The prior difficulty to carry out decision-making is also because on multiple occasions, the criteria are contrary and conflict is generated (Yepes, 2018). Therefore, the problem is broken down into a hierarchy. Figure 1 shows the arrangement of the criteria in an Analytic Hierarchy Process.



**Figure 1:** AHP Hierarchical Structure Example.

**Source:** Yepes (2018). <https://cutt.ly/9bJyhr7>

A hierarchy is established in which the objective to be achieved is located at the top, followed below the criteria, sub-criteria, and alternatives with the idea that the comparison between criteria of the same level can be carried out simply (Yepes, 2018). In its elaboration, the preference scale shown in Table 1 is usually used, known as the fundamental comparison scale by pairs (Saaty, 1980).

**Table 1.** Fundamental comparison scale by pairs

Value	Definition	Comments
1	Equal importance	Criterion A is just as important as Criterion B
3	Moderate importance	Experience and judgment slightly favor criterion A over criterion B
5	Great importance	Experience and judgment strongly favor criterion A over criterion B
7	Very great importance	Criterion A is much more important than criterion B
9	Extreme importance	The greater importance of criterion A over criterion B is beyond doubt
2,4,6 y 8	Intermediate values between the previous ones, when it is necessary to qualify them	

**Source:** Saaty (1980)

As observed in the studies on decision-making with multicriteria techniques in the elaboration of models for the analysis of success factors, this scale continues to be implemented today (Guijarro et al., 2018, p. 1419; Velastegui et al., 2020, pp. 161-162). It is used to carry out the paired comparison between criteria, quantifying the qualitative elements. The steps to carry out this type of process are, firstly, to establish the weight of each criterion and later to compare the existing alternatives for each criterion, weighing the results (González, 2019).

The study of analytical frameworks on the aspects that contribute to success and popularity in technological communication can be approached through the study of multicriteria models linked to the analysis of organizations' communication on Twitter. Along these lines, there are research works aimed at external communication of public bodies linked to security profiles, such as the one carried out by Guijarro et al. (2018).

Because Twitter is a relatively new platform, it emerged in 2006, the studies that deal with it are current and there is a wide space in which to advance researching the analysis of communication strategies in this network. The purpose of this study is to provide information that facilitates the selection of the most relevant elements that should be taken into consideration in the communication processes on Twitter.

This study addresses the issue of the elements that contribute to communication success and popularity through research, framed in the analysis of health communication, which aims to measure the main variables used by health profiles to influence society.

## **2. Objectives**

The general objective of this research is to provide a better understanding of the influence of digital social networks in the health field. Providing a tool that enables institutions to make qualitative decisions in these communication processes on Twitter, applying the Analytic Hierarchy Process (AHP).

The specific objectives of this study are to develop a hierarchical analysis model following the research lines of authors who have redirected this model to the social networks field (Guijarro et al., 2018; Lamirán-Palomares et al., 2020), as well as evaluate its validity in the case of institutional profiles in the public health field, determining the weight of the criteria that have a greater influence on Twitter and establishing which public institutional profiles, linked to health issues, have a greater weight in the criteria proposed by this model.

## **3. Methodology**

To achieve these objectives, it has been proposed to analyze the use of Twitter carried out by 21 public bodies in the Spanish health field, as well as the assessment of the success criteria of their communication strategy on the network, through the multi-criteria model, following the line of research proposed by the authors Guijarro et al., (2018).

Twitter has been selected because of its relevant number of users and because it is a platform in which the information that prevails is mainly informative. In this sense, other apps with more users than Twitter have been ruled out, such as Facebook, because, although the latter allows its use by organizations, it is a social network more focused on personal relationships.

This study aims to analyze health communication carried out by the public administration. For this reason, analyzing this social network has been considered a priority, since all the messages on this network are publicly accessible.

The unit of analysis is the tweet and the scope of the study are the tweets published by Spanish institutional profiles in the public health field. In the selection of profiles, two levels have been established, one determined by the national character of the profiles and the other defined by the regional character. It is taken into account that the public to whom each of the profiles is addressed and the scope of the information is different on the national and regional axis. In this way, the entire range of institutional information transmitted on public health matters is collected. The communication of the regional profiles is close information, mainly focused on the territory, while the national profiles are aimed at the population as a whole. In this sense, aspects that may influence

the scope of communication have also been taken into account, such as the language used, since some regional accounts have established their information in several languages. In this way, the 21 user profiles detailed in table 2 have been monitored.

**Table 2.** Profiles of the analyzed Twitter users

<b>Level of national representation in the health field</b>	
Ministry of Health, Consumption, and Social Welfare: Min. Health (MSCBS)	@sanidadgob
National Institute of Health Management (INGESA)	@INGESAnidad
<b>Level of regional representation in the health field</b>	
Castilla La Mancha Health Council	@SanidadCLM
Castilla y León Health Council	@Salud_JCYL
Valencia Health Council	@GVAsanitat
Canary Islands Health Council	@SanidadGobCan
Health Council of the Junta de Extremadura	@JuntaEx_Sanidad
Health and Families Council of the Junta de Andalucía	@saludand
Health Council of the Community of Madrid	@SaludMadrid
Health Portal of the Principality of Asturias	@astursalud
Basque Health Service	@osakidetzaEJGV
General Directorate of Public Health of Aragon	@SaludPublicaAra
<i>Institut Català de la Salut. Departament de Salut. Generalitat de Catalunya</i>	@icscat
Health Space of the Government of Navarra	@snsalud_na
<i>Servei de Salut (IB-Salut) Govern de les Illes Balears</i>	@ibsalut
Murcia Health Council	@Murciasalud
La Rioja Health Service	@riojasalud
<i>Perfil oficial da Consellería de Sanidade da Xunta de Galicia</i>	@SanidadeXunta
Health Council of the Government of Cantabria	@saludcantabria
National Institute of Health Management in Ceuta	@Ingesa_Ceuta
National Institute of Health Management in Melilla	@Ingesa_Melilla

**Source:** self-made based on Twitter information

The universe is made up of all the tweets that each of the accounts of these profiles have published on Twitter since they were created. The difficulty involved in analyzing messages on Twitter is, as the researchers Pérez et al. (2013) point out, that “Twitter is a good spokesperson, but a nefarious archivist” (p. 11). The extraction of its information is limited to the number of tweets. The selected temporal space is determined by the availability of the data through the free tool Twitonomy that analyzes the 3,200 most recent tweets from each of the users. The content extraction of the 21 profiles studied was carried out during the first week of December 2020. It has been considered appropriate to use a data sample amid the health crisis produced by the COVID-19 pandemic, given that through them, it is possible to obtain information on what is the performance of the health profiles in a period of high interest in health information.

This study is based on the AHP methodology in decision-making. In line with other research, the information obtained through the free access tool Twitonomy (Caldevilla-Domínguez et al., 2021, p. 3) has been quantified, proceeding to select the variables linked to the dissemination of messages on Twitter. The data extracted correspond to 63,985 tweets.

To determine the study variables, two experts from the field of communication from public and private organizations were consulted. In the selection of experts, aspects such as years of experience in the field of corporate communication, their professional career in communication on social

networks, and, finally, the criterion of parity have been taken into account. In this way, two experts in corporate communication have been selected, with more than 20 years of professional experience linked to strategic communication. One of the experts is Mercedes Pastor García, Dircom specialized in strategic communication. She has an experience of more than 25 years in the field of communication and has worked on communication strategies in different institutions. She is currently the communication director at the Ministry of Health. The other expert is Cristóbal Fernández Muñoz, current Vice Dean of Communication and Institutional Relations at the Faculty of Information Sciences of the Universidad Complutense de Madrid (UCM). He has more than 20 years of experience in the field of corporate communication. He has been director of communication for the social network Tuenti and Reclamaror.es, directing the entity's communication strategy in both positions.

These criteria have been contrasted with those used in the research on Twitter communication by Guijarro et al. (2018, p. 1417); Lamirán-Palomares et al., (2020, p. 8). Thus, we have chosen to select two clusters, cluster 1: account activity; cluster 2: impact of the account, varying some of the criteria to adjust them more to the needs of the study. In this way, it has been chosen to include the efficiency criterion, that is, the retweets and favorites received from third parties compared to the total number of tweets made.

Table 3 shows the 17 criteria analyzed. Some of them are, the user profile of the account, the number of followed; the number of total tweets; the number of retweets made by the account; the number of replies; the average tweets/day; the number of followers; the amplification of the message through the number of tweets retweeted by other users, as well as the number of times that the published tweets have been retweeted; the total number of hashtags, and the mentions made to the profile.

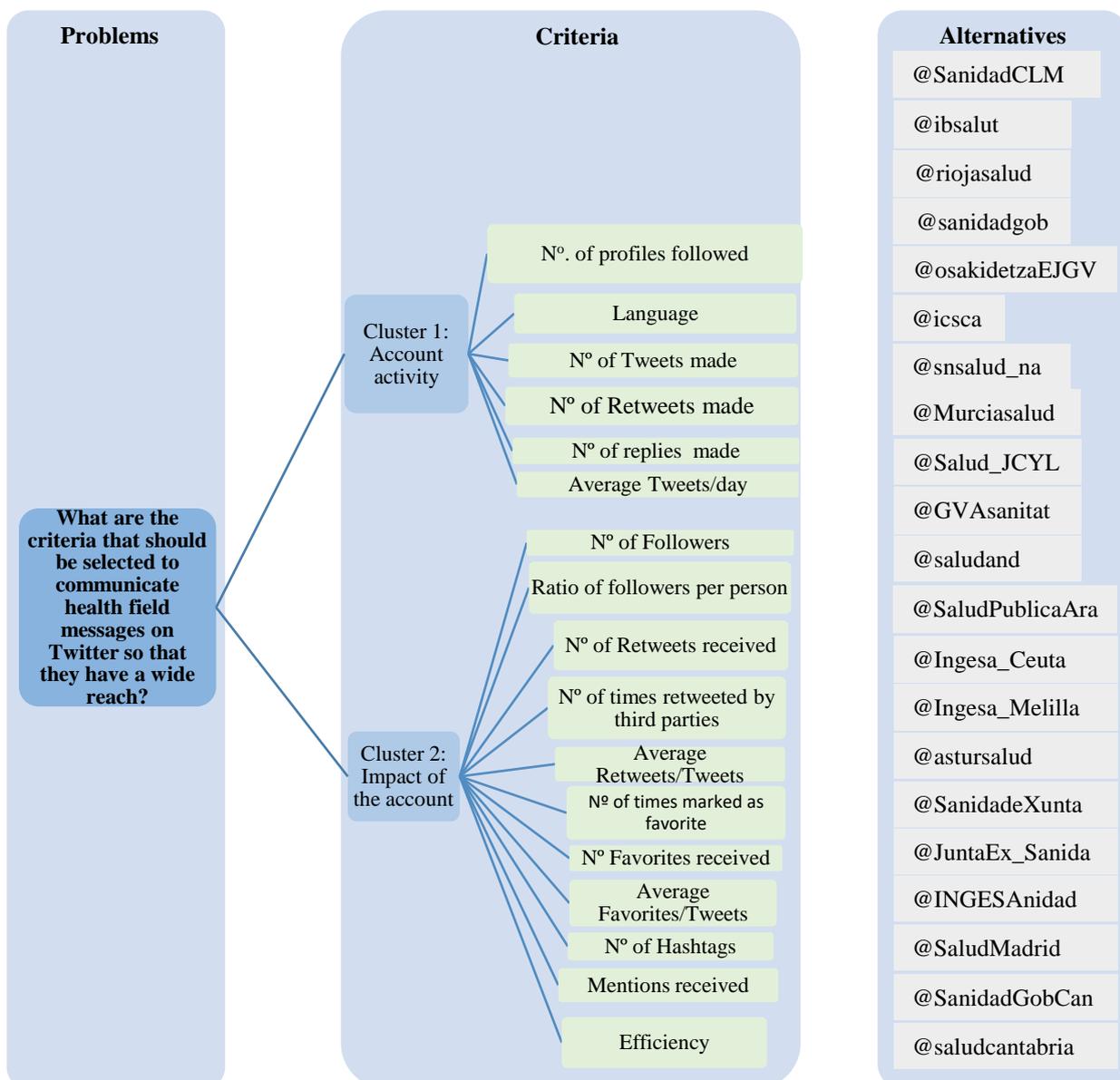
**Table 3.** *Analysis variables*

<b>Twitter profile:</b>	<b>Analysis of the 3200 most recent Tweets</b>
Level	National/regional
Cluster 1: Account activity	
Publication language	
Number of followed	
The total number of Tweets	
Number of Retweets	
Number of replies	
Average Tweets/day	
Cluster 2: Impact of the account	
Number of followers	
The ratio of followers per person (measures the level of influence)	
Number of Retweets received	
Number of times retweeted by third parties	
Average Retweets/Tweets	
Number of favorites received	
Nº. of times marked as favorite by third parties	
Average favorites/Tweets	
Efficiency (Retweets and favorites from others towards it) / Total number of Tweets	
Number of hashtags	
Mentions received	

**Source:** self-made based on Guijarro. 2018

Once the variables are defined, the next step is to decompose the problem and rank it. To compare the used alternatives and the criteria, it is necessary to determine which of the 21 analyzed profiles performs better communication on Twitter based on those criteria.

In terms of quality, when the Analytic Hierarchy Process is developed, it is necessary to study the level of consistency of the experts' criteria for it to be considered valid, that is, for it to be valued as rational. So that for the proposed model to be considered valid, it is essential to measure the inconsistency index of the matrix that determines whether the experts' judgment is acceptable or not (Favret et al., 2015, p. 6; Guijarro et al., 2018, p. 1420; Lamirán-Palomares et al., 2020, p. 7). A consistency ratio (CR) less than or equal to 0.10 is considered consistent (Velasategui et al., 2020, p. 163; Lamirán-Palomares et al., 2020, p. 8; Shan, 2021, p. 61). In this way, the relative importance of each criterion has been previously weighted by communication experts, taking into account the levels of consistency necessary for the acceptance of the AHP model.



**Figure 2:** Hierarchy of the problem  
**Source:** self-made

Figure 2 indicates the problem to be solved, the 17 criteria that are part of the decision process, condensed into two clusters. Cluster 1 encompasses criteria related to account activity and cluster 2 those related to impact. Finally, the 21 Twitter profiles analyzed are shown, considering each one a communication alternative.

To determine the qualitative importance of each criterion, paired comparisons have been made using the pairwise comparison scale established by Saaty (1980), still in force (Beltrán et al., 2021, p. 252; Sirakaya et al., 2020, p. 5; Guijarro et al., 2018, pp. 1418-1419). Following the 9-point scale of Saaty (1980), the result of the expert consultation has resulted in two matrices. In them, the relative importance of each criterion has been compared with each other, based on their dominance. The result of the pairwise comparison can be seen in the matrices in tables 4 and 5.

**Table 4. Paired Comparison Matrix, Cluster 1: Account Activity**

	Language	N° of Followed	N°. of Tweets made	N° of Retweets made	N° of replies made	Average Tweets/day
Language		1	1/2	1/2	1/2	1/2
N°. of followed			1/2	2/1	1/2	1/2
N°. of Tweets made				2/1	1	1
N°. of Retweets made					1/2	1/2
N°. of replies made						1/2
Average Tweets/day						

**Source:** self-made through the criteria of two communication experts

**Note:** Inconsistency level 0.03

It can be observed that the experts have considered that the number of followed, tweets made, retweets, replies made, and the average number of tweets/day have a moderate dominance over the language.

**Table 5. Paired Comparisons Matrix, Cluster 2: Impact of the account**

	N° of followers	The ratio of followers per person (measures the level of influence)	N° of Retweets received	N° of times retweeted by third parties	Average Retweets/Tweets	N° of Favorites received	N° of times marked as favorite by third parties	Average favorites/Tweets	Efficiency (Retweets and favorites from others towards it) / Total number of	N° of Hashtags	Mentions received
N° of followers		1/2	1/5	1/2	1/5	1/2	1/2	1/2	1/4	2/1	1/3
The ratio of followers per person (measures the level of influence)			1/5	1/3	1/3	1/2	1/2	1/2	1/4	4/1	1/3
N° of Retweets received				1/2	1	3/1	3/1	3/1	1/2	7/1	2/1
N° of times retweeted by third parties					1	3/1	3/1	4/1	1	7/1	2/1

Average Retweets/Tweets						3/1	3/1	3/1	1/3	7/1	2/1
Nº of Favorites received							1	1	1/3	3/1	1/2
Nº of times marked as favorite by third parties								1	1/2	3/1	1/2
Average favorites/Tweets									1/2	4/1	1/2
Efficiency (Retweets and favorites from others towards it) / Total number of Tweets										6/1	1
Nº of Hashtags											1/3
Mentions received											

**Source:** self-made through the criteria of two communication experts

**Note:** Inconsistency level 0.03

To determine that the evaluation matrix of this study is acceptable, the inconsistency ratio calculated through the Expert Choice program has been measured. The inconsistency ratio (IR) for the matrices represented in tables 4 and 5 is 0.03. As the IR is less than 0.1, it falls within the accepted parameters (Mendoza et al., 2019, p. 352).

The final step is to know the eigenvectors and weigh each of the alternatives to find out which is the variable that explains the problem based on the initial assessment made by the experts (Guijarro et al., 2018, p. 1420).

#### 4. Results

Each of the analyzed profiles may show a greater or lesser development of their communication strategy on Twitter depending on the time they have been using the app. Through the Analytic Hierarchy Process, information is obtained about which of the 21 communication alternatives analyzed is the most appropriate to disseminate information on health matters on Twitter and to know the balanced weight of each criterion (Table 6). After treating the information matrix provided by the consulted experts, it is observed that, between the two clusters, they give greater relevance to "cluster 2: Impact of the account", with a weight of 0.750, while the "cluster 1: account activity" weights 0.250.

**Table 6.** Cluster's balanced weight

Cluster	Weight of the cluster
C1. Account activity	0.250
C2. Impact of the account	0.750

**Source:** self-made

The weight of each of the criteria is shown in table 7. Within "Cluster 1: Account activity", the criterion "average tweets per day" is the one with the greatest relevance, with a weight of 24.8%, followed by the tweets made (21.6%) and the number of replies made (19.6%). With these data, it can be indicated that in communication strategies in digital social networks, constancy is a relevant factor, confirming the observations carried out by Guijarro et al. (2018).

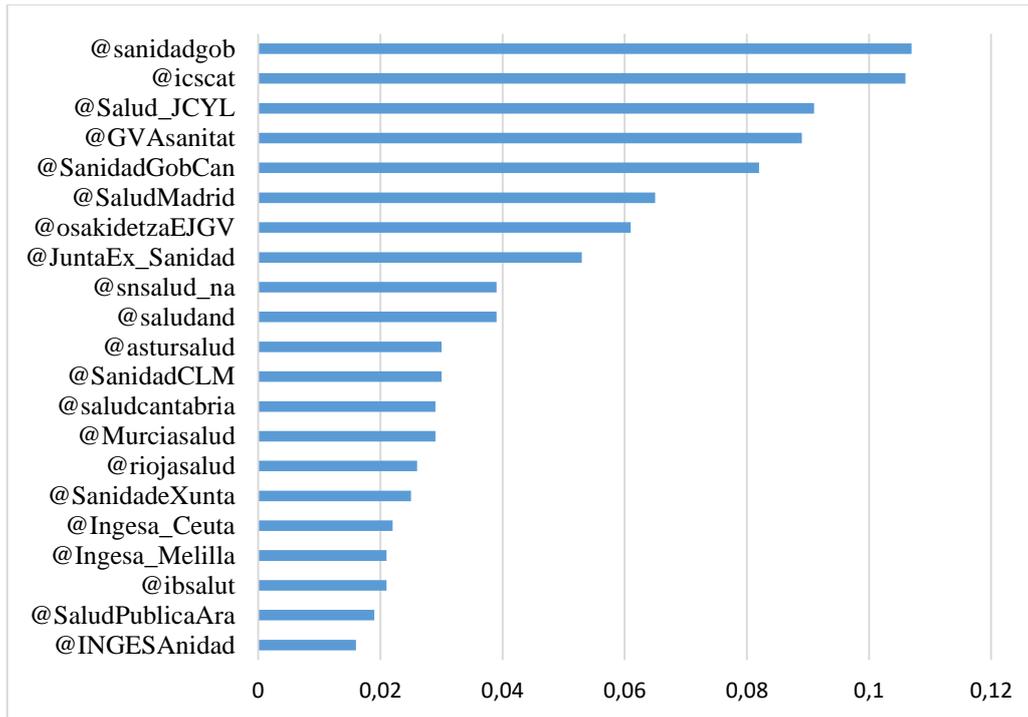
In "cluster 2: Impact of the account", the most important criterion is effectiveness (17.3%), followed by the number of times it has been retweeted by third parties (16.4%) and the number of retweets (14.8%).

**Table 7.** Weight of each of the criteria. The year 2020

	Percentage of relative weight according to cluster	Overall weight	Overall weight percentage
<b>Cluster 1: Account activity</b>			
Language	10	0,025	2,5
Nº. of followed	12,8	0,032	3,2
Nº. of Tweets made	21,6	0,054	5,4
Nº. of Retweets made	11,2	0,028	2,8
Nº. of replies made	19,6	0,049	4,9
Average Tweets/day	24,8	0,062	6,2
<b>Cluster 2: Impact of the account</b>			
Nº of followers	3,47	0,026	2,6
Ratio of followers per person (measures the level of influence)	4,27	0,032	3,2
Nº of Retweets received	14,80	0,111	11,1
Nº of times retweeted by third parties	16,40	0,123	12,3
Average Retweets/Tweets	14,53	0,109	10,9
Nº of Favorites received	5,60	0,042	4,2
Nº of times marked as favorite by third parties	5,87	0,044	4,4
Average favorites/ Tweets	5,87	0,044	4,4
Efficiency (Retweets and favorites from others towards it) / Total number of Tweets	17,33	0,130	13
Nº of Hashtags	2,00	0,015	1,5
Mentions received	9,87	0,074	7,4

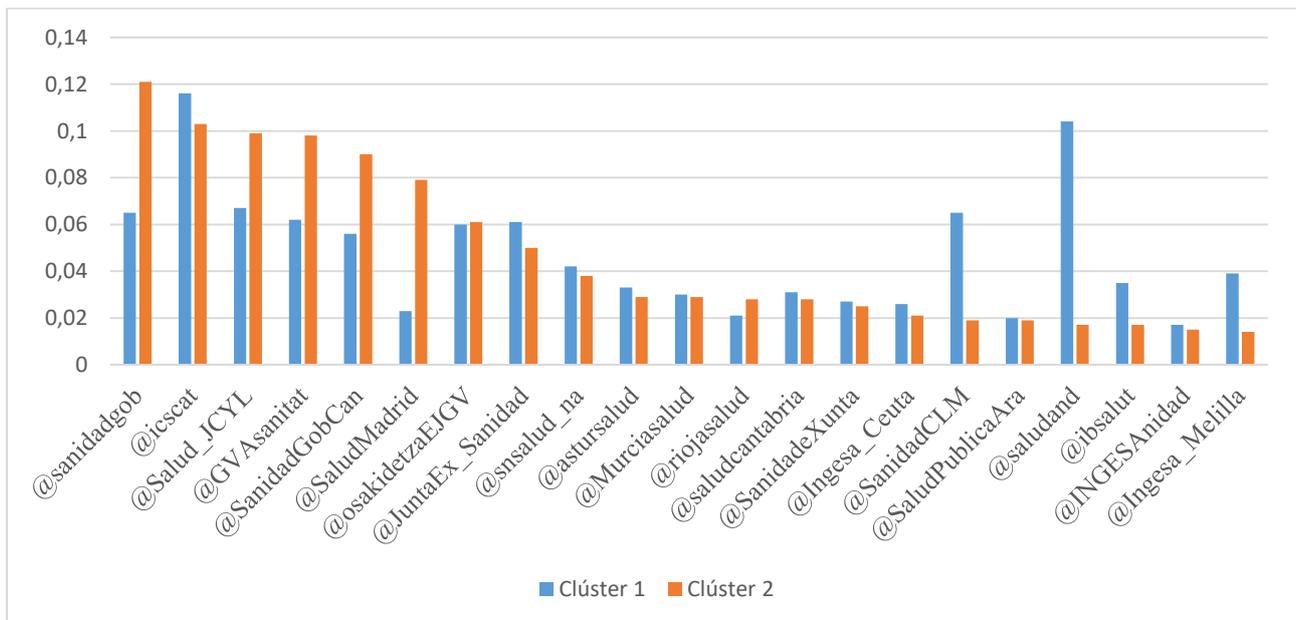
**Source:** self-made

Knowing the weight of each criterion, chart 1 shows the weighting of each of the 21 profiles analyzed. In the first place, there is the profile of the Ministry of Health, Consumption, and Social Welfare: Min. Health (MSCBS), @sanidadgob, with importance according to the model of 10.7%, practically equal to the profile of the *Institut Català de la Salut. Departament de Salut. Generalitat de Catalunya*, @icscat, with 10.6%. In third place, is Castilla y León Health Council, @Salud\_JCYL, with a weight of 9.1% compared to the total.



**Chart 1:** *Balanced weight of each alternative*  
**Source:** Self-made

Chart 2 shows the weight of the 21 alternatives broken down by each of the two clusters. In its preparation, the weight of the 17 variables that make up the account activity and impact clusters has been taken into account.



**Chart 2:** *Weight of the alternatives regarding "Cluster 1: Account activity" and "Cluster 2: Impact of the account"*  
**Source:** self-made

This information shows, according to the evaluated criteria, which are the most relevant profiles. Likewise, the data corroborate that the greatest weight of the model falls on cluster 2.

The alternative of the Ministry of Health, Consumption, and Social Welfare: Min. Health (MSCBS), @sanidadgob which, as mentioned above, is the one with the greatest relevance in the model, together with @icscat, is in turn, the one that has the greatest weight in the impact cluster. It is also observed that the *Institut Català de la Salut. Departament de Salut. Generalitat de Catalunya*, @icscat, has a more balanced profile between both clusters. The case of the profile of the Health and Families Council of the Junta de Andalucía, @saludand, is striking. Analyzing the weight of the model of this profile, it is observed that it is located in the ninth position compared to the 21 institutional profiles analyzed, however, it has reached that position, being one of the profiles with the least weight in the impact cluster (cluster of greater weight in the model), but counteracting this situation with a high weight in the activity cluster (10.4%) that causes it to occupy the second position next to the profile of the Catalan institute (11.4%) within that cluster.

## 5. Discussion and conclusions

When establishing a communication strategy in digital social networks, those responsible for the institutional profiles in the health field on Twitter must bear in mind different criteria that hinder decision-making when disseminating information on the network.

This study provides an analysis of the communication carried out on Twitter by 21 public organizations linked to the health field, in which the relationship between the different elements that make up communication on this social network and the scope of the information published on it has been observed. For this, an Analytic Hierarchy Process (AHP) has been developed that facilitates knowledge of the health communication strategy carried out on Twitter by each of these 21 public organizations. Through it, this study proposes a multicriteria model that aims to enable decision-making in the development of communication on Twitter, in line with the idea of previous studies (Guijarro et al., 2018).

This work facilitates knowing those criteria that benefit communication on Twitter and that can be taken into account by different organizations when they carry out digital communication strategies, following the thesis of authors who point out the importance of knowing the key aspects that determine that communication has a greater reach, encourages greater interaction, and exchange of information (Sanz-Lorente et al., 2018, p. 5; Thackeray et al., 2012, p. 5).

The data confirm that the impact cluster is the one with the greatest weight in communication on Twitter. In this study, the efficacy criterion has also been included, understood as the number of retweets and favorites received over the total number of tweets, observing that it is one of the most relevant within the impact of the account cluster.

It is confirmed that, in communication strategies in digital networks, if the impact of a Twitter profile is observed, among the three most relevant elements are, in this order, effectiveness (13%); the number of times retweeted by third parties (12.3%), and the number of retweets received (11%), in line with the results obtained in other areas such as security (Guijarro et al., 2018, p. 1422). Analyzing the factors related to the activity of the profile, the average number of tweets per day stands out, with 24% compared to the weight of that cluster.

The results of this study reveal that the organization that obtains a greater weight in the proposed model is the one corresponding to the Ministry of Health, Consumption, and Social Welfare: Min. Health (MSCBS), @sanidadgob, practically equated with the alternative of the *Institut Català de la Salut. Departament de Salut. Generalitat de Catalunya*, although one of the aspects that hinders this positioning is the language, since it exclusively uses the Catalan language, unlike other regional accounts that have combined other languages with Spanish. This fact means that its diffusion is restricted among Catalan-speaking users and, therefore, coverage may be less.

One of the conclusions that can be drawn from this study is that, regardless of the type of organization that is analyzed, the AHP is a facilitating tool for decision-making in the field of digital communication in social networks (Osorio and Orejuela, 2008, p. 252; Guijarro et al., 2018, p. 1424).

Some limitations present in this study should be noted. Due to the novelty of the use of AHP in the field of communication and social networks, there is room to refine the used methodology. In this study, only elements related to the activity of the account and its impact have been taken into account. Some relevant aspects can be included, such as the analysis of the social and technological context in which each analyzed Twitter profile operates, as well as the variables related to the organization such as the existence of a communication plan or a department in charge of social networks communication. It also has limitations regarding data collection, since the Twitonomy app offers limited results, reducing the information to the last 3,200 Tweets of each profile.

As future lines of research, the possibility of analyzing what has been the impact of the health crisis produced by COVID-19 on digital health communication is proposed, making a comparison of the weight of these alternatives before and after the pandemic occurred. Likewise, it is considered relevant to complement this research with the content analysis of the selected tweets to observe their impact on the model. It is also suggested that in-depth interviews be carried out with those responsible for communication of the analyzed profiles to find out their criteria, preferences, and values when establishing this communication and the difficulties they are subjected to in decision-making.

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ANNEX I

**Table 8.** *Data of the 21 Twitter profiles analyzed*

ACCOUNT ACTIVITY							
	Profile: @sanidadexunta	Profile: @SaludCantabria	Profile: @sanidadgob	Profile: @INGESAnidad	Profile: @SanidadCLM	Profile: @Salud_JCYL	Profile: @GVAsanitat
<b>Analysis</b>	3.200 2oct 2019 (may 21)	3,105 11 of February 2020	3200 14 March 2020-27 Nov 2020	1127 5 November 2014-06 December 2020	3184 11 May 2018- 06 December 2020	3200 03 March 2020-06 December 2020	3199 21 June 2019-06 December 2020
<b>Level</b>	Regional	Regional	National	National	Regional	Regional	Regional
<b>Publication language</b>	Galician and Spanish	Spanish	Spanish	Spanish	Spanish	Spanish	Spanish
<b>Year it joined Twitter</b>	2.016	2.019	2.010	2.014	2.013	2.011	2.011
<b>Number of followed</b>	388	488	680	256	1.304	23	4.458
<b>Total number of tweets</b>	6.882	3.105	16.650	1.134	31.826	35.237	22.714
<b>Analyzed tweets</b>	3.200	3.105	3.200	1.127	3.184	3.200	3.199
<b>Number of retweets to other users</b>	1.577	1.781	1.117	636	2.061	175	418
<b>Number of replies (to see the level of interaction)</b>	31	214	422	127	421	199	222
<b>Average tweets/day (the higher the number, the more active the user)</b>	5,54	6,98	11,99	0,51	3,38	11,47	5,98

ACCOUNT ACTIVITY							
	Profile: @SanidadGobCan	Profile: @JuntaEx_Sanidad	Profile: @saludand	Profile: @SaludMadrid	Profile: @astursalud	Profile: @osakidetzaEJGV	Profile: @SaludPublicaAra
<b>Analysis</b>	3200 07 March 2020-06 December 2020	3200 28 March 2018-06 December 2020	3200 21 April 2020-06 December 2020	2740 01 February 2018-06 December 2020	3200 25 February 2019-06 December 2020	3200 02 October 2019-06 December 2020	2654 09 February 2011-06 December 2020
<b>Level</b>	Regional	Regional	Regional	Regional	Regional	Regional	Regional
<b>Publication language</b>	Spanish	Spanish	Spanish	Spanish	Spanish	Spanish and Basque	Spanish
<b>Year it joined Twitter</b>	2.019	2.013	2.011	2.018	2012	2010	2011
<b>Number of followed</b>	82	73	1.239	112	524	72	420
<b>Total number of tweets</b>	4657	7.365	41.762	2.741	7.908	10.138	2656
<b>Analyzed tweets</b>	3.200	3.200	3200	2740	3200	3200	2654
<b>Number of retweets to other users</b>	420	727	2455	559	1746	621	1482
<b>Number of replies (to see the level of interaction)</b>	770	1.446	8	453	450	1165	121
<b>Average tweets/day (the higher the number, the more active the user)</b>	11,64	2,37	13,91	2,63	4,92	7,41	0,74

ACCOUNT ACTIVITY							
	Profile: @icscat	Profile: @snsalud_na	Profile: @ibsalut	Profile: @Murciasalud	Profile: @riojasalud	Profile: @Ingesa_Ceuta	Profile: @Ingesa_Melilla
<b>Analysis</b>	3198 24 March 2020-06 December2 020	3200 16 September 2019-06 December 2020	3200 29 September 2016-06 December 2020	3199 14 December 2018- 06 December 2020	3199 11 January 2017- 06 December2020	3181 26 May 2017-06 December 2020	3199 11 June 2017-06 December 2020
<b>Level</b>	Regional	Regional	Regional	Regional	Regional	Regional	Regional
<b>Publication language</b>	Spanish and Catalan	Spanish	Spanish	Spanish	Spanish	Spanish	Spanish
<b>Year it joined Twitter</b>	2010	2010	2012	2010	2009	2011	2011
<b>Number of followed</b>	3957	935	907	159	574	274	210
<b>Total number of tweets</b>	35870	12366	4489	11765	6470	5320	7440
<b>Analyzed tweets</b>	3198	3200	3200	3199	3199	3181	3199
<b>Number of retweets to other users</b>	163	836	2562	1754	459	1556	2724
<b>Number of replies (to see the level of interaction)</b>	761	623	91	20	13	240	57
<b>Average tweets/day (the higher the number, the more active the user)</b>	12,4	7,14	2,09	4,42	2,24	2,46	5,87

IMPACT OF THE ACCOUNT							
	Profile: @sanidadexunta	Profile: @SaludCantabria	Profile: @sanidadgob	Profile: @INGESAnidad	Profile: @SanidadCLM	Profile: @Salud_JCYL	Profile: @GVAsanitat
Number of followers	8.318	4.165	600.349	583	16.292	28.488	59.054
The ratio of followers per person (measures the level of influence)	21	8,53	883	2,28	12	1238	13
Number of tweets retweeted by other users	1.402	1.067	1.954	199	756	2.565	2.640
Number of times tweets have been retweeted	6.333	10.289	295.909	488	13.273	27.090	76.854
Average retweets/ tweets	43,81%	57,00%	61,10%	17,66%	23,74	80,16	82,53%
Favorites received from other users	1.405	1.212	2.023	143	911	2.675	2.698
Number of times marked as favorite by others	9.060	18.779	450.544	398	14.707	34.556	128.209
Average favorites/ tweets	43,91%	39,00%	63,2%%	12,69%	28,61	83,59	84,34%
Efficiency (retweets and favorites of others towards it) / Total number of tweets	87,72%	71,22%	124,28%	30,35%	52,36%	163,75%	166,86%
Total hashtags	3.688	2.749	2.822	715	476	6.474	2.294
Mentions made to the profile	149	1.518	1.023	472	938	2.199	2.435
Average number of mentions per tweet	0,05	0,49	0,32	0,42	0,29	0,69	0,76

IMPACT OF THE ACCOUNT							
	Profile: @SanidadGobCan	Profile: @JuntaEx_Sanidad	Profile: @saludand	Profile: @SaludMadrid	Profile: @astursalud	Profile: @osakidetzaEJGV	Profile: @SaludPublicaAra
Number of followers	24.637	6.080	43.039	66.289	14.728	25.213	5.091
The ratio of followers per person (measures the level of influence)	300	83	35	543	28	350	12
Number of tweets retweeted by other users	2323	1.525	713	1.918	1265	2238	853
Number of times tweets have been retweeted	50255	4.108	10.349	105.968	25.767	28473	5505
Average retweets/tweets	72,59%	47,66%	22,28%	70,00%	39,53%	69,94%	32,14%
Favorites received from other users	2594	1.584	736	2.004	1359	2416	602
Number of times marked as favorite by others	115.700	5.103	17.084	135.417	51040	37805	4905
Average favorites/tweets	81,06%	49,50%	23,00%	73,14%	42,47%	75,50%	22,68%
Efficiency (retweets and favorites of others towards it) / Total number of tweets	153,66%	97,16%	45,28%	143,14%	82,00%	145,44%	54,82%
Total hashtags	2400	1.394	825	5.841	2020	697	1431
Mentions made to the profile	1367	3.797	144	1.288	1211	255	823
Average number of mentions per tweet	0,43	1,19	0,05	0,47	0,38	0,08	0,31

IMPACT OF THE ACCOUNT							
	Profile: @icscat	Profile: @snsalud_na	Profile: @ibsalut	Profile: @Murciasalud	Profile: @riojasalud	Profile: @Ingesa_Ceuta	Profile: @Ingesa_Melilla
Number of followers	56928	9022	7802	17579	5870	2403	2547
The ratio of followers per person (measures the level of influence)	14	9,65	8,6	111	10	8,77	12
Number of tweets retweeted by other users	2691	1553	593	1431	1321	997	394
Number of times tweets have been retweeted	25402	8222	6759	34786	3308	4277	1700
Average retweets/tweets	84,15%	48,53%	18,53%	44,73%	41,29%	31,34%	12,32%
Favorites received from other users	2966	1644	605	1443	1524	977	373
Number of times marked as favorite by others	72520	11191	9393	45540	4620	4536	1623
Average favorites/tweets	92,75%	51,38%	18,91%	45,11%	47,64%	30,71%	11,66%
Efficiency (retweets and favorites of others towards it) / Total number of tweets	176,89%	99,91%	37,44%	89,84%	88,93%	62,06%	23,98%
Total hashtags	5828	4969	320	4632	2981	230	300
Mentions made to the profile	4454	1170	869	617	542	207	50
Average number of mentions per tweet	1,39	0,37	0,27	0,19	0,17	0,07	0,02

Source: self-made

ANNEX II

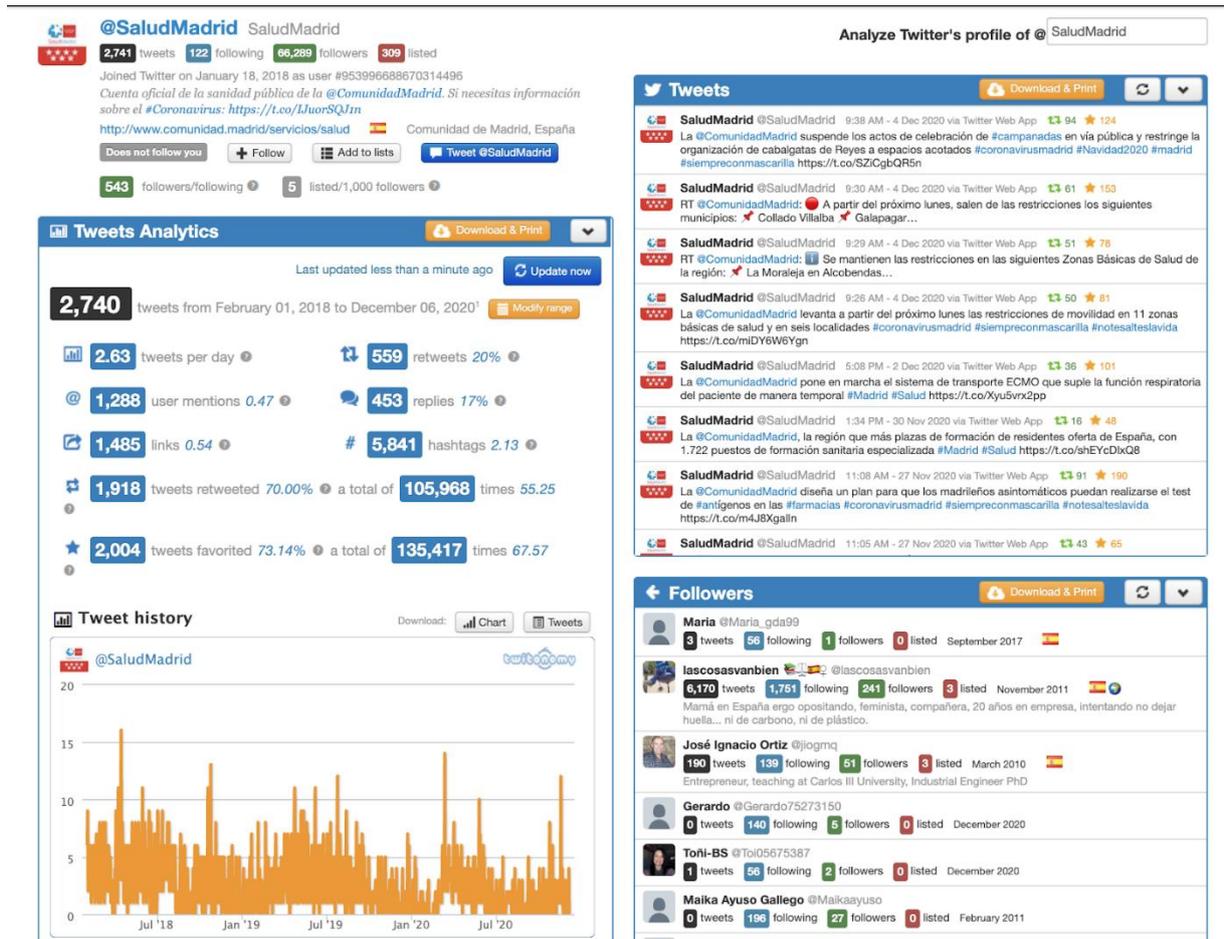


Figure 3. Image of the information extracted from one of the profiles through Twitonomy  
Source: self-made through Twitonomy