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Challenges facing COVID-19 in rural areas: An experience from Lebanon

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ABSTRACT

The COVID-19 pandemic first affected Lebanon on February 21st, 2020, and one month later it reached Bcharri, a small remote town in northern Lebanon. When similar rural areas with under-equipped facilities and financial limitations are affected, outcomes could be catastrophic, raising the need for meticulous preparation and rapid response.

In our study, we describe the different measures taken to prepare this town for the COVID-19 outbreak, as well as our rapid response after the first case was confirmed. We emphasize the distinctions and the needs of rural areas when facing such threats, and the importance of a proactive community and local initiatives. We also detail our contact tracing strategy and massive testing campaign, as well as our early management of patients infected with COVID-19. We hope that our experience can be reproducible in areas with similar rural settings, during the COVID-19 pandemic and future outbreaks.

1. Introduction

COVID-19 was first identified in December 2019 in Wuhan and has since spread globally [1]. It was quickly declared as a pandemic by the World Health Organization (WHO) on March 11, 2020 [2]. More than four and a half million confirmed cases have been reported as of May 15 2020 [3].

Lebanon reported its first case of COVID-19 on February 21 2020, a 45-year-old woman traveling from Iran [4]. Governmental and private hospitals in the capital Beirut quickly prepared for the imminent outbreak by implementing emergency protocols and training their staff, as well as dedicating specific units and intensive care unit (ICU) departments for COVID-19 cases. Several testing centers were launched across the city and its suburbs. Awareness campaigns were created by the Ministry of Public Health, local news, and media outlets.

On March 15 2020, the total number reached 99 confirmed cases with 3 deaths, which led the government to declare a state of a medical emergency and announce the closure of schools, airport, seaports and land entrances, as well as lockdown measures enforced by the security forces [5].

Although the outbreak initially appeared in highly urbanized settings, fears were growing over the spread of the virus to more rural and remote areas in the country. The rural population in Lebanon represents 11.41% of its total population (as reported by the World Bank collection in 2018) [6]. Rural areas presented a particular threat due to the lack of access to awareness, testing, and healthcare. Bcharri is a remote northern Lebanese town of approximately 5000 residents. With only one small and under-equipped hospital, Bcharri had to be prepared for a possible spread amongst its people. On March 26, Bcharri confirmed its first case, announcing the beginning of its battle against COVID-19.

In our study, we aim to describe the different measures taken to prepare this town for the first wave of COVID-19, as well as our early
experience with patients infected with the virus. We hope that our experience serves as an example to other healthcare systems in similar rural underserved settings for future outbreaks and a possible second wave at their hospitals.

2. Preparation for COVID-19: being one step ahead

2.1. Getting the community ready

Long before the town’s first reported case, healthcare workers, local associations, and the municipality took matters into their own hands and joined efforts to prepare the town for an imminent outbreak. After Lebanon confirmed its first case, an emergency response team was set up in Bcharri and developed strategies for awareness campaigns, hygiene, and social distancing measures.

Despite the numerous awareness campaigns spreading on social media, it was necessary to use a different approach in order to reach Bcharri’s seniors and elderly that were not connected to these platforms. Since most residents of this small town are very devout Christians, the church masses were the ideal location for awareness campaigns. At that time, COVID-19 cases were still very low and among people with travel history, so the country had not taken any lockdown measures yet and social gatherings were still allowed. We took this opportunity every Sunday to educate the town residents on the virus, ways of prevention, sanitization instructions, and the importance of social distancing. Checkpoints were set up at the borders of Bcharri and surrounding towns to register the names, addresses and contact information of people entering and leaving the area. They also included body temperature checks and vehicle sanitization.

2.2. Getting the healthcare facilities ready

Bcharri, like most remote rural towns, suffers from financial limitations that jeopardize its ability to prepare and respond to a possible outbreak effectively. The response team quickly reached out for financial support and cooperation from the local government, churches, members of parliament, Lebanese diaspora, local donors and other stakeholders in the community. Their contributions allowed the response team to equip the hospital with ventilators, oxygen supply, portable X-Ray equipment, and provided the medical staff with the needed protective equipment such as isolation gowns, face masks, and N95 respirators. We also reached out to special manufacturers to provide negative pressure rooms. In addition, we used a part of the gathered funds to provide sufficient testing kits, food packages and sanitizing products for vulnerable families affected by the pandemic.

2.3. Getting the medical staff ready

Lebanon already suffered from a severe shortage of physicians and medical staff in rural areas before the COVID-19 pandemic. Bcharri’s healthcare system, like most rural communities, was not ready for a potential surge in COVID-19 cases and would quickly be overwhelmed. We reached out to doctors and nurses from key specialties (infectious diseases specialists, internists, and pulmonologists) from other well-staffed healthcare facilities to have them be prepared to work at Bcharri Governmental Hospital (BGH) if the pandemic worsens. Our team then developed solid protocols and surge plans to quickly and effectively respond to a first wave of COVID-19 cases. A team of radiologists also agreed on a detailed protocol for the diagnosis of COVID-19, specific indications of CT scans and the sanitization precautions needed to ensure the disinfection of the department.

2.4. Multidisciplinary collaboration

One of our top priorities was to locate all suspected infected individuals as quickly as possible before they spread the infection to others. This is why we collaborated with all the pharmacists of the region to make sure we identify all patients seeking medicine for coronavirus related symptoms. This agreement ensured that no symptomatic cough, cold or flu medication (antipyretics, anti-cough medicine, antihistamines, etc) would be dispensed to patients without having consulted with the response team physicians. Through this multidisciplinary collaboration, we were able to know exactly where, when and who to test.

3. Crisis management

3.1. Tracking and isolating direct contacts

Despite all our best efforts and preparation to prevent COVID-19 from getting to Bcharri, the virus found its way to the town on March 26 2020, infecting a physician at Bcharri Governmental Hospital. At that time all the infrastructure and strategies were set in place to face this upcoming threat and were quickly activated.

3.2. Activating the hospital infrastructure

Since the hospital was scheduled to reopen for admissions in the matter of days, it was critical to guarantee a disinfected, clean and safe environment for both admitted patients and hospital personnel. The necessary cleaning and disinfection precautions were taken and a sanitization team was deployed to clean the hospital four times a day once it opens, according to the hygiene recommendations of the Centers for Disease Control and Prevention (CDC). We dedicated an isolated unit at the hospital to receive patients infected with COVID-19. Sixteen beds were made available for confirmed cases and sixteen for suspected patients who have been tested but have pending PCR results. Another section was set up as a quarantine facility. We also supplemented our personal protective equipment (PPE) provisions and made sure we had sufficient medicine in the hospital pharmacy to guarantee the full treatment protocol to all admitted patients.

3.3. Locating clusters

During the week after the first confirmed case, we initiated our testing protocol by targeting both close contacts and symptomatic individuals. At this time, several patients presented pneumonia highly suspicious of COVID-19 and typical lesions on their CT scan, such as bilateral ground glass opacities in the posterior and peripheral lung, consolidations, linear opacities, “crazy-paving” pattern, “reversed halo” sign and vascular enlargement [7].

We decided to consider them infected with COVID-19 based on their symptomatology and CT scan imaging while the Polymerase Chain Reaction (PCR) results were still pending, in order not to delay the initiation of treatment protocol.

On April 4, 27 nasopharyngeal swab specimens were collected for PCR testing, of which 12 (44.4%) came out positive. Two days later, 24 PCR tests were performed, of which 10 were positive (41.6%). An epidemiologic analysis located three clusters. These results were alarming, so we proceeded to test all three clusters and their close contacts, and subsequently launched our massive random testing
3.4. Massive testing

Our testing capacity was very limited at the beginning, and was dependent on the small number of PCR test kits donated by local health initiatives and sponsors. We had to prioritize our target patients for testing and constantly adapt the numbers to the amount of PCR tests we were receiving. The first and essential step was to test all symptomatic patients in order to locate and isolate the apparent vectors of the disease. For that reason, we dedicated an open-air area in front of the hospital for nasopharyngeal swab collection. This system allowed residents to be tested in a secure area without being in close contact with others. The samples were collected daily by trained doctors and sent to central laboratories where PCR tests were performed. During this period, an average of 20 PCR tests were performed each day.

In the next step, with increased PCR testing donations, we initiated a systematic testing program that targeted the residents, owners and employees of institutions with high human interaction and big crowds (churches, pharmacies, gas stations, shops and supermarkets), as well as people who had recently visited these places.

At this point, we received a big number of free PCR tests which allowed us to proceed to a final more aggressive testing method: a completely random large-scale testing campaign launched across Bcharri under the guidance of the response team, aiming to locate as many asymptomatic carriers as possible. In order for our campaign to be highly efficient and to cover the biggest area possible, we scattered the testing on different households and areas to ensure all neighborhoods were covered. In each household, we prioritized the elderly and those with comorbidities who were the most vulnerable subpopulation at risk of developing severe symptoms and needing critical care.

Several initiatives by university hospitals launched mobile clinics that targeted rural areas with no access to medical care. Their teams tested the residents of surrounding villages that had possibly been in contact with infected patients inside Bcharri.

During this second phase, an average of 57 PCR tests were performed each day (see Chart 1).

3.5. Complete lockdown

With the alarming outbreak announcing itself, the “wait and see” approach was too risky to be tried at Bcharri due to its limited resources and poor infrastructure; extreme measures had to be taken early on in order to maintain control over the spread of the virus. A complete lockdown of Bcharri and surrounding villages was implemented on April 11, a measure that was not taken anywhere else in the country. This drastic measure restricted entry and exit from Bcharri and surrounding towns, and was imposed by the security forces and the army. All transportation services in and out of the city were shut down, and the municipality issued an official request demanding all the community to self-isolate for 14 days even if asymptomatic. The residents were instructed to remain at home and were given the option to contact the municipality for necessities such as food and medicine. The response team worked hard to provide all essential products that were requested in order to limit the number of residents leaving their house. Journalists and local media outlets were also banned from entering the town. Food suppliers were the only exception but they had to deposit their products in garages transformed into warehouses. Once disinfected, the products were distributed to stores and supermarkets.

3.6. Setting up quarantine facilities

Patients with moderate symptoms and a stable condition were advised to quarantine at home in order not to overwhelm the hospital. However, many Bcharri residents live in small crowded households, and could not safely quarantine without putting their families at risk. For these cases where strict home isolation was impossible, we urgently needed to provide alternatives for quarantine. We dedicated a section at the hospital where patients could safely quarantine and have access to monitoring and care if their condition deteriorated. In addition, two hotels were converted to quarantine facilities and were put on standby from the beginning in case the hospital quarantine unit is saturated. A team of nurses were set to do routine temperature and vital signs checks to all admitted patients everyday. Hotel cooks were also ready to prepare three meals a day and have them delivered to the patients’ doors.
Special garbage bins were installed in the hotels as well as neighborhoods affected by the pandemic. Waste from infected people was collected in separate garbage trucks.

3.7. Collaboration with other hospitals and colleagues

With the expansion of our testing campaign and the hospital laboratory not being ready to perform PCRs, we joined forces with five central labs and sent them all our collected samples. Although we were able to optimize our hospital equipment and respirators, we feared that creating an ICU unit in the extremely short amount of time available would not be able to guarantee the best standard of care to critical patients. Our patients’ health was our highest priority and we were not willing to take any measure that would put their lives at risk. This led to the agreement to transfer all severe patients to central hospitals for better care.

We also partnered with physicians from university hospitals in Beirut who had acquired more experience in the management of COVID-19 patients being on the frontline ever since the beginning of the outbreak. Together, we elaborated our treatment protocol and therapeutic strategies, and had weekly online meetings for follow-up and protocol improvements. Our collaboration with fellow medical facilities and physicians allowed us to fill the remaining gaps in our response plan, and this emphasizes the importance of cooperation and joint efforts in similar rural areas during any upcoming outbreaks.

3.8. Patient management

After performing PCR tests, patients who were highly suspicious of being infected were hospitalized and isolated for 24–48 h in a specific section at the hospital dedicated for highly suspicious cases with pending results.

3.8.1. Negative PCR test (Graph 1)

Asymptomatic patients with negative PCRs were instructed to continue to self-isolate at home following the general social-distancing precautions and report back to the hospital if they presented new symptoms.

However, due to the alarming reports of false negative PCR results, patients with negative PCRs that presented COVID-19 related symptoms or typical lesions on CT scans were hospitalized and isolated for 24–48 h in a section for suspicious cases until the PCR test was repeated [8]. [9].

3.8.2. Positive PCR test (Graph 2)

Patients who were confirmed COVID-19 positive were triaged into two subgroups according to the duration of their symptoms and clinical condition:

1. Patients with a positive PCR who already presented symptoms for more than two weeks and were in a stable clinical condition were asked to strictly self-isolate at home for a period of two weeks after the resolution of their symptoms. The medical team of the COVID-19 unit considered this subgroup on the path of recovery and agreed not to treat them. They followed-up by calling the patients twice a week to make sure their condition was still stable. The patients who were estimated to be at risk for complications were instructed to get a pulse oximeter for daily monitoring from their home, and to contact the hospital if their saturation drops below 95%. Two weeks after the resolution of their symptoms, PCR testing was repeated to confirm their recovery.

2. Patients with a positive PCR test who presented symptoms for less than two weeks or were in a poor clinical state, as well as asymptomatic patients received a proper history and physical examination at the emergency department. Blood tests were realized to complete the assessment and consisted of a complete blood count (CBC), creatinine, electrolytes, albumin, calcium, magnesium, phosphore, ferritine, lactate dehydrogenase (LDH), triglycerides, prothrombin time (PT), partial thromboplastin time (PTT), creatine phosphokinase (CPK), creatine kinase-MB (CPKmb) and Troponin. A CT scan was done in patients who presented respiratory symptoms (cough, dyspnea, chest pain) as well as patients with oxygen saturations lower than 95%. Specific criteria based on our findings and workups allowed us to decide if we wanted to initiate our treatment protocol, hospitalize the patients or transfer them to other hospitals.

- **Treatment protocol initiation**

  The treatment protocol was initiated when at least one of the following criteria was present: patients with comorbidities, patients aged more than 45 years old, patients with a confirmed pneumonia on chest CT scan.

- **Hospitalization**

  Patients were hospitalized when they met at least one of the following findings: high grade fever, oxygen saturations lower than 95%, extended lung lesion of more than 25% on chest CT scan.

- **Transfer**

  Patients with severe disease were transferred to central hospitals, based on the following criteria: oxygen saturations lower than 90%, ferritine values of more than 2000 ng/ml, CRP values of more than > 150 mg/L (Graph 2).

![Graph 1](image_url) Management of patients with a negative PCR test.
3.8.3. Treatment protocol

The treatment protocol consisted of Hydroxychloroquine (200 mg three times daily for 10 days), Azithromycin (250 mg twice on day 1, followed by 250 mg daily for 4 days), Zinc (20 mg daily) and Pit-avastatin (2 mg daily), as well as Enoxaparin (40 mg SQ) for hospitalized patients. An electrocardiogram (EKG) was done prior to the initiation of treatment and three days into the treatment. The patients who were treated at home were instructed to come back for an EKG after three days as well.

3.8.4. Recovery and discontinuation of isolation

Hospitalized patients were discharged when they exhibited sustainable improvement of their clinical status and symptoms. Before discharge, the patients received a detailed education on strict home isolation and symptom monitoring so they know when to seek medical attention. Follow-up after discharge was done through messaging platforms; we recommended the use of a pulse oximeter in order to monitor blood oxygen saturation levels three times a day. The patients also updated their physicians daily on their clinical status and symptoms.

PCR testing was systematically repeated in all positive patients. This was done ten days after the completion of the treatment for those who were given the protocol, and two weeks after symptom resolution for the patients who were not treated.

As per the CDC guidelines, two negative tests conducted 24–48 h apart were needed to consider the patient fully recovered. The discontinuation of home isolation was allowed five days after the second negative PCR test [10].

4. Our population

Bcharri has a population of approximately 5000 residents, out of which 76 tested positive (≈1.52%). A total of 1016 PCR tests were performed between March 27th and May 8th, including repeated PCRs done after symptom resolution.

Overall, 772 individuals were tested during this period which represents 15.4% of the Bcharri’s population. 76 tested positive out of all 772 tested patients (9.8%).

Thirty-four patients received the treatment protocol (44.7% of total positive cases), while 42 patients did not receive treatment.

The mean age of treated patients is 60.1 years and their median age 57.5, whereas the mean age of non-treated patients is 31 years, with a median of 27.

Patients that did not receive treatment did not require hospitalization, but 10 of them were hospitalized because they could not effectively and safely quarantine at home.

Out of all 34 patients who received treatment, 31 met the criteria for hospitalization (40.8% of total positive cases), and 14 of them were directly or secondarily transferred to central hospitals (18.4% of total positive cases).

Out of all positive PCRs, 16 patients (21.05%) were asymptomatic at the time of diagnosis, out of which 4 showed symptoms later on (25%).

Overall our population had a favorable outcome, with only one death of a 92-year-old patient that was transferred to a central hospital (Graph 3).
5. Discussion

*Know your community, prepare strategically, test massively and treat early*

During any infectious outbreak, the ideal response by public health authorities is early massive testing. This allows for rapid identification of infected cases, initiation of treatment protocols, and more importantly immediate isolation to prevent transmission. The WHO repeatedly emphasized the importance of testing in controlling the pandemic. It explained that while personal hygiene and social distancing measures are enough to flatten the curve, massive testing is far more efficient at putting a definite end to the pandemic [11].

This method was the key to the successful containment of the outbreak in countries like South Korea and Iceland. In those countries, widespread testing was adopted at a very early stage. Early isolation of potentially infected individuals and extensive contact tracing helped break transmission chains [12].

At Bcharri, our ultimate goal was to be able to detect as many asymptomatic carriers as possible, to flatten the curve at our town’s scale so we do not overwhelm the hospital, and to contain the spreading of the disease. In total, over the period of three weeks we managed to test 772 residents, the equivalent of 15.4% of the total population (154 tests per 1000 people), making Bcharri the city with the highest number of tests performed per capita across Lebanon. This was a significant improvement compared to the average of 7.6 tests per 1000 people that was done in the rest of the country [13]. In comparison to countries considered as models for successful virus containment, Iceland is the country that tested the most people for COVID-19 per capita, having reached a maximum of 155.95 total COVID-19 tests per 1000 people [14]. Very little data is available on the amount of testing being done in rural areas around the world for a smaller scale and more representative comparison, however rural areas in states like Louisiana, USA have reported less than 20 tests per 1000 residents [15]. By the end of April 2020, 725 cases were confirmed in Lebanon, out of which 76 were from Bcharri (10.5% of the total number of cases).

Asymptomatic carriers are considered to be a crucial contributor to the high transmission rate of COVID-19 compared to other outbreaks [16]. Thanks to our massive testing campaign, we were able to detect 16 asymptomatic carriers (21.05% of all positive cases), which was an essential factor that allowed the control of the outbreak.

Furthermore, the WHO persistently urged all governments to prepare for an eventual pandemic in their country even before the virus appeared between their citizens [17]. However, when facing national threats such as pandemics, overwhelmed government officials and high authorities tend to centralize their efforts on the capital and urbanized crowded areas where outbreaks often begin and spread rapidly. In this process, rural and remote areas may be left out. This poses great risks for these regions because any delay in the implementation of protocols and surge plans can be disastrous [18]. Our experience showed us the value of preparation on a small scale and the importance of teamwork between local initiatives. The pressure should not be put exclusively on governments. To ensure efficient application of surge plans and the fair distribution of measures across the country, even in the most remote areas, the responsibility should be decentralized and the efforts divided between the authorities and local committees. Municipalities, citizen-led initiatives, NGOs, clergy, private sponsors and activists are all essential components of a survival chain that is only fruitful when all players join efforts and coordinate to protect their community from a possible tragedy.

This approach proved to be especially beneficial in remote areas and unprivileged settings; in these areas, crisis management can be best handled through preparedness and planning rather than big resources. Remote towns must not feel falsely reassured by the distances that separate them from the epicenter of the outbreaks. Instead, they must prepare meticulously with the assumption that the virus will eventually reach their area. Before this happens, they must make sure they are capable of social-distancing precautions, early detection, strict isolation, contact tracing, and a sufficient standard of medical care. It is especially

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*Graph 3. The distribution of our population.*
vital for areas with limited financial and health resources to invest in prevention and strict precautions, because an uncontrolled outbreak would have a bigger health and economic burden than any costly preventive measure.

Most proactive measures taken at Bcharri were developed and executed locally. The response team knew their community, its weaknesses and strengths, better than any government official. They worked hard to fill the gaps that existed in order to be fully prepared. For example, targeting the population in churches had far more impact than any social media campaign.

Free tests from the ministry of public health were certainly very helpful, but were sent almost three weeks after the beginning of the outbreak. Our proactive community acted long before receiving external help and this is what kept the outbreak under control and avoided what could have been a catastrophe. By the time the outbreak started, a complete infrastructure and detailed protocols were ready to be quickly activated. This was the key to our success at containing the virus.

Despite the challenges of a pandemic in a remote area, this experience unveiled some positive distinctions: aggressive contact tracing was easier to achieve compared to other highly populated cities in Lebanon. In this closed community where everyone knew each other, most residents felt a responsibility to help out and assisted the response team in tracking all contacts of an infected patient. This cooperation optimized our chances of tracing suspected infections and immediately isolating them. Early detection, early isolation and early treatment were the three building blocks of our response success and favorable outcomes. Similar towns must take this into account when establishing surge plans by involving their residents in their contact tracing strategies.

CT scan imaging proved to be a very valuable and reliable alternative for PCR testing, providing sensitive and fast results and aiding the diagnosis of COVID-19 [19]. It allowed us not to delay the diagnosis and initiation of treatment in patients with highly suspicious clinical symptoms but pending PCR results. In some highly suspicious patients who had a negative PCR result, we relied on typical lesions on CT scan to initiate the treatment before repeating PCR testing, which helped us avoid the risk of false negative results. CT scans must be used as an alternative in areas where PCR testing is limited, and when results take long to confirm or are doubtful. From our experience, 5 patients had a negative PCR result but were considered positive based on their CT scan abnormalities, and their second PCR turned out positive thus confirming the diagnosis.

We also recommend the use of oximeters for patients who self-isolate at home because it allowed the doctors to safely monitor their patients without overwhelming the hospital with mild cases. They were more at ease when sending a patient home. All patients who did not require hospitalization and were instructed to home quarantine with oxygen monitoring had a positive outcome with no decrease in oxygen level on pulse oximetry.

With the entire infrastructure that is now in place, Bcharri is ready for a second outbreak. Our experience in Bcharri may be a successful model that can be reproduced in areas with similar rural settings during the COVID-19 pandemic and possibly future ones.

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The authors declare that there are no conflicts of interest.

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