

Systematic approaches for telemedicine and data-coordination for COVID-19 in Baja California, Mexico.

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Date of submission: 27, October, 2020 | Date of approval: 15, July, 2021

Abstract

The article presents a model for systematic implementation of telemedicine within a large evaluation center for COVID-19 in the area of Baja California, Mexico and also the results achieved with its implementation. The model is based on human-centric design factors and cross disciplinary collaborations for scalable data-driven enablement of smartphone, cellular, and video tele-consultation technologies to link hospitals, clinics, and emergency medical services for point-of-care assessments of COVID testing, and for subsequent treatment and quarantine decisions. A multidisciplinary team was rapidly created, in cooperation with different institutions, including: the Autonomous University of Baja California, the Ministry of Health, the Command, Communication and Computer Control Center of the Ministry of the State of Baja California (C4), Colleges of Medicine and the College of Psychologists. The objective is to provide information to the public and to evaluate COVID-19 in real-time and to track, regional, municipal, and state-wide data in real-time that informs supply chains and resource allocation. The propose is the anticipation of a surge in COVID-19 cases.

Keywords: Telemedicin; Digital Health; COVID 19; Systems Design.

Resumen

Enfoques Sistemáticos de Telemedicina y Coordinación de Datos para COVID-19 en Baja California, México.

El artículo presenta un modelo para la implementación sistemática de la telemedicina dentro de un gran centro de evaluación para COVID-19 en el área de Baja California, México y sus resultados. Dicho modelo se basa en factores de diseño centrados en el ser humano y en colaboraciones interdisciplinarias para la habilitación escalable basada en datos de tecnologías de tele-consulta por teléfono inteligente, celular y video para vincular hospitales, clínicas y servicios médicos de emergencia para evaluaciones en el punto de atención de las pruebas de COVID, y para las posteriores decisiones de tratamiento y cuarentena. Se creó rápidamente un equipo multidisciplinario, en cooperación con diferentes instituciones, entre ellas: la Universidad Autónoma de Baja California, la Secretaría de Salud, el Centro de Mando, Comunicación y Control Informático de la Secretaría del Estado de Baja California (C4), los Colegios de Medicina y el Colegio de Psicólogos. Lo objetivo es proporcionar información al público y evaluar COVID-19 en tiempo real y hacer un seguimiento de los datos regionales, municipales y estatales en tiempo real que informan las cadenas de suministro y la asignación de recursos. Lo esperado es la anticipación de un aumento de los casos de COVID-19.

Palabras clave: Telemedicina; Salud Digital; COVID 19; Diseño de Sistemas.

Resumo

Abordagens sistemáticas para telemedicina e coordenação de dados para COVID-19 em Baja California, México.

O artigo apresenta um modelo para a implementação sistemática da telemedicina dentro de um grande centro de avaliação da COVID-19 na área da Baja California, México bem como os resultados alcançados. O modelo é baseado em fatores de projeto centrados no ser humano e colaborações interdisciplinares para a capacitação escalável e orientada a dados de tecnologias de telefonia inteligente, celular e video-tele-consulta para ligar hospitais, clínicas e serviços médicos de emergência para avaliações de ponto de atendimento de testes COVID, e para subseqüentes decisões de tratamento e quarentena. Uma equipe multidisciplinar foi rapidamente estabelecida, em cooperação com diferentes instituições, incluindo: a Universidade Autónoma da Baja California, o Ministério da Saúde, o Centro de Comando de Informática, Comunicação e Controle da Secretaria de Estado da Baja California (C4), as Faculdades de Medicina e o Colégio de Psicólogos. O sistema tem como principal objetivo fornecer informações ao público e avaliar a COVID-19 em tempo real e rastrear dados regionais, municipais e estaduais em tempo real que informam as cadeias de abastecimento e alocação de recursos. Espera-se com a implantação do sistema a antecipação do aumento dos casos de COVID-19.

Palavras-chave: Telemedicina; Saúde Digital; COVID-19; Desenho de Sistemas.

INTRODUCTION

The State of Baja California in the year 2019 had a total population of 3,682,063 inhabitants; 68.57% or 2,524,740 people were covered by the Mexican Institute of Social Security (IMSS); the Institute of Security and Social Services for State Workers (ISSSTE) represents 5.17%, with 190,324 people on its roll; the Institute of Security and Social Services for Government and Municipal Workers of the State of Baja California (ISSSTECALI), 3.79%, with 139,494 beneficiaries, and the population with affiliation to the Popular Insurance accounts for 1,707,51 people, which corresponds to 29.08% of the total population of the State ^{1,2}

There are 12 Red Cross ambulances and 1 firefighter's ambulance. The prevalent diseases in Baja California are: Acute respiratory infections, intestinal infections from other organisms, urinary tract infections, gingivitis and periodontal diseases, conjunctivitis, ulcers, gastritis and duodenitis, arterial hypertension, obesity, non-insulin-dependent diabetes mellitus (Type II) and asthma and asthmatic conditions. ^{3,4}

The Autonomous University of Baja California (UABC) offers the subject of Telehealth in the Faculty of Medicine and Psychology since 2016, reinforcing its experience in the area of Telehealth. UABC use the Telmedx platform for practice, in the first approach. 4 years ago, 10 teleconsultations in the area of pediatrics were conducted, from San Quintin —with tutors and students—, to Tijuana, Baja California. Five specialists from Tijuana were contacted in the areas of Genetics, Neurology, Ophthalmology, Dermatology and Orthopedic. The student located in San Quintin enters through the Telmedx platform in his Smartphone. For the realization of the Teleconsultation, the values are shown in the following table (see table 1), where the total number of services used for Teleconsultation are presented. Three relevant cases were detected, which were subsequently followed up.

Table 1: Teleconsultation case in San Quintin-Tijuana

total number of services that used Teleconsultation	Important cases	Students at San Quintin	Doctors in San Quintin	Specialist Doctors
12	3	4	2	5

Another Telehealth tool that is used is the EMS track system. The objective is the Optimization of the Prehospital Emergency System. This tool was created due to the overwhelming scope of action for the Red Cross: 98% of Emergency Services are attended by the Red Cross Tijuana, and there are 13 ambulances and a population of 1,559,683 people. This system was designed in collaboration with the UABC-Faculty of Medicine and Psychology, the University of California at San Diego (UCSD) and the Technological Institute of Tijuana (ITT). ⁵

Telemedicine allows doctors, nurses, and patients to communicate 24/7, using smart phones or computers with webcams. This makes it easier to assess the progress of patients who are in home quarantine. Several studies have presented the potential for the use of telemedicine in disasters and public health emergencies.^{6,7,8} According to some studies, the potential benefits of an alternative integrated mobile health program include improved resource utilization, reduction of unnecessary emergency department visits that contribute to crowding, and access to care ⁹

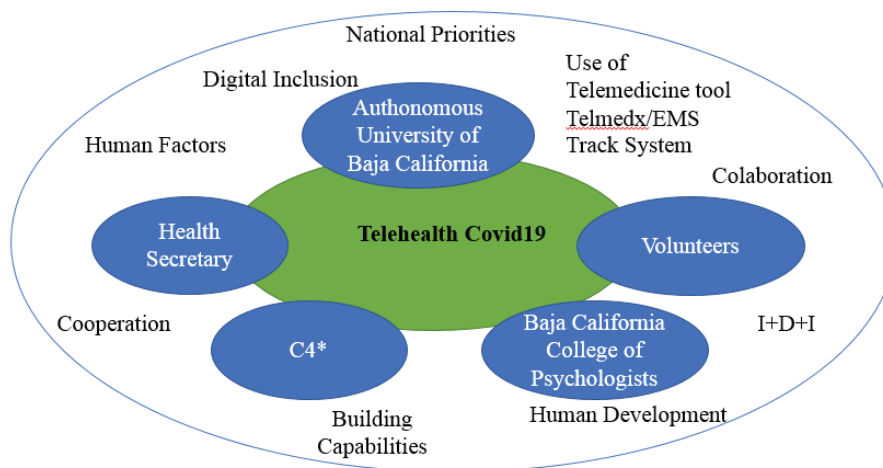
A multi-dimensional data coordination was created. Authorities from the three levels of government, as well as Civil Protection and Red Cross are concentrated in the Control Center, Communication and Computer Command (C4) to attend emergency calls (911). The C4 also has a power backup, so that in case of a blackout, continues conducting redundant telephony, digital mapping of the city, closed circuit security systems, thermal cameras to operate without lighting, as well as a fingerprint access control. An average of 461,981 calls are received monthly in the state. C4 started operations in 2001.¹⁰ This paper present the steps and stages for creating a Telemedicine Evaluation Center for Rapid Triage of COVID-19.

METHOD

Researchers from the Faculty of Medicine and Psychology met to discuss support for the community in view of the contingency. The idea was to create a COVID 19 Telehealth evaluation center and, since it had human resources, it was decided to create a center for the evaluation of tele-health, which would be staffed by internal doctors, medical interns, and students of medicine, psychology, and nutrition. Since it needed infrastructure for receiving calls, computers and all technological equipment, the State Government was contacted for the C4, whose command, communication and computer

centeris under the State Government’s control. It is where the emergencies are dispatched, having the physical structure, the technological structure and the equipment. Likewise, the Ministry of Health was contacted to coordinate and not to duplicate efforts (Figure 1).

Figure 1: Governmental and non-governmental institutions integration into the contingency plan.



* Command, Communication and Computing Control Center of the Secretary of State in Baja California

The Faculty of Medicine and Psychology provided students of Psychology and Nutrition. The total number of human resources participating are showed in table 2.

Table 2. Total number of FMP students

Program	Basic	Discipline	Terminal	Total
Psychology	250	213	145	608
Medicine	422	415	164*	1001*
Nutrition	68	81	24	173
Total	740	709	333	1782

* Of the total 164 terminally ill medical students (MIP + MPSS), we have only approximately 27 of the 57 MPSS in the university program, although this number may increase as non-priority services are closed.

A call for volunteer support was also created for professionals, retirees and students of health and administrative careers, who are willing to be a second line if necessary in the care of the contingency. Likewise, a Facebook group called Telehealth COVID19 was created with the purpose of updating volunteers with the information that was available on a daily basis. The college of psychologists joined the volunteering, resulting in collaboration and multidisciplinary cooperation. The number of volunteers is 1,526.

Two tools are used in the COVID 19 Telehealth evaluation center: Telmedx and EMS track. The Telmedx platform is a tool for transmitting video and image in a synchronous (bidirectional) way where annotations or drawings on the photo or close-ups can be made. For reasons of data protection, Telmedx does not save any patient information. They are HIPAA and HITECH compliant. It can be installed on any smart device, available for Android and IOS [11] The EMS track tool is used to dispatch units for patients with COVID 19, the unit is tracked by GPS through the real time app and the receiving physician is notified by SMS message.

Operational Model

First contact doctors. 2-3 doctors will be assigned to be physically present at C4 to capture incident data and channel calls to volunteers.

Volunteer Advisors.

There are three levels of telephone advisors to meet the following consultation needs (Figure 2):

A) Medical Consultation

1. Level 1: General recommendations at Community level
2. Level 2: Monitoring of suspected patients in home confinement
3. Level 3: Specialist medical advice.

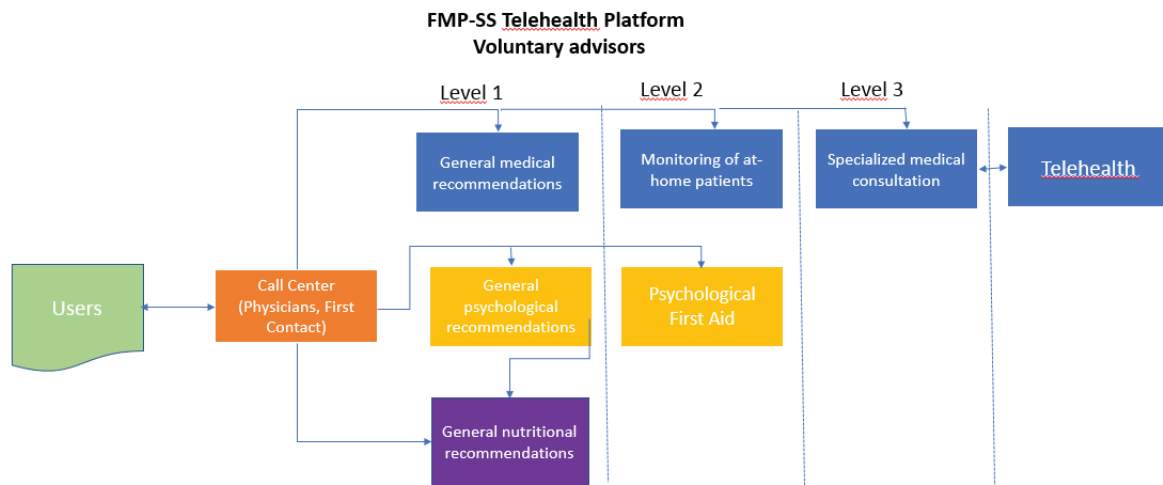
B) Psychological Consultation

1. Level 1: General psychological recommendations
2. Level 2: Psychological First Aid

C) Nutritional Consultation

1. Level 1: General nutritional recommendations

Figure 2. Conceptual Design of the Telehealth System



The following procedure is followed for the training of volunteers:

A) Medical Consultation

1. Community telephone counselors (Level 1) are required to complete the following training:
 - a) Complete and accredit the Prevention and Control of Infections (PCI) caused by the new coronavirus (COVID-19)[12]
 - b) To know and implement the algorithm of medical telephone advice on the general and control recommendations of the COVID-19 (Developed by the Secretary of Health).
 - i. Online course.
 - ii. Online training video.

2. Telephone monitoring advisors for patients in home confinement (Level 2), in addition to Level 1, will be required to complete the following training:

a. Know and implement the algorithm for telephone monitoring of suspected homebound patients (developed by the Ministry of Health).

3. The specialized advisors (Level 3), in addition to what is considered in the previous levels, must have current training and certification of specialization or postgraduate medical degree in the area they wish to advice.

B) Psychological Consultation

1. General Counselors (Level 1) are required to complete the following training:

a. Complete and accredit the Prevention and Control of Infections (PCI) caused by the new coronavirus (COVID-19).

b. To know and implement the algorithm of psychological telephone advice on the general and control recommendations of the COVID-19 (Developed by the Secretary of Health).

- i. Online course.
- ii. Online training video.

2. Psychological First Aid consultants (Level 2), in addition to Level 1, will be required to complete the following training:

a. Psychological First Aid Course.

C) Nutrition Consultation

1. General nutritional advisors (Level 1) are required to complete the following training:

a. Complete and accredit the Prevention and Control of Infections (PCI) caused by the new coronavirus (COVID-19)

b. To know and implement the algorithm of nutritional telephone advice on the general and control recommendations of the COVID-19 (Developed by the Secretary of Health).

- i. Online course.
- ii. Online training video.

The COVID 19 Telehealth Assessment Center is physically located at C4 on the first floor, where the medical area is located (6 doctors) who make rotating guards. Each shift is 12 hours long. On the second floor, there is the area of psychology (2 psychologists). In both cases they take calls from users.

SYSTEMATIC DATA TRIAGE AND COVID-19 PATHS OF CARE:

The dispatcher performs the following procedure:

1. Call Center Procedures

1.1. Medical Call Procedure

1.1.1. Identification of Cardinal Medical Signs: Do you or anyone you have had contact with in the last 7 days have any of these signs and symptoms?

- Cough
- Fever
- Headache in adults / Irritability in children

1.1.2. Complementary Medical Signs: Have these signs been accompanied by...?

- Difficulty in breathing
- Joint pain
- Muscle pain
- Sore or burning throat
- Nasal flow
- Red eyes
- Chest pain

1.1.3. Medical call transfer

- 911: If an emergency is being reported in which there is immediate danger to life.

- Medical Advisor Level 1:

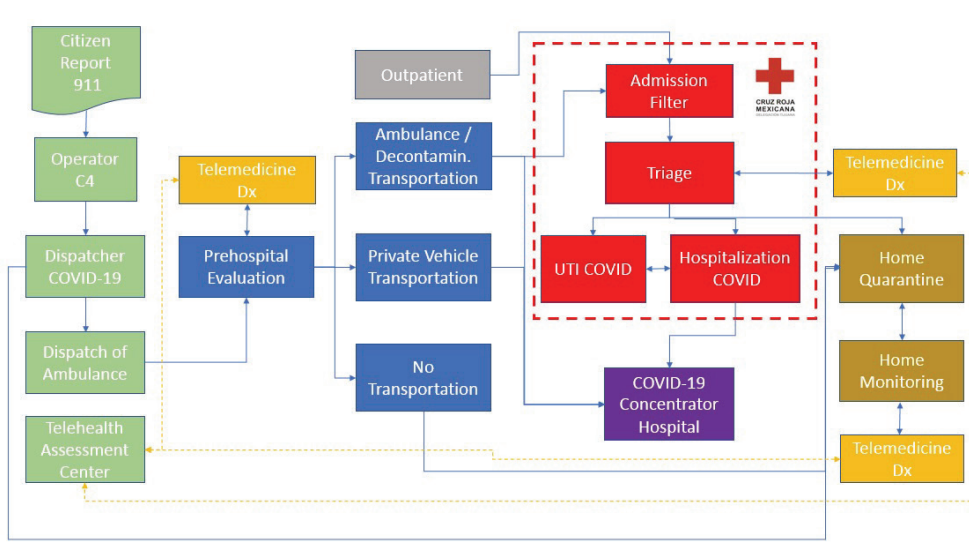
- If you only require general information or have medical questions
- If someone you have had contact with in the last 7 days shows the signs

- Medical Advisor Level 2

- If the person reporting presents 2 of 3 of the cardinal signs

Figure 3 shows the patient care route. It starts when you receive the call referring to the advisor to make the evaluation of the patient, once you have the data referred to the service you need.

Figure 3 : Path of care

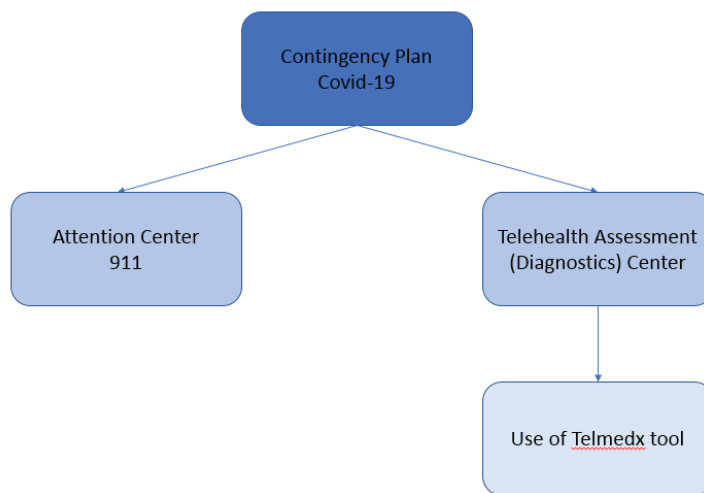


The criteria used by the hospital triage (red rectangle) for their decision are based on the Guide for COVID-19 Critical Patient Care (Appendix A). For home monitoring, Telmedx is used (yellow rectangle in figure 3), the patient is daily monitored until they recover. This monitoring is performed by volunteer doctors participating in the COVID 19 Telehealth project: Fever, dry cough, headache, difficulty in breathing, joint pain, muscle pain, sore throat, runny nose, conjunctivitis, chest pain, and the ROTH scale is used to determine oxygen saturation.

4.1 Intake of COVID-19 calls and Contingency Plans

The contingency plan has two lines: the first is to receive calls to 911, the second the Telehealth evaluation center. The Telehealth system requires at least one central station that is responsible for providing medical services and one or more remote units, where the patient and the specialist doctor are located; both units will have some elements such as: Mobile phone or computer with webcam. Figure 4 presents a diagram for the application of the COVID19 Telehealth contingency plan.

Figure 4. General diagram



When a user calls 911, the first contact physician asks a series of questions that are presented below:

1. Receiving the call and capturing initial data

1.1. Give a welcome message “Thank you for calling the COVID19 Telehealth system”, then request the following information:

- Address
- Name
- Age
- Sex

- Ask: *Are you or anyone in your household quarantined for having symptoms of COVID-19?*

- Ask: *What is the reason for your call?*

- If the reason for the call is medical, follow the Medical Call Procedure
- If the reason for the call is for psychological reasons, follow the Psychological Call Procedure
- If the reporting person or someone living in your home is quarantined for symptoms of COVID-19, follow the Home Quarantine Procedure
- If technical or advanced medical advice is required, follow the Telemedicine Procedure

5. Telehealth for Psychological Care

A fundamental issue that is being integrated into the ecosystem is psychological care, since an increase in anxiety has been observed during health crises. Public health emergencies may affect the health, safety, and well-being of both individuals (causing, for example, insecurity, confusion, emotional isolation, and stigma) and communities (due to economic loss, work and school closures, inadequate resources for medical response, and deficient distribution of necessities). Extensive research in disaster mental health has established that emotional distress is ubiquitous in affected populations, a finding to be echoed in populations affected by the Covid-19 pandemic^{13,14,15}

In the case of psychological assistance, the following procedure is carried out.

5.1. Psychological Call Procedure

5.1.1 Identify the patient’s age group (adult or child/adolescent) Ask: *Does the patient have any of these symptoms?*

In adults:

- Sadness
- Depression
- Anxiety
- Fear and concern for their own health and that of their loved ones.
- Changes in your sleeping or eating patterns
- Difficulty sleeping or concentrating.
- Worsening of chronic health problems
- Increased use of alcohol, tobacco, or other drugs

In children and adolescents:

- Excessive crying or irritation in young children
- Returning to behaviors they have outgrown (e.g., having “accidents” [wetting or soiling underwear] or wetting the bed)
- Excessive worry or sadness
- Unhealthy eating or sleeping habits
- Irritability and impulsive behavior in adolescents
- Poor school performance or avoiding school
- Difficulty paying attention and concentrating
- Avoiding activities that were enjoyed in the past
- Headaches or body aches with no apparent cause
- Use of alcohol, tobacco, or other drugs

5.1.2 Identification of active crisis state: Ask if the patient has a crisis state:

- State of disorganization / invaded by emotional stress
- “Tunnel vision”
- Difficulty for thinking or making decisions
- Excess activity without objective or immobilization
- Cognitive impairment, accompanied by concerns or ideas distorted by events such as the perception of being unable to overcome obstacles, problems, or experienced events
- Changes in behavior such as aggression, impulsiveness, hyperactivity
- Changes in emotional state with feelings of confusion, tiredness, exhaustion, guilt, helplessness, alienation, anger, irritability, fear, sadness, depression, nightmares, anguish, anxiety, panic, mental tension, indecision, lack of confidence and feelings of inadequacy
- Vulnerability to crying with bursts of tears.

5.1.3 Psychological call transfer:

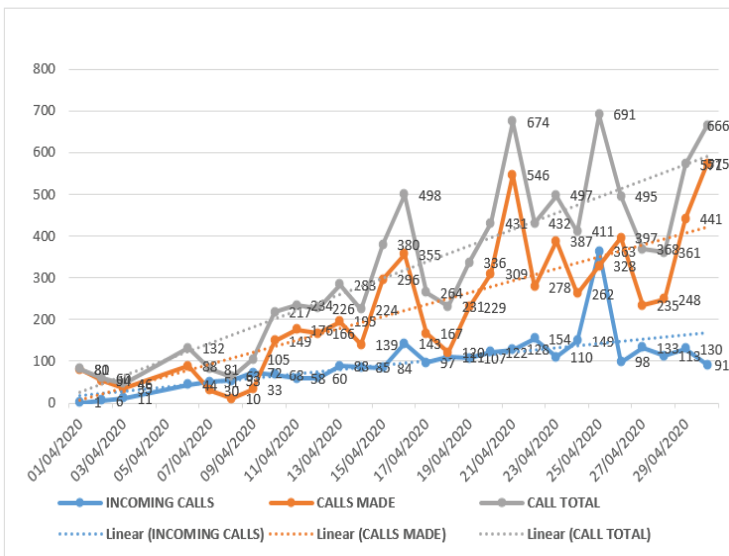
- 911: If the reporter feels that they want to harm themselves or others

- Psychological Counselor Level 1: If you have any of the psychological symptoms or require general psychological counseling
- Psychological Counselor Level 2: If you have an active crisis state (have any of the above symptoms)

RESULTS

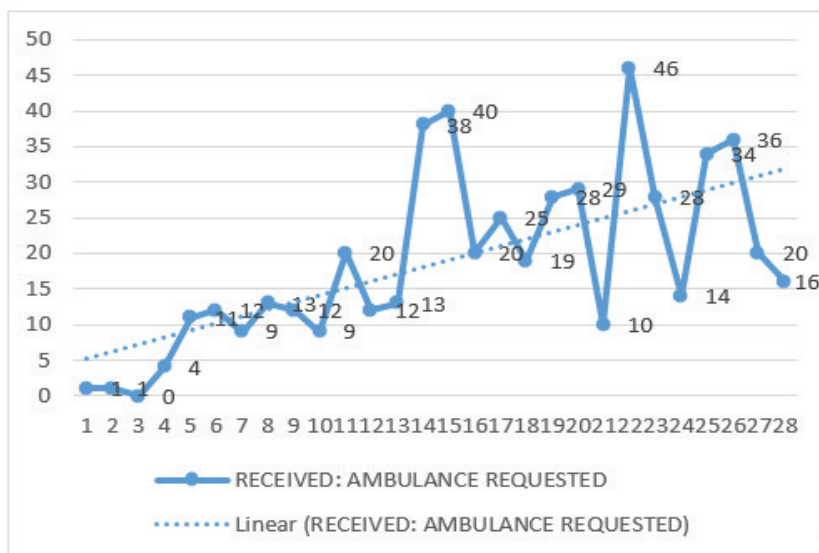
The results of COVID-19 Telehealth System are showed in figure 1, 2 e 3. Graph 1 shows the number of calls received, calls made by the COVID 19 Telehealth System team and the total number of calls during a period of 29 days during the month of April, that is, and the period from April 1 to 29.

Graph 1. Telehealth System COVID 19 Calls handled per day April 2020



Graph 2 shows the number of calls when ambulances were requested. The presence of an ambulance was requested on 520 occasions, due to the severity of the patients' symptoms (this represents 18.8% of the calls received).

Graph 2. Telehealth System COVID 19 Calls requiring ambulance dispatch April 2020



Graph 3 shows the percentage of ambulances required, which represents 18.8% of calls received.

Graph 3. Telehealth System COVID 19 Percentage of received calls requiring ambulance April 2020

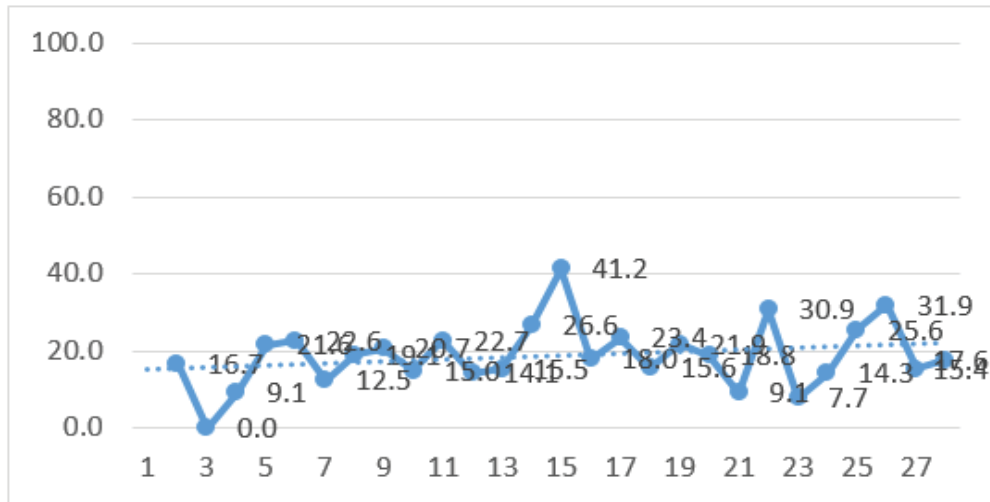
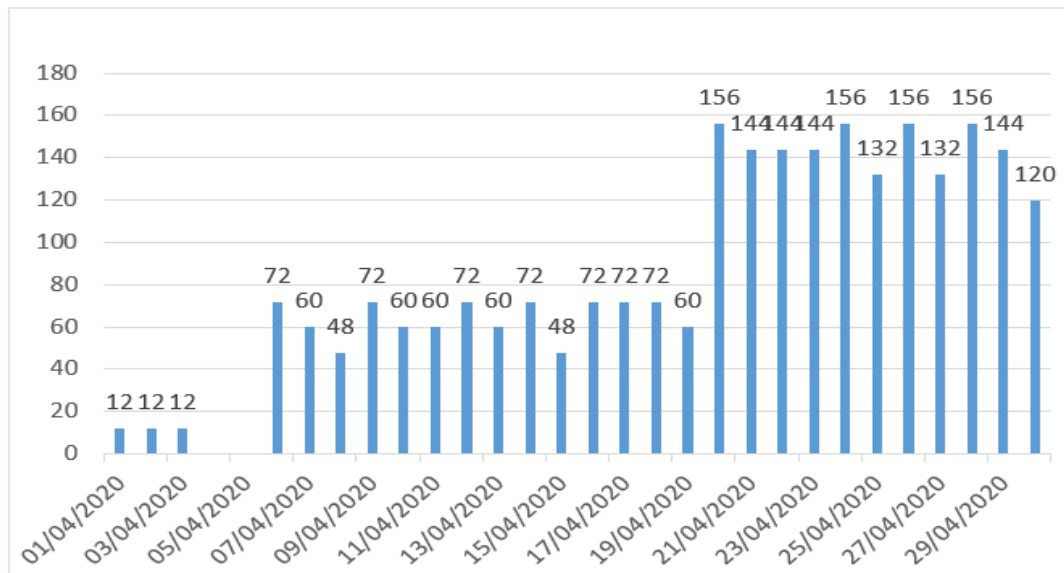


Figure 4 shows the worked hours by volunteers located in the C4 where the COVID19 Telehealth Assessment Center is located. During the 29-days period, a total of 2,520 operator hours were worked in 24-hour shifts starting on April 1.

Graph 4. Telesalud System COVID 19 Hours Worked April 2020



It is possible to appreciate the contribution of Information and Communication Technologies to Teleconsultation. It is observed that, besides facilitating the communication between doctors, a faster and more effective diagnosis can be made, which allows the optimization of time and transportation costs. From the perspective of Health Institutions, it is possible to offer a better, more efficient service and reduce diagnosis and treatment periods, which is not only important to make health sector services more operational, but also to increase their coverage and social impact, particularly in this COVID 19 contingency.

CONCLUSION

It was concluded that telehealth offers capabilities for remote detection, care, and treatment; helps with supervision, surveillance, detection and prevention; and to mitigate the effects of health care indirectly related to COVID 19.

ACKNOWLEDGEMENTS

The authors would especially like to express their gratitude to the Faculty of Medicine and Psychology of the Autonomous University of Baja California, which made available its students and interns; to the Secretary of Health who provided its organizational resources; to the Command Control Center, Communication and Computing of the Attorney General's Office of Baja California (C4) who provided its facilities and equipment; and the colleges of physicians, psychologists and nurses, its volunteer staff, as well as Clint Carney of Telmedx and Mauricio de Oliveira researcher of UCSD-Mechanical and Aerospace Engineering.

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Conflict of interest: nothing to declare.

Financial support: no

Contribution of each author: all authors had the same participation