Original Research Article

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Post-COVID conditions response: a collaborative approach to establishing multidisciplinary clinics in Ecuador

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ABSTRACT

Introduction: Worldwide, 3.7% (144.7 million) of people diagnosed with COVID-19 developed Post-COVID Conditions (PCC). Therefore, creating and implementing multidisciplinary rehabilitation clinics is important to address the needs of patients and improve overall recovery. This study was made possible with support from the United States Agency for International Development funded RISE program, under the terms of the cooperative agreement 7200AA19CA00003.

Methods: This case study was conducted in Ecuador and describes the creation and implementation of 21 PCC rehabilitation clinics in primary healthcare centers and secondary level hospitals in 7 provinces across the country. Data was gathered for the identification of partnering health facilities and needs, for the evaluation of knowledge enhancement in health professionals after a specific training program, and for the measurement of key performance indicators. This article emphasizes the organization, educational strategies, and implementation of rehabilitation programs tailored specifically for the management of Post-COVID Conditions in Ecuador.

Results: The implementation of PCC rehabilitation clinics involved a collaborative effort between the Ministry of Public Health (MOPH), the private sector and a non-governmental organization (Jhpiego). Twenty-one health facilities from the primary and secondary level of care were selected, and PCC rehabilitation implemented in 7 provinces of Ecuador. Additionally, 133 health providers were trained and a total of 13,846 patients treated, among whom 859 had a diagnosis of PCC. Medical doctors outperformed nurses in both pre- and post-tests scores. However, all healthcare professionals demonstrated comparable improvement in knowledge acquisition. Rehabilitation manuals were developed and adopted by the MOPH, rehabilitation equipment was donated and a mobile application, "RESPIRA", was developed and disseminated free of charge.

Conclusion: The establishment of PCC rehabilitation clinics in Ecuador was successful in identifying patients in need of early rehabilitation. The insights of this study can serve as a guide for the development of similar initiatives in other countries. Tailored courses are essential to address disparities and ensure comprehensive skill development and promote equitable healthcare delivery.

Key words: Multidisciplinary care; post-COVID Conditions; rehabilitation; specialized care; under-resourced settings

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on reasonable request. These databases don't contain patient data; instead, they delve into the structure, educational strategies, and implementation of programs designed for the development and implementation of multidisciplinary clinics for the management of Post-COVID Conditions in Ecuador.

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Introduction

Globally, 3.7% (144.7 million) of people diagnosed with COVID-19 developed Post- COVID Conditions (PCC) [1]. Although the clinical presentation of acute COVID-19 varies from asymptomatic to critical, about 80% of patients have mild to moderate infections with symptoms lasting 4-5 days and with full recovery 7-10 days post-infection [2]. However, among follow up of recovering patients, persisting symptoms can be identified longer than 12 weeks after the acute infectious period, leading to Post-COVID Conditions (PCC) [3]. Although a correlation between severity of acute infection and likelihood of developing PCC has not been clearly established [3-5], there is evidence of persisting dyspnea following COVID-19 pneumonia [6]. These symptoms are not restricted solely to pulmonary effects but may span across multiple organ systems [2, 3, 7]. Post-COVID Condition develops after SARS-CoV-2 infection and is diagnosed due to the persistence of symptoms after 12 weeks of the onset of the disease [8]. Symptoms vary in severity and include but are not limited to reported symptoms such as shortness of breath, fatigue, changes in taste or smell, and joint or muscle pain [9].

The multi-system nature of PCC has placed a burden on both patients and health systems requiring specialized teams to tackle a plethora of multi-organ symptoms involved. Hence the relevance of establishing PCC rehabilitation clinics to strengthen rehabilitation care in Ecuador and specifically to introduce multidisciplinary rehabilitation for patients with PCC. Unfortunately, Ecuador is under-resourced and understaffed, rehabilitation services are scarce and in many geographical areas inexistent. To this end, in this article we depict key steps in establishing PCC rehabilitation clinics in Ecuador, including creating governmental alliances, educating, and training healthcare staff to identify and manage PCC patients.

Methods

Project background

RISE is a global program funded by the U.S. President's Emergency Plan for AIDS Relief

(PEPFAR) and the U.S. Agency for International Development (USAID) that supports over 20 countries worldwide in both attaining and maintaining epidemic control through collaboration with strong local partners managing sustainable, self-reliant, and resilient health systems by 2024. Within the RISE expansion of COVID-19 response in Ecuador, one of the objectives was to increase and potentiate national capacity in case management, coordination, and operations for COVID-19 rehabilitation and home-based care. This objective was achieved with USAID´s support and in collaboration with the Ministry of Public Health, through the selection of facilities, equipment procurement and subsequent training of health providers.

Additionally, protocols, standards of practice, guidelines and digital tools were developed for case management.

Study setting

In Ecuador, the health system is organized into different levels of care, ranging from the primary level to the tertiary level. Our study focuses on primary and secondary level of care. The primary level of care provides primary and preventive medical care. It includes health centers and medical units located in communities and rural areas and offers basic health services. The secondary level of care comprises general and specialized hospitals for medical and surgical services. These facilities offer specialties such as surgery, gynecology, pediatrics, and internal medicine, among others.

Implementation of multidisciplinary PCC rehabilitation clinics in Ecuador

Identification and selection of public health facilities

RISE developed a program titled: "Functional recovery of COVID-19 and PCC" that included a series of ten webinars provided by national and international experts to raise awareness and disseminate evidence-base knowledge about PCC. The webinars were conducted via Zoom© and transmitted by Facebook© Live through the Universidad San Francisco de Quito's (USFQ) School of Medicine homepage. A total of 4,930 individual health professionals attended. This program allowed us to identify the need for additional training and capacity building, through the development and implementation of multidisciplinary rehabilitation clinics (Figure 1).

After the program completion, and in collaboration with the Ministry of Public Health (MOPH), a facility level assessment focusing on rehabilitation services was completed online by 123 publicly funded health facilities around the country. The assessment results and the facility treatment of patients with diagnosis of COVID-19 determined the selected institutions where the PCC rehabilitation clinics would be implemented.

In consultation with the Ministry of Public Health (MOPH), 18 of 123 health facilities throughout 7 provinces in Ecuador were selected for expanded services, rehabilitation, and treatment of PCC. Furthermore, after the implementation of these first

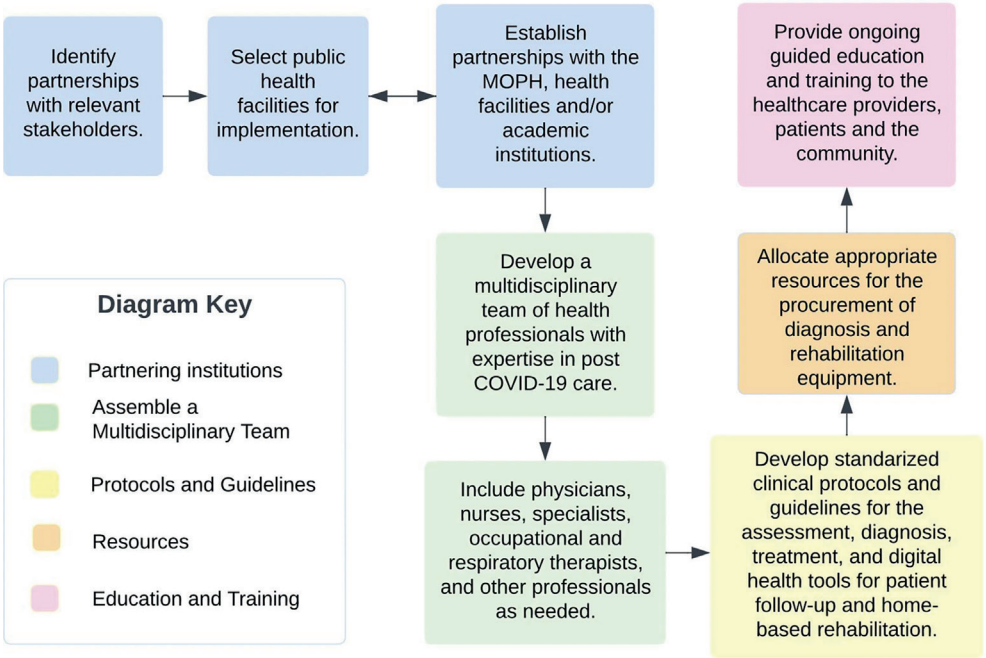


Figure 1. Key steps to establish a PCC rehabilitation clinic.

clinics, the Municipality of the Metropolitan District of Quito requested RISE to develop PCC rehabilitation clinics in three Metropolitan Health Units, located at the North, Center and South of Quito, increasing the total number to 21, located in 7 provinces of the country (Figure 2).

Development of multidisciplinary teams

Health professionals working in the selected facilities received further on-site training, taking into consideration their availability and willingness to work in a high-demand environment and in a multidisciplinary team. Health facilities were under-staffed, and training was challenging as it had to be individualized to each health provider´s area of competence which wasn´t represented in all facilities. Training was provided to health postgraduate students, physiatrists, family physicians, attending physicians, general practitioners, rural physicians, interns (medical students in the last year of their career), psychologists, psychiatrists, pediatricians, nurses, technicians, physical therapists, respiratory therapists, and paramedics.

Equipment donation

Although PCC affects diverse organs and effective treatment relies on a multidisciplinary approach, respiratory equipment was specifically selected for donation in Ecuador, as the devices were scarce and/or new to the country. Therefore, donations included spirometers, oximeters, non-invasive gas analyzers, and inspiratory muscle trainers (IMT). These devices play a crucial role in evaluating respiratory function, lung volumes, monitoring oxygen levels, analyzing gas exchange and improving respiratory muscle strength.

Based on the identified needs, RISE prepared a comprehensive procurement plan, considering equipment specifications, quantity, estimated costs, and timelines. The project followed processes and guidelines

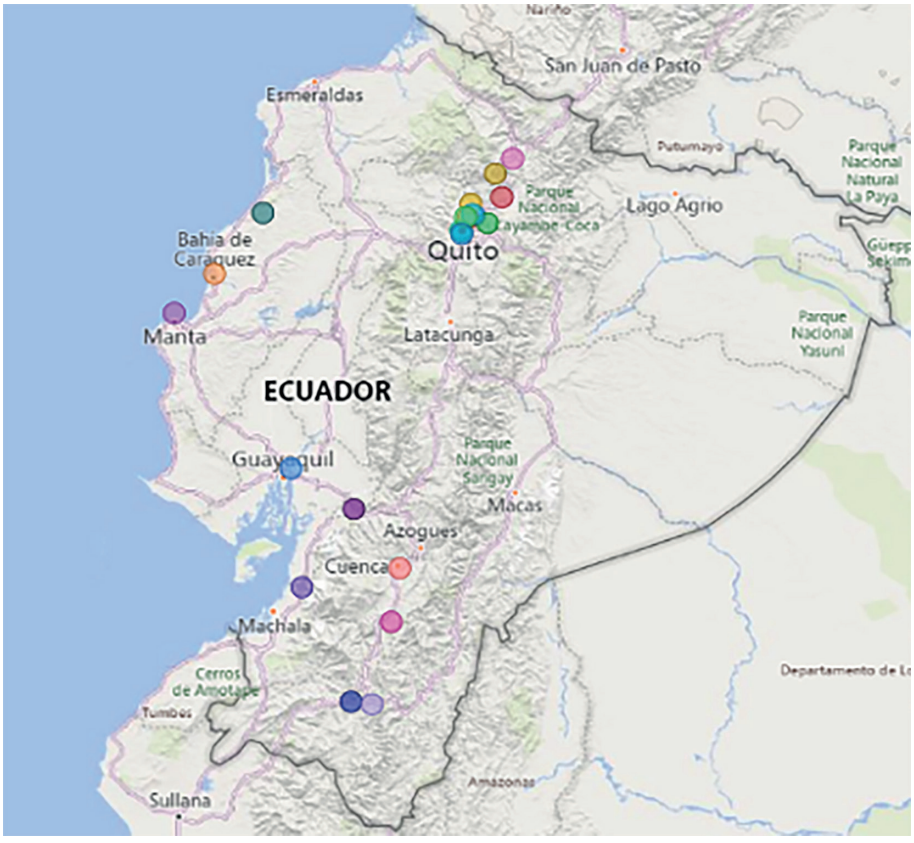


Figure 2. Location of health facilities where the PCC rehabilitation clinics were implemented.

aligning with the donor´s and the MOPH´s policies and evaluating the equipment for quality and appropriateness. The donated equipment was allocated to 21 health facilities and healthcare staff received training on equipment use, ensuring seamless integration and improved patient care. RISE continuously monitored and evaluated the impact of the donation for potential adjustments and additional support.

Development of a mobile application for PCC: RESPIRA APP

RISE developed a mobile application for Android and iOS mobile devices, called RESPIRA.

RESPIRA informs patients about symptoms inherent to PCC and provides rehabilitation exercises that can be done at home. RESPIRA supports domiciliary rehabilitation with the supervision of a health provider and has multimedia content such as illustrations, photos, audio, and videos.

Android users can download RESPIRA App for free by clicking on the following link:

https://play.google.com/store/apps/details?id=com.app.postcvid

For iOS devices, it can be downloaded from the following link:

https://apps.apple.com/ec/app/respira/id6446152507?l=en

Development of standardized protocols, guidelines, and tools for patient assessment

RISE developed evidence-based PCC rehabilitation manuals for health providers and patients that were adopted by the MOPH, nationally. RISE developed infographics that health providers offered to the patients, increasing access to timely rehabilitation and home care (Figure S1 in the appendix supplementary material).

Ongoing guided education and training to healthcare providers

RISE developed the training package: "Identification and management of Post COVID-19 Conditions in Ecuador" to provide tools for health professionals and patients to gain understanding and knowledge of PCC. Additionally, a "Post COVID-19 Conditions Rehabilitation Manual" in two versions (one for health professionals and one for patients) was developed. While both manuals focus on PCC rehabilitation, with a multidisciplinary and multisystemic approach, the interventions of respiratory rehabilitation have been used as a guide for other pulmonary conditions. Moreover, training courses based on constructivism, were created along with the manuals, to encourage participants to build their knowledge based on their experiences and newly acquired knowledge. These courses applied methodological resources such as practice-based education, experiential learning, virtual learning, and case analysis, which allowed for the development of decision-making and teamwork. All training topics adhered to current management guidelines and biosafety protocols [10]. The training consisted of two modalities: in-person and virtual.

The virtual modules were delivered daily by Zoom©, for two hours, during three consecutive days and provided a theoretical background of PCC, including symptoms, signs, and multi- system manifestations. The goal was to enable early diagnosis and timely management.

The on-site training strengthened and deepened the knowledge acquired in the virtual meetings, through participatory discussions with questions and answers and practice-based learning involving rehabilitation procedures and techniques. The same participants that attended a virtual component attended the in-person training, which lasted 12 hours in total. The training schedule and topics are depicted (Table S1 in the appendix supplementary material).

Evaluation

The practical sessions were done on-site, which included 3 sessions of 4 hours each. The methodology included practice-based education. During these sessions, participant's new knowledge was reinforced and evaluated through simulated clinical case presentations. A moderator provided a brief introduction and discussion on the most important components of the case presentations. Participants were divided into smaller groups and were assessed on procedures such as the 6-minute gait test [11], the proper use of Inspiratory

Muscle Training, IMT, breathing exercises, early mobilization, the Sit to Stand Test [12], Barthel Index, and the Post COVID-19 Functional Status Scale [13].

To evaluate knowledge acquisition, participants were given questionnaires consisting of 15 questions written by local experts. Each questionnaire included the material detailed in the course and was applied twice, before the training and immediately after completing all the course components (theoretical, practical, virtual and in-person). The evaluation was applied through Qualtrics, with the aim to increase participant´s engagement and accessibility from any mobile device.

Data collection tool

After the overall implementation of the 21 post COVID-19 rehabilitation clinics (training, guidelines, manuals, and equipment), a survey was generated on the KOBO platform that allowed the determination of the number of patients with a diagnosis and who received treatment for PCC. Due to the lack of an established protocol or clinical practice guidelines in the health facilities, the diagnostic criteria were determined according to evidence-based information available at that moment, from the PCC manuals created by RISE (Figure S2 in the appendix supplementary material).

Follow up

After completing the overall implementation of the PCC rehabilitation clinics, a comprehensive follow up assessment was conducted and RISE worked with each institution´s team to create tailored flowcharts that addressed the unique needs and capabilities of each healthcare center and hospital, ensuring a seamless and efficient process for referring patients to the appropriate area of need.

Results

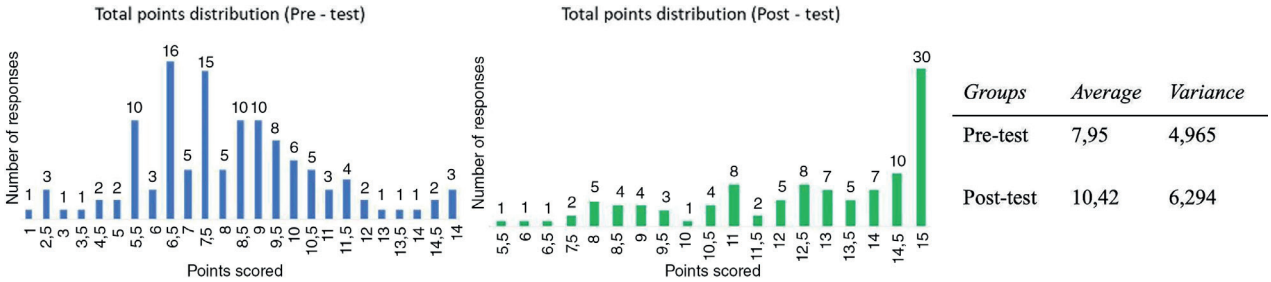
Participant demographics

From July 2022 to February 2023, RISE conducted three in-person theoretical and practical training sessions including 133 participants from 21 facilities. Out of these, 50 (37.59%) were physical therapists, 42 (31.58%) medical doctors, 8 (6.02%) respiratory therapists, 4 (3.01%) occupational therapists, 2 (1.50%) speech therapists, 12 (9.02%) nurses and 15 (11.28%) had other health professions. The cohort was mainly female (71%).

Knowledge acquisition

Evaluation of knowledge acquisition was done before and after the training, to determine the impact of the theoretical and practical sessions through a 15-question evaluation. On average, the participants showed an increase of 2.47 points when comparing average scores from the pre-test (7.95) to post-test (10.42), with a maximum score of 15 points (Figure 3). Additionally, our results evidenced a more homogenous distribution of the post-test scores vs pre-test scores. Although this suggests a significant impact ($p = 0.0000003$) on knowledge acquisition, the higher variance values portray variability on an individual level within the groups. Overall, we could determine that the training sessions provided knowledge acquisition regarding identification and management of patients with PCC.

Additionally, three distinct statistical analyses were conducted to determine any difference in prior knowledge and acquired knowledge among categories of healthcare professionals. These professionals were classified into four groups: medical doctors, nurses, respiratory therapists, and others. The initial analysis reviewed pre-test scores across professional categories, revealing a statistically significant difference between medical doctors and nurses, with medical doctors exhibiting higher scores. Contrary, no significant difference was observed when comparing the other group of professionals. A second analysis of post-test scores demonstrated similar findings, with medical doctors achieving significantly higher scores compared to nurses, while other comparisons remained statistically equivalent. Finally, the third analysis evaluated participants' knowledge acquisition, calculated by subtracting post-test scores from pre-test scores. This analysis indicated no statistical disparity among healthcare



Groups	Average	Variance
Pre-test	7,95	4,965
Post-test	10,42	6,294

Figure 3. Recorded scores of participants' pre and post-test.

Table 1. Patients cared for in the PCC rehabilitation clinics (from July 5, 2022, to March 31, 2023).

Patients care by RISE supported facilities		
Facility	**Patients**	**Post COVID-19 Patients**
Hospital Docente De Calderón	5,090	157
CS Tabacundo	2,181	61
CS La Troncal	1,973	23
Hospital Vicente Corral Moscoso	1,648	109
Hospital Básico Yaruqui	1,540	191
CS Nabón	399	47
Hospital San Luis De Otavalo	202	65
Hospital General San Vicente De Paul	171	20
CS Comité Del Pueblo	148	25
CS San Antonio De Pichincha	137	14
Hospital Isidro Ayora De Loja	126	88
Cs Catamayo	90	25
Unidad Metropolitana Centro	50	12
CS Ponce Enríquez	46	4
CS Calderón	30	6
Unidad Metropolitana Norte	10	9
Hospital General Enrique Ortega	3	2
Unidad Metropolitana Sur	2	1
Total	**13,846**	**859**

professionals, suggesting that all groups demonstrated comparable improvement following the training.

Patient outcomes

Up to March 31, 2023, 13,846 patients received care in the areas of physical and respiratory rehabilitation within the RISE project facilities. From these, 859 patients (6.2%) met criteria for post COVID-19 condition (Table 1). Data was uploaded daily by health providers. Of the total of patients cared for at the PCC rehabilitation clinics 32.7% were children and adolescents, 51.2% adults, 16.1% older adults (Table 2) and 54% were women, while 46% were men.

Table 2. Patients cared by age group.

Patients cared by age group		
Age group	**Patients**	**Percentage**
0-19 years	4,528	32.7%
20-39 years	1,924	13.9%
40-64 years	5,165	37.3%
65 years or more	2,229	16.1%

Discussion and conclusion

The impact of the COVID-19 pandemic can still be seen in patients exhibiting long-lasting effects on their overall health. Although, initially, identification of these patients was essential, it was clear that establishing specialized and multidisciplinary centers for their rehabilitation was required [14, 15]. Health organizations worldwide have invested in the creation of these clinics, and although pioneer services were developed in countries such as the USA, Canada and the UK [16] it was essential to bring this care for patients to Latin America where resources are scarce. Additionally, rehabilitation is an area that requires strengthening in Ecuador, and due to the PCC cases reported, an opportunity to implement rehabilitation clinics in the country was evident [9]. Our approach in

Ecuador was to create PCC rehabilitation clinics that included the procurement of specific equipment, and the development of guidelines and training healthcare personnel for adequate treatment of patients, due to an ever-growing demand from the population [17].

Initially, it was essential to establish the clinics in health facilities, mainly in public institutions, and the MOPH. The relevance of establishing the clinics in both primary health care centers and secondary-level hospitals lies in the ability to refer patients with more extended needs or specialized care to hospitals, while patients with less severe needs could be cared for in primary health centers, avoiding saturation of hospitals [18]. The MOPH and Municipality´s support enabled us to establish 21 PCC rehabilitation clinics in 7 provinces. The public sector collaboration increased the sheer area of impact; moreover, the clinics were free of charge, therefore ensuring patients all over the country equal access to high quality and specialized care after COVID-19.

The equipment acquisition for the PCC clinics was primarily centered around respiratory rehabilitation (spirometers, pulse oximeters, inspiratory muscle trainers and gas analyzers) due to the prevalence of respiratory sequela in patients recovering from COVID-19 [6] and due to the lack of overall respiratory rehabilitation in the country [19]. Effective implementation of clinics involves not only equipment but also comprehensive training for health personnel. This training ensures accurate device usage, data interpretation, and high-quality care delivery. The need for these clinics is visible, particularly when considering aging populations that were severely affected during the pandemic [17]. Thus, creating these spaces and tools to continue healthcare professional training and education can benefit not only patients suffering from PCC, but also a population of non-COVID patients who need respiratory rehabilitation but haven't had access to such a service previously. Although COVID-19 has a particular impact on the respiratory system, many PCC clinics apply a multidisciplinary approach, including neurological, psychological, sport medicine, physiotherapy, and nutritional care, as it is evident that PCC can affect a variety of organs and systems [20].

The training sessions conducted by RISE saw the participation of 133 individuals from 21 health facilities, representing various health professions. Evaluation of knowledge acquisition, assessed through a pre-and post-training test, revealed a significant improvement in participants' average scores, indicating the effectiveness of the theoretical and practical sessions. Despite the overall positive findings, there was statistical variability in individual performance within groups. Statistical analyses revealed that medical doctors achieved higher scores than nurses in both pre-tests and post-tests. However, when assessing knowledge acquisition, no significant difference was observed among healthcare professionals, suggesting that all groups benefited equally from the training. This suggests the need for targeted courses and programs tailored to nurses' needs, ensuring comprehensive skill enhancement across all healthcare disciplines.

PCC multidisciplinary rehabilitation clinics, situated within the public sector, provide inclusive access to care regardless of financial status. The proactive identification of over 800 patients with PCC between July 2022 and March 2023 highlights the clinics' crucial role in addressing long-term impacts and reducing pressure on referral hospitals. In a future study we will analyze the effectiveness of targeted rehabilitation of the patients attending to the post-COVID-19 clinics. However, overall, PCC rehabilitation clinics represent a holistic and innovative approach to patient recovery in the country.

Additionally, PCC rehabilitation clinics play a role in COVID-19 education and prevention [20], and, by providing information on disease symptoms and prevention measures, they may contribute to reducing the spread of the disease and minimizing its further impact on the population. This preventative approach, in addition to the collaboration between primary healthcare centers and hospitals, helps alleviate the burden on referral hospitals. In conclusion, the establishment of PCC rehabilitation clinics was successful in identifying patients with PCC for early rehabilitation and strengthened respiratory rehabilitation for patients with additional diseases in Ecuador. The insights of this study can serve as a guide for the development of similar initiatives in other countries.

Key summary points

- Post-COVID Conditions (PCC), have placed a burden on both patients and health systems as multidisciplinary treatments are needed that require specialized teams to tackle a plethora of multi-organ symptoms involved.
- This article provides a post implementation reflection that seeks to describe the processes, infrastructure requirements, training needs and the challenges faced in developing and implementing multidisciplinary rehabilitation clinics for patients with PCC, in an under-resourced setting.
- Twenty-one post COVID-19 rehabilitation clinics were established in primary healthcare centers and second level hospitals in 7 out of 24 provinces of Ecuador.
- The establishment of PCC clinics in Ecuador was successful in identifying patients for early rehabilitation.
- The implementation of PCC rehabilitation clinics involved a collaborative effort between the Ministry of Public Health, the private sector and a non-governmental organization.
- The insights of this study can serve as a guide for the development of similar initiatives in other countries.

Abbreviations

PCC: Post COVID Condition
PEPFAR: President's Emergency Plan for AIDS Relief
USAID: U.S. Agency for International Development
RISE: Reaching Impact, Saturation and Epidemic Control
MOPH: Ministry of Public Health
Jhpiego: Johns Hopkins Program for International Education in Gynecology and Obstetrics
IMT: Inspiratory muscle trainers

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Supplementary Material

Figure S1: Infographic

Figure S1: Infographic *(continued)*

Table S1: Schedule of activities

SCHEDULE OF ACTIVITIES			
Description of the Activity	**Session 1**	**Session 2**	**Session3**
Definitions of post COVID-19 condition	X		
Identify risk factors and symptoms	X		
Diagnostic studies and differential diagnosis	X		
Functional tests		X	
General treatment		X	
Universal Rehabilitation		X	
Targeted Rehabilitation			X
Evaluation and Vaccination			X
Practical training			X

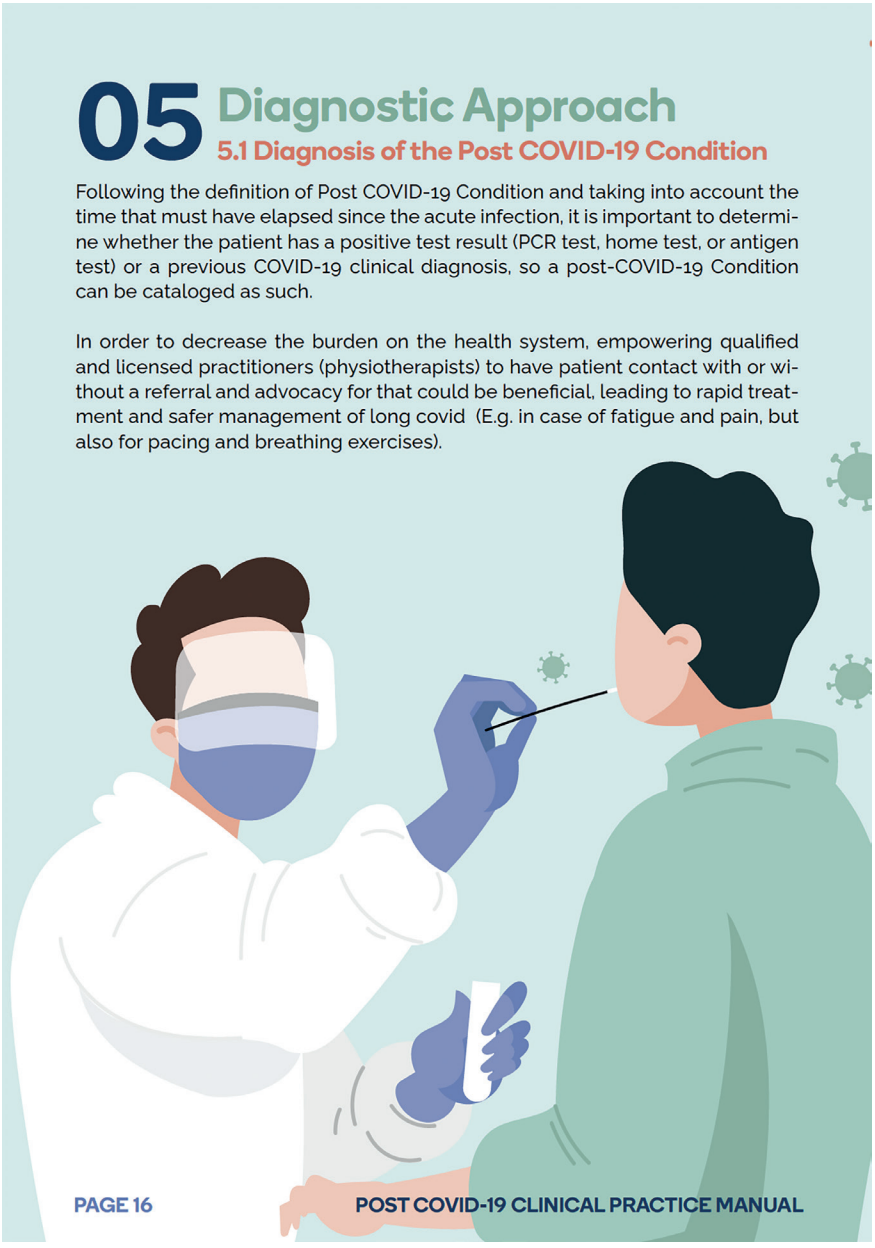

Figure S2: Diagnostic criteria

Figure S2: Diagnostic criteria *(continued)*

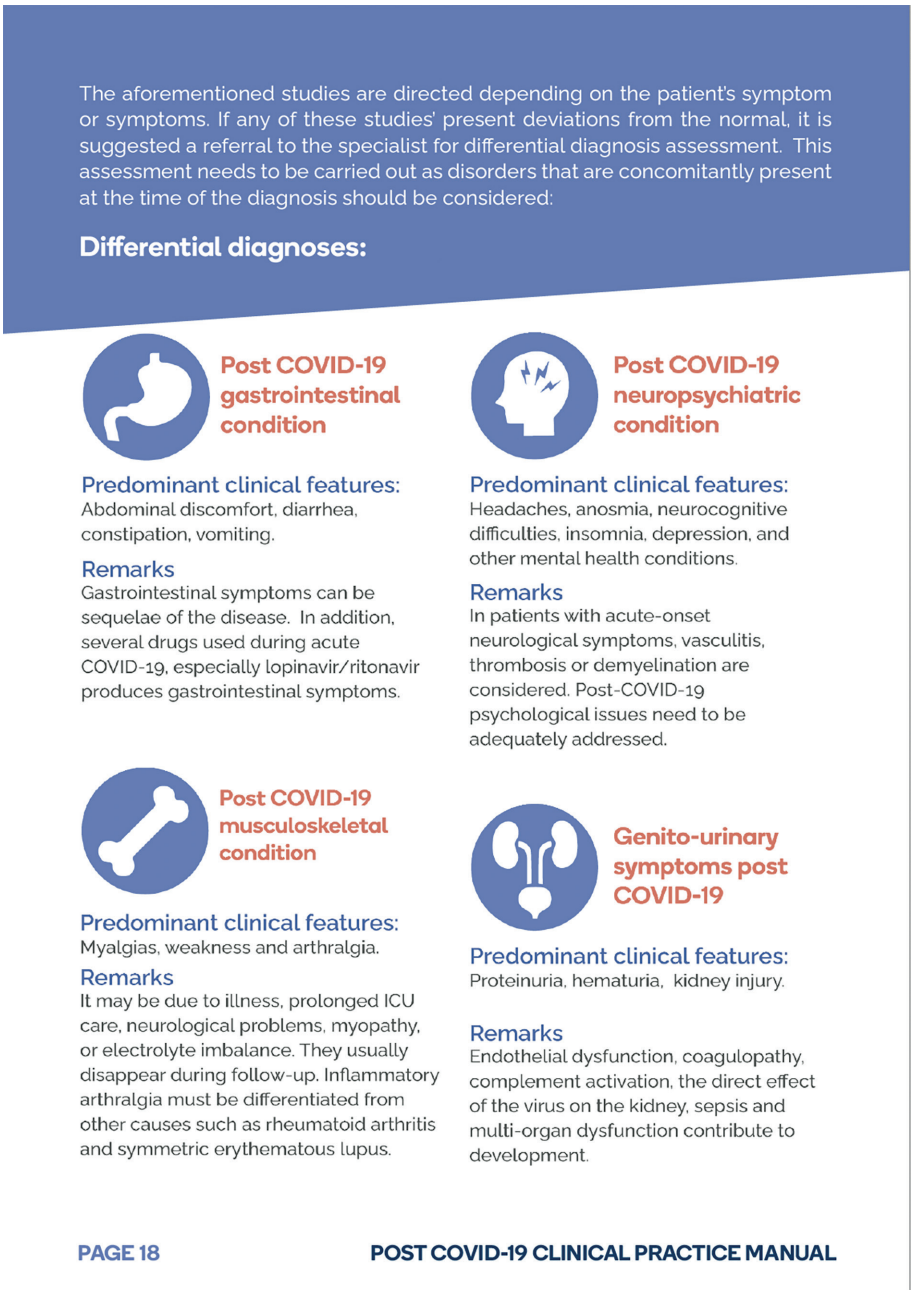

Figure S2: Diagnostic criteria *(continued)*