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Context: determinant factor for eHealth strategies in rural areas? case study Mexico.

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ABSTRACT: *The objective of this paper is to identify the factors that intervene in the rural context of Mexico when implementing an e-health strategy and/or program in rural and suburban areas. This study is based on the Soft Systems Methodology (SSM) written by Peter Checkland, in his version of the four stages, this methodology makes use of techniques such as rich vision, CATWOE, root definition, and activity models, which allow the actors of the problem to intervene in the alternative solutions. To collect the visions and experiences of those involved, questionnaires were sent to men and women who belong to the health personnel and/or community in rural and suburban areas of Mexico. The interest of this study is to know what aspects should be addressed so that the solution alternatives can be objective towards this type of community. It is the beginning of a project that is being carried out to propose the guidelines that should be considered in the eHealth strategies of these communities, which can be taken into account by countries that have a context close to that of Mexico.*
KEYWORDS: *rural zones, suburban, health, eHealth; strategy; education; SSM; prevention.*

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I. INTRODUCTION

Mexico is among the countries with the highest number a marginalized population, along with Bolivia, Guatemala, and Peru, it is important to take into account that a large part of this population is located in rural areas (Meneses-Navarro et al., 2020), being the southwest of Mexico the region with the highest degree of marginalization, highlighting states such as Guerrero, Oaxaca, and Chiapas (Diario Oficial de la Federación, 2020). Marginalization reflects inequalities in education, health care, basic services, among others. This causes rural dwellers to migrate to the peripheries of urban areas, causing poorly planned growth.(Noreña, 2009) (CONAPO, 2016).(Day-Collins, 2017)(ONU-Habitat, 2017)(Herrero-Olarte, 2018)(FAO, 2020).

This study focuses on the health care service, since the health sector is one of the most important for the inhabitants, however, these present deficiencies that limit the inhabitants from having decent care, being more evident in rural areas (OECD, 2016)(Secretaría de Salud, 2019).

The problems in the health system require a mechanism that allows to thoroughly articulate a series of steps that lead to an improvement with respect to the current conditions, this, is known as a strategy. It is important to keep in mind that governments must have health strategies that take into account the conditions of rural areas and alternatives that help to bring specialized care closer.

Due to the potential of eHealth, which was seen by the WHO, it has proposed the Global Strategy for eHealth 2020-2025 to promote eHealth services(World Health Organization, 2020). The proposal strengthens health services with the use of technological tools. However, an important aspect that this does not contemplate is the adoption or adaptation of these digital services in rural areas, which do not always have the best conditions, it is clear the need to strengthen health systems with mechanisms such as those proposed in this strategy (Budd et al., 2020), this was evidenced with the arrival of the new coronavirus (COVID 19) in which they have had to resort to digital mechanisms to cope with the activities of daily life.

Although several countries have implemented different programs focused on rural areas, in the face of the pandemic they have not been enough, since health inequity continues to persist, showing that much of the world has as one of its challenges to bring care to their most vulnerable communities such as Brazil, Africa, India, United States, Belgium, Thailand, among others, which, this present social, racial and regional inequalities, lack of medical coverage and presence of chronic diseases. Countries such as Nicaragua, whose inhabitants had to take their security measures, Guatemala, at the beginning of the pandemic, did not have a strategic plan before the COVID19 and the disinformation on the part of its government was present. However, there are countries such as China, Armenia, and Australia that at the beginning of the pandemic have made use of their programs to cover the most vulnerable areas (Shadmi et al., 2020).

As mentioned, the geocultural problems of each country may vary, therefore, the programs and actions that are considered to be applied in rural areas should be focused on the conditions of the country, currently

working on rural health strategies with the support of technology, where it is mentioned that it is important to know the context of the community that is sought to benefit, such is the case of the strategies that are being carried out in Australia (National rural health alliance INC., 2009) (Norton, 2019)(South West Hospital and Health Service, 2019). Studies mention that it is important to take into account the opinions and experiences of health professionals and rural residents (Chawurura, Manhibi, Dijk, & Stam, 2019).

The pandemic has allowed us to see how most countries do not have protocols to deal with emergencies like this one, making it even more important to generate such mechanisms as the strategy proposed by the WHO (World Health Organization, 2020), but always taking into account linking all aspects and actors around the problem The WHO in 2009 proposed to apply the systems approach to health systems, where it mentions the use of ten steps divided in the design and evaluation of the intervention, allowing the adoption of systemic thinking, which aims to analyze a system from the integration of its subsystems, as well as actors and processes of the system itself, taking into account their interconnections. This would strengthen the health system by seeing it as a macrosystem, contemplating the synergy within it.(OMS, 2009)(Erazo, 2015).

According to the above, the programs and/or strategies that are carried out must consider as a first step the context of the country, formulating its concept of eHealth as mentioned by the WHO (OMS, 2012), then they should be adapted to each type of community in the country. Therefore, this study seeks to use the soft systems methodology to analyze the problem situation of health care in rural and suburban areas of Mexico, taking into account the opinions and experiences of those involved, seeking the factors that should be taken into account to develop an alternative solution that integrates the use of eHealth in these areas.

II. METHODOLOGY

The methodology used is the Soft Systems Methodology (SSM) developed by the scientist Peter Checkland, which allows through systemic thinking to address complex situations where human intervention is essential to make a change or improvement in the system(Checkland & Poulter, 2006). The analysis based on this methodology allows us to describe the system holistically.

As mentioned, the SSM is based on the different perceptions of the actors involved in the system, these are known within the SSM as "Weltanschauung" (Checkland & Scholes, 1994). To know the initial situation of the problem, it is important to be aware of the different perceptions that the actors have about the problem, allowing the structuring of the problem on which we are working, since, as mentioned, human participation is essential for the application of the SSM. Therefore, in this work, the actors taken into account are:

1. Inhabitants of rural and suburban areas
2. Health professionals

A total of 40 questionnaires were completed to learn about the views of these two actors. For the first profile corresponding to the inhabitants, a questionnaire with multiple-choice answers was chosen. The second questionnaire was addressed to the second profile associated with health professionals, and was of a mixed type, asking questions with predetermined answers and on topics of greater interest, open questions were asked to obtain more information on their experiences by inquiring about their professional trajectory.

The first version of the SSM was represented by blocks and arrows, representing a series of iterative steps, however, this interpretation was modified in 1981, when the most recognized version of the 7 stages was presented, which later divided it into two streams, where the problem situation and systems thinking are identified. Although the representation of the methodology utilizing the 7 stages presented a greater investment in time for the analysis than for the practice, so it was modified to four stages, which is the one used in this work (Checkland & Poulter, 2006)(Murillo Sandoval, Badillo-Piña, & Peón-Escalante, 2019).

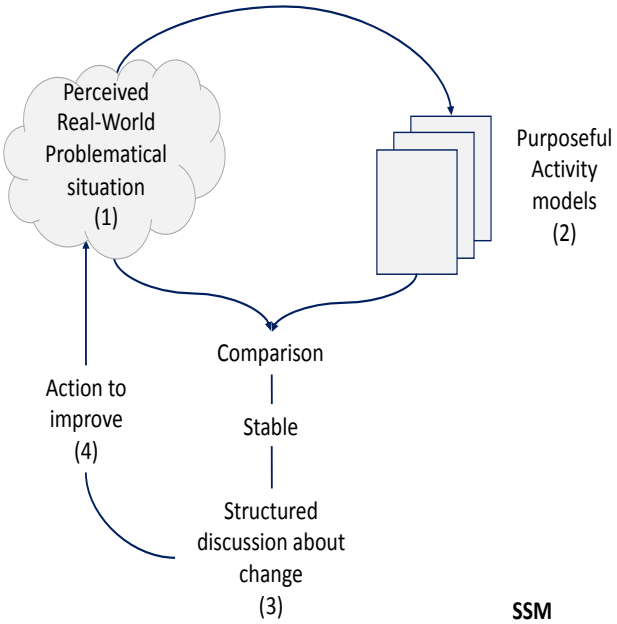

Figure 1: Peter Checkland's Soft Systems Methodology.
Source: From the book "Learning for Action" written by Peter Checkland and John Poulter. (Checkland & Poulter, 2006)

Figure 1 shows the four-stage representation of the MSS, which is a social learning cycle, where the learning, experience, and visions of each stakeholder contribute to the research. The stages are (1) Initial situation, here an analysis of the problem is made, identifying which are the actors involved in it, one of the support tools is the elaboration of a rich image, which is a holistic representation of the situation under study, (2) Activity models, allow structuring the problem situation, with the support of tools such as the root definition that includes the transformation process considering the CATWOE technique, whose acronyms represent (C) client, beneficiaries, (A) actors, (T) transformation is the process of change, (W) Weltanschauung or worldview, (O) owner and (E) environment or environmental limitation. The set of these tools and techniques will allow us to know what the current situation is. (3) Comparison of the models with the real situation with the support of experts, the aim is to approximate the models to the real world (4) Define/act for improvement, this stage can be defined according to the researcher, since being a cycle, the end of the study can be defined as action or realization. Although the MSS is shown as a cycle, it is essential to keep in mind that the stages are not a series of steps, so the activities can be developed and fed back in parallel to others (Checkland & Poulter, 2006)(Wheeler & Checkland, 2000).

III. RESULTADOS

To transform the problematic situation of interest, it is essential to know the initial conditions of this, performing techniques that support the feedback of the context of the study, this through the inquiry of the points of view of those directly involved in the problem. Therefore, this process was carried out utilizing questionnaires as mentioned, and the results of these points of view are presented below.

Stage 1: Initial situation

As mentioned in the previous section, two main profiles were surveyed, and the views of both profiles are presented below.

Perception of the inhabitants of rural and suburban communities.

The objective of the questionnaires conducted with this profile was to learn about the approach and service of medical care they receive, the relationship with electronic devices, and the acceptance of technology for medical care. Respondents belong to Mexican territory to populations such as Tezontepec de Aldama, Santa Cruz Xoxocotlan, Mixteca, Tribu Yaqui, Pilateno Xilitla, among others. Fifty percent of those surveyed live in rural communities. Of the total number of people surveyed, 62.5% have an advanced command of the Spanish language, that is, they can understand and express their ideas.

In the first section of the questionnaire regarding medical care, it was observed that most of the inhabitants go to the doctor at least twice a month and that 75% have had to go to a health center or hospital outside their community. An important fact is that the population tends to go to the doctor for curative

consultations; only 25% go only for preventive consultations. Among the deficiencies found in the health centers in their communities are the lack of medicines (45.8%) and the lack of doctors (41.7%). However, 12.5% mentioned that there is no health center in their community, so they are forced to travel outside of it.

Regarding the second section of the questionnaire referring to technological aspects in the community, 95.8% of the respondents have a mobile device and/or computer. However, only 66.7% have internet access, because some of these communities still do not have this service or the inhabitants do not have the monetary resources to contract the service. It is important to note that the inhabitants who have internet service tend to use it to communicate with their families and acquaintances through social networks, with 8.2% of users using the service to communicate with a doctor or search for health-related information.

Given that the Mexican population does not have an education in preventive health, it was asked whether the inhabitants would be willing to receive information sessions related to preventive health. 83.3% answered affirmatively. In addition, 54.2% of those surveyed considered that the use of mobile applications could help to promote health. This last percentage coincided with the acceptance of receiving medical consultation through the use of video calls. Finally, 70.8% would be willing to participate in groups that promote disease prevention.

Perception of health professionals

For health professionals, the questionnaire was carried out to inquire about their professional trajectory and to find out if they have provided their services to rural and suburban communities. Respondents included physicians, specialists, and nurses. The professionals surveyed have between 2 and 25 years of experience.

According to the results obtained, 85.7% have worked in some rural or suburban area of Mexico; however, only 57.1% of the total received a course on rural health. In addition, 100% of the professionals agreed that they do not have the necessary resources to provide quality care since there are insufficient material resources, infrastructure, and personnel, which cause patients to be referred to other units to receive comprehensive medical care.

The lack of medical equipment is the main problem mentioned by professionals who have worked in this type of area, followed by the lack of medicines and telecommunication services, these factors did not allow them to perform their work adequately. Even though 75% of them attended between 10 to more than 15 people daily. The period they have worked in these communities does not exceed two years, 33.3% mentioned that they left their work because the payment was not competent, also 33.3% left their work in these areas due to personal situations.

The professionals faced mostly patients with respiratory diseases, however, other types of diseases can be caused by the context of the community, such as stomach diseases and bites from snakes, spiders, and scorpions. An important fact is that according to the experience of the experts, 91.7% mentioned that patients are recurrent to curative consultations.

We also inquired about the acceptance of technology by health professionals, in which 100% considered that the use of telemedicine would support this type of area, however, none of the respondents had telemedicine equipment in their work area. A curious fact was that 92.9% do not know about the eHealth trend. However, 100% are willing to be trained remotely.

Finally, all the professionals surveyed consider that it is important to have health strategies that focus on rural areas. Although there are disease prevention and monitoring programs, the professionals mentioned that it is essential to address the lack of a culture of preventive health, to take into account the conditions of the population, and to provide security for medical personnel working in these types of areas.

Rich vision and root definition

At the end of the analysis of the different perceptions of the respondents, a rich vision was elaborated in which the role of those involved is expressed, which is shown in Figure 2. These show some of the inequalities faced by the people in these communities since the context is different from urban areas.

However, some programs focus on bringing health services closer to the villagers, such as health caravans, doctors without borders, telemedicine programs, and Mobile Medical Units, however, a visit to the Josefa Ortiz de Dominguez Maternal and Child Hospital, which is included in the Telepresence program of the State of Mexico (Secretaria de Salud, 2014), reflects that the lack of training of medical staff, structural conditions and lack of telecommunications infrastructure limit the use of this program. In addition, those involved agree that it is essential to promote preventive health since this could be a key factor that could benefit the general population in the short, medium, and long term.

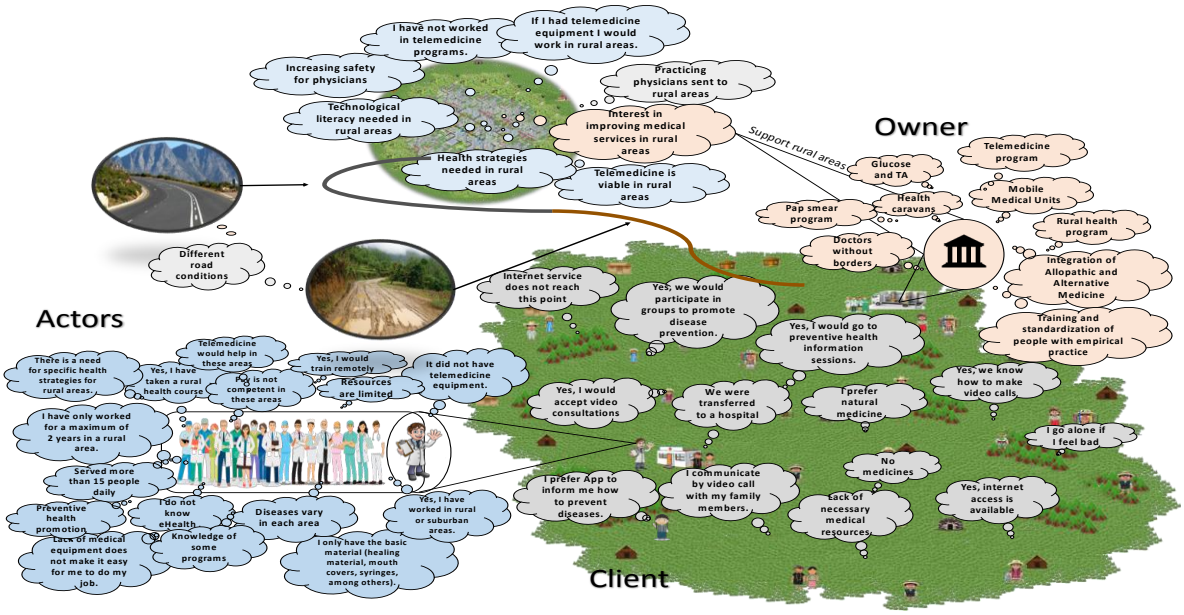

Figure 2: Rich image of the initial situation.
Source: Own elaboration.

By using the CATWOE, Table 1 shows the actors involved, allowing us to be aware of the transformation and the role of each one of the stakeholders present in the problem situation, this information considers the observations and perceptions that were mentioned above.

Table I: CATWOE.
Source: Own elaboration

System element	*Description*
Client	Inhabitants of rural and suburban populations.
Actor	Health professionals
Transformation	Empowerment of rural dwellers
Worldview	Generate strategies to promote preventive health in rural areas through the use of technology.
Owner	Government agencies involved in the health sector
Environment	Technological literacy, language, geographic conditions, and human development.
Performance metrics	E_1, Efficiency Bringing specialized care closer to the community E_2, Efficiency support from governmental institutions in the education and health sectors. E_3, Effectiveness decreases in cases of specific diseases in the community.

Based on the analysis of the contributions of the actors involved, the following integral root definition is proposed:

To have a guide that supports the realization of preventive health strategies for rural and suburban areas of Mexico, through multidisciplinary groups, that propose and integrate programs that currently work, to reduce in the long term the number of chronic diseases through the promotion of preventive health.

Stage 2: Activities model

Based on the information obtained from the stakeholders and the proposed root definition, a model of activities was developed, as shown in Figure 3, which shows the actions that should be carried out, where the first four activities refer to having a diagnosis that allows being aware of the geo-cultural conditions and services available to the community. The set of activities, from five to nine, refers to education and training of medical personnel and of the community, the latter at the educational level and in topics related to preventive health.

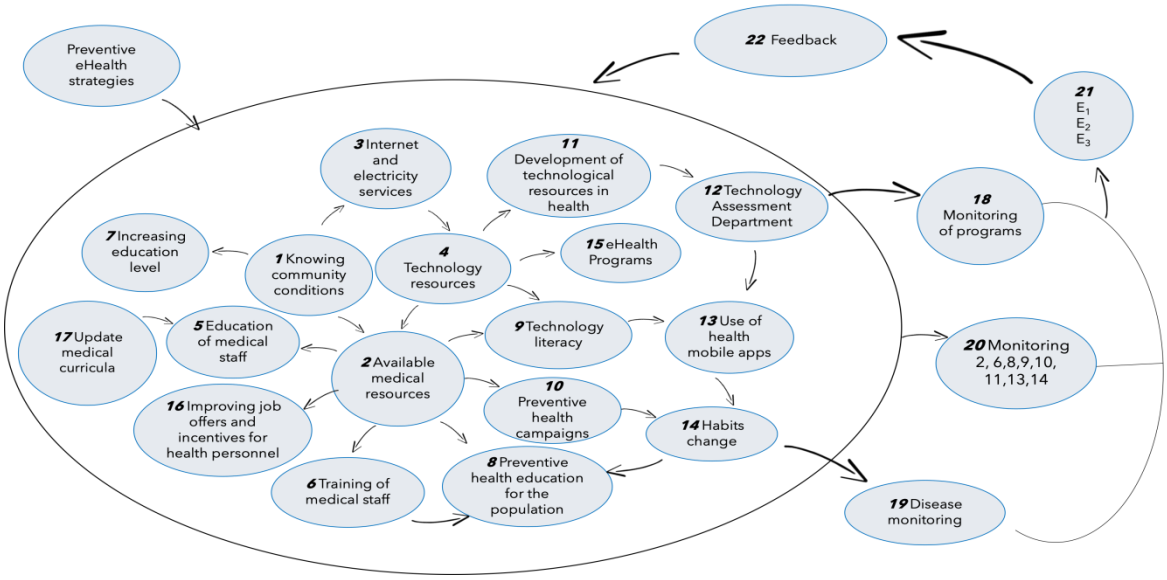

Figure 3: Activity model.
Source: Own elaboration

Activities ten and eleven refer to the actions to be taken to promote preventive health in the population through the use of technological resources, where the support of a department for the certification of technological resources is proposed, which corresponds to activity twelve. The integration of technological resources such as mobile applications should be evaluated by a group of experts so that they can be used by the population later, this is proposed inactivity thirteen, these actions seek to move on to activity fourteen which is to create a change of habits. For activity fifteen it is proposed to integrate eHealth programs to the communities according to the acceptance of technological resources.

Activity sixteen seeks to improve job offers for health professionals in this area, to maintain health centers in service with trained personnel, and activity seventeen seeks to integrate knowledge about rural health and technological aspects into the curricula of medical careers. Finally, the set of activities from nineteen to twenty-one is the monitoring process of the other activities that allow the activity twenty-two feedback of the system for continuous improvement.

Stage 3 Comparison of the model with the real situation

In this stage, the aim is to bring the model closer to reality; therefore, a literature review was carried out to support the model. As mentioned by the National rural health alliance INC (2009) in its strategy aimed at rural areas of Australia, the creation of health strategies is fundamental to make the use of eHealth sustainable. It mentions that it is important to have the necessary technological resources to carry it out, through strategies that support those communities that do not yet have this type of infrastructure(National rural health alliance INC., 2009). The ITU (2017) mentions different technology alternatives for rural and remote areas to have access to these services (ITU, 2017).

The importance of being aware of the factors involved in having an eHealth strategy is fundamental since the conditions of developed and developing countries are different, as well as the context in which rural communities live in each country and many cases within the same country, which is why the WHO (2012) made available a guide, which can be adapted by each country to formulate its eHealth concept (OMS, 2012). Also, the authors Scott & Mars (2013) comment that, fundamentally, eHealth programs and strategies should consider the geocultural conditions of the community to be sustainable (Scott & Mars, 2013). America's rural health strategy, also supports that knowing and taking into account the context of communities can help to be objective in carrying out projects, strategies, and/or programs (Centers for Medicare & Medicaid Services, 2018).

Some of the health strategies and programs in rural areas in countries such as Australia, Guatemala, Tanzania, Ireland, and Mexico, contemplate the use of telemedicine, providing teleconsultation services, tele-education, and specialized care, to bring services closer to the community, avoiding the need to travel to urban centers. Also, they train medical personnel, making use of videoconferencing (National rural health alliance INC., 2009) (TulaSalud, 2013) (Innovation and Technology for Development Center, 2014), (Secretaria de Salud, 2014)(Nyamtema et al., 2017) (Centers for Medicare & Medicaid Services, 2019). Other authors such as Saleh et al. (2018), Hung et al. (2016), Currie, Philip & Roberts (2015), discuss the use of telemedicine and

mHealth to address chronic diseases and provide education and/or training to medical personnel (Saleh et al., 2018)(J.A et al., 2016)(Currie, Philip, & Roberts, 2015).

However, the availability of health professionals to serve in rural areas for an indefinite period is often difficult, as they are truncated by the conditions in which their health care facilities are located and the resources they have. As mentioned in an analysis conducted by J. Doherty & I. Couper (2013) universities need to offer attractive educational models that allow them to encourage future health professionals to provide their services in these areas (Doherty & Couper, 2016).

Stage 4 Recommendations

In this fourth stage, the following recommendations are mentioned that should be taken into account:

- **Multidisciplinary groups:** Work team that includes experts in different areas.
- **Linkage between the education and health sectors:** Generate preventive health talks at any educational level.
- **Integration of sectors:** It is suggested that a diagnosis be made of the sectors that could benefit from the use of technology, to take advantage of the telecommunications infrastructure in the community.
- **Internet access centers:** It is recommended that the community have a free computer center for the community in which they can carry out procedures related to medical care.
- **Educate the natives in their community:** Bring health-related professional careers closer to the community, to prevent community members from moving to urban centers to study for a university degree and that in the end, they can offer their services to their community (Doherty & Couper, 2016).
- **Perform motivational models:** It is suggested to perform mechanisms that allow the medical student to feel interested in providing service to rural communities.
- **Focused eHealth solutions:** According to the acceptance of the population regarding the use of eHealth, propose the use of mobile applications and telemedicine equipment in the consultation, covering the characteristic conditions of the population.
- **Include alternative medicine:** It is important to take into account that there are people with different beliefs, which do not allow or do not feel safe in using drugs to alleviate their ailments.
- **Adaptability of eHealth solutions:** Consider the different indigenous languages spoken in the communities.
- **Safety of medical personnel:** Create a safe environment for health professionals, preventing them from being assaulted or intimidated.

IV. DISCUSIÓN

Technological advances in the health sector have made it possible to bring health care services closer to rural areas; however, including the use of technology in this type of area goes beyond having telecommunications infrastructure resources, even though this is one of the main means to bring e-health services closer. However, as mentioned by Alam et al (2019) a problem that directly intervenes in the use of technology in rural areas is the educational and socioeconomic level, and the use of these services in remote locations is less likely (Alam et al., 2019).

An important factor mentioned by Alam et al. (2019) is knowledge about the acceptance of e-health services, to have a sufficient basis for creating strategies. It is important to take into account the general context of the community (Alam et al., 2019), as mentioned by the authors LeBlanc, Petrie, Paskaran, Carson, & Peters (2020), who through a literature review in the period from 2000 to 2018, consider the perceptions of the community and health providers in Canada and Australia, where it is observed that the use of e-health services was 90.1% positive, however, the barriers faced are systemic, where one of the essential actors are governments (LeBlanc, Petrie, Paskaran, Carson, & Peters, 2020). For this reason, in the analysis carried out in this work using the CATWOE technique, the government is considered as the owner, since it is the key piece to make a change.

The contributions of programs and strategies in rural health using technology have been present in countries such as Guatemala (Innovation and Technology for Development Center, 2014), Tanzania (Nyamtema et al., 2017), Canada, Australia(National rural health alliance INC., 2013)(National rural health alliance LTD., 2019), United States (Centers for Medicare & Medicaid Services, 2019), Mexico(CENETEC Salud, 2020), India(George Clinical, 2016), Africa *(Herselman, Ruxwana, & Conradie, 2010)*(Chawurura et al., 2019), among others. An example is the case of the strategy that is developed by the Australian state Queensland, which plans to have patient-centered care presenting actions focused on eHealth (Norton, 2019). Among the hospitals contributing to this strategy is the South West Hospital Service (SWHHS) which serves rural and remote areas (South West Hospital and Health Service, 2019). But it is essential to know the real context of the country and even involve the community through their constant participation, as mentioned by the authors Chawurura, Manhibi, Dijk, & Stam (2019)(Chawurura et al., 2019), although this work also seeks that the strategies are

patient-centered to achieve empowerment of their health, the conditions of the facilities of rural health centers and medical resources may be different in each country and/or community, coupled with this, other factors should be taken into account before making use of eHealth solutions.

Therefore, a contribution of this work is to address factors that can help to achieve acceptance of this type of services before making an investment in eHealth infrastructure in the health care center. In the case of Mexico, it is evident that, according to the results of the analysis carried out, a determining factor is the education of the population and a predominance of curative health. For this reason, preventive health education is proposed and before implementing an eHealth solution, it is important to teach the community about technological aspects to familiarize them with the use of electronic devices.

This work also makes use of systems thinking, which makes it possible to analyze the system as a whole, instead of focusing only on the health sector, since it is clear that interventions in the educational sector can be transcendental for these strategies, so the formation of multidisciplinary groups is fundamental. One of the institutions that recommended systems thinking is the WHO (2009), which proposes the ten steps that can be followed to strengthen health systems, where the first step is the convening of stakeholders as stated in the study(OMS, 2009).

Finally, in the case of Mexico, although there are telemedicine programs that support rural areas, not all communities have health services, so it is important to have strategies with a systemic approach that facilitate the integration of these programs, through prior education of the population and health personnel, allowing both actors to have an acceptance of these mechanisms. These results are the beginning and one of the important pillars of a project that is being carried out to implement eHealth strategies in rural and suburban areas.

V. CONCLUSION

The use of technologies in the health sector has proven to be an alternative for medical care in rural areas, benefiting them by reducing travel time, costs, bringing specialized care closer, training health professionals, among others. However, the use of these alternatives should not be taken lightly, since there is a difference in geocultural contexts in each country. Knowing the perceptions and experiences of those involved helps to have an overview of what alternative solutions may be feasible to carry out. This analysis shows that there are factors that can indirectly intervene in eHealth strategies in rural and suburban health, which should be addressed simultaneously so that the proposals for this type of strategy can be objectively seen by the actors, helping to reduce the abandonment of eHealth programs in these types of areas.

The analysis carried out with the SSM, which considers the human being as the main actor, allows us to be aware of other factors as mentioned above. In the case of Mexico, strengthening the education of the population can help the possible acceptance of the use of these strategies, since it is not enough to focus only on the internal needs of the centers and hospitals that provide these services. Undoubtedly, it is important to have the medical and technological resources to make use of these alternatives, however, other factors that can enhance the results of eHealth programs in rural and suburban areas must be addressed, and for this case study, an important factor to consider is the education of the population and medical personnel.

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