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Hurricane Maria: Challenges Faced by Clinical Laboratories in Puerto Rico

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Abstract:

Hurricane Maria created an unprecedented crisis on Puerto Rico. This paper aims to describe the effects of Hurricane Maria on clinical laboratories in Puerto Rico. The study offered an opportunity to identify the challenges faced by clinical labs after the storm, how do they struggle to maintain their lab and also provide clues on possible solutions to mitigate similar situations on the future. This exploratory research used a questionnaire with twenty-three (23) questions. Data was collected 4 to 5 months after Hurricane Maria. The sample consisted of sixty-three (63) clinical laboratories in Puerto Rico. Participants were recruited face-to-face, by telephone, and email. Clinical laboratories faced telecommunication problems, lack of electricity and water, shortage of supplies, damage of infrastructure, employee's problems, reduction of patients, and flooding at facilities. Despite problems faced, the owners of the laboratories helped their employees, patients, and those affected in the community. Clinical laboratories, as well as other small and medium-sized enterprises, in Puerto Rico need to overcome obstacles created by Hurricane Maria and mitigate similar situations on the future. The study is of particular significance as it intends on reaching out small and medium-sized enterprises (SMEs) situation in Puerto Rico, specifically clinical laboratories, facing such a disaster. It studied the impact of Hurricane Maria on clinical laboratories and their responses to the disaster.

Keywords: Hurricane, maria, clinical laboratorios, puerto rico, huracan, disaster management, disaster reponse

1. Introduction

Hurricane Maria destroyed infrastructures and affected the entire Island. The hurricane caused devastation in different aspects, including but not limited to water system disrupted, flooding, limited medical treatment, and food supply problems. As many other small and medium-sized enterprises (SMEs), clinical labs in Puerto Rico faced a number of significant challenges after Hurricane Maria. This research was interested in identifying the main challenges faced by clinical labs owners on their recovery. Clinical laboratories within hospital facilities were not included in the sample for the current study. It focused on clinical laboratories and their performance after disaster recovery. In Puerto Rico, it is a relatively under-studied topic and the data was provided by clinical labs owners who described their recovery after Hurricane Maria. The research question of the study was: What challenges do clinical laboratories faced after Hurricane Maria and how did they respond to the crisis?

2. Literature Review

In terms of recent hurricanes of great impact, Hurricane Katrina in 2000 has to be mentioned. Corey and Deitch (2011) performed a research using a 30-question survey. Its sample, selected by convenience, was made of 183 businesses affected by Hurricane Katrina. Businesses needed to exist before Hurricane Katrina and still operating at the time of the study which was 6-8 months after the storm. The study mentioned that 37% of the organizations operated in an alternate, out-of-town location until utilities had been restored. The study also revealed that 38% had business recovery insurance, 64% of the organizations had flood insurance, and 68% had business interruption insurance. The research suggested that older organizations did not have significantly greater organizational performance. Business owners also lost access to their internet. Regarding sustained damage, it was mainly to inventory supplies, physical structure, electronics, and files. Cater and Chadwick (2008) performed an exploratory study to examine the response of two small business to the crisis situation caused by Hurricane Katrina, using a case study approach. They found four factors that inhibited the small business

response to the crisis: limited financial resources, communication difficulties, supply logistic problems, and government bureaucracy. In addition to those factors, they identified six factors that enhanced the firm's response to the crisis: a sense of proximity, the ability to move rapidly, a concern for employee welfare, employee versatility, networking relationships with strong ties to stakeholders, and a concern for the welfare of the community.

The Hurricane Center issued a warning on September 17, 2017. Hurricane Maria made landfall three days later (September 20, 2017). Eventually, 100% of the island power went down. According to an economic research firm, it is considered the second-largest blackout on record (Criss, 2018). The only blackout identified in history that is considered bigger is the one after Typhoon Haiyan in Philippines in 2013. In US history, this blackout caused by Hurricane Maria has been the worst one (3.4 billion hours of electricity lost). It beats the one caused by Hurricane Georges in 1998 (1.1 billion hours), Hurricane Sandy in 2012 (780 million hours), Hurricane Irma in 2017 (750 million hours), and Hurricane Hugo in 1989 (700 million hours).

According to Hsiang & Houser (2017), in Puerto Rico, decades of economic progress were undone in twelve hours by Hurricane Maria. The authors highlighted the situation of the electrical system which was in a very vulnerable situation before the atmospheric phenomenon. The residents of the island, as well as the business owners, depend almost entirely on the service offered by the Puerto Rico Electricity Power Authority (PREPA). To determine the effect that Hurricane Maria will have on the economy of Puerto Rico, Hsiang and Houser (2017) used an econometric model of the costs of cyclones over the past 60 years and applied it to the characteristics of Hurricane Maria and the pre-storm economic conditions in Puerto Rico. They calculated that Maria could lower Puerto Rican incomes by 21 percent over the next fifteen (15) years, a cumulative \$180 billion in lost economic output. It could now take twenty (20) years for the next generation to get back to where they were today, assuming that per capita growth rate would have continued. Conversely, Goldstein (2018) establishes that the most optimistic estimate is that Puerto Rico will face a two-year economic recovery. The statement assumes that Puerto Rico can rebuild its power grid, restructure its finances in a court-supervised process, and not get hit by another devastating storm during the recovery.

On the other hand, Campoy (2017) pointed out that, according to a forecast performed in November by the Economic Intelligence Unit, the island's economy will shrink by about 8% in 2018. The forecast puts Puerto Rico at the top of the list of the slowest growing economies in the world. The author also pointed out that for years the island has been struggling to curb an exodus of jobs and working people to the United States and a ballooning public debt. On top of that, the government of Puerto Rico filed for bankruptcy during 2017.

Banco Popular of Puerto Rico (2017) in its monthly publication Progreso Económico has raised the effect of the cost of electricity in Puerto Rico in small and medium businesses. The publication reviewed the PREPA data on electricity generation two months after the passage of Hurricane Maria through the Island. It indicated that 58% of the service was restored. An approximation to the energization of residential customers is the percentage of homes used by the firm Nielsen to measure television ratings, of which only 28% had electricity towards the end of November 2018. It can be deduced that the percentage of businesses with electricity in Puerto Rico was somewhere between these two figures. The bank's publication considers that many businesses were not in the first round of access to electricity and that they were even closed due to lack of electricity. Those who survive will be able to compensate the reduction in population and in demand since they will have less competition in the market.

Information published by different newspapers in Puerto Rico indicate that thousands of businesses have been unable to open due to ongoing blackouts more than two months after the storm. At least 5,000 small businesses have closed, and many others operated with reduced hours as effect of the shortage of electricity on the island more than a month after Hurricane Maria (Torres, 2017). The radio industry lost millions of dollars, both in infrastructure as in income. One month after the atmospheric phenomenon, radio executives predict that the restoration exceeds \$20 million (Vargas, 2017).

According to the data presented by the president of the Association of Restaurants of Puerto Rico (ASORE for its acronym in Spanish), more than 1,000 restaurants have closed from September to December 2017. It was also reported that two hundred clinical laboratories have closed after the hurricane (EFE, 2017) and others reduced hours of operation (Covas, 2018). Also, Maria produced a serious blow to tourism; thirty-six hotels on the island remain closed (Costa, 2017). On the other hand, according to Rodríguez (2017), the Department of Labor and Human Resources announced that the island lost about 31,600 non-agricultural salaried jobs. Among the sectors affected by the loss of jobs, all of the private sector, are recreation and lodging, commerce, transportation and utilities, educational and health services, professional services and manufacturing.

López (2018) conducted a research with marketing students at the University of Puerto Rico in Ponce to study and analyze the reality of small and medium-sized businesses from sixteen towns in the south of the island after this devastating hurricane. The sample of the study was 557 business owners. The study revealed that the majority (52%) of the entrepreneurs did not have insurance against natural disasters. The main obstacle faced by the owners were the lack of electricity (90%), problems with telecommunications (83%), and 56% had to face the shortage of products for sale and supplies to process. After the hurricane, the entrepreneurs surveyed have managed the situation by reducing the hours of service (68%), acquiring a generator (44%), and 22% started selling products of high demand in this time. The study also revealed that 80% of the business owners considered that the situation of their business before the hurricane was excellent, very good, or good.

López (2018) also found that 62% of the participants considered that the restoration of electricity in the country has been poor. However, 56% believe that the restoration of potable water service has been good and regular and 62% considered that the aid to small and medium businesses by the government has been poor. Likewise, 33% of the surveyed sample considered that the assistance of the Federal Emergency Management Agency (FEMA) has been poor, 28% qualifies it as regular, while 21% as good. About 38% of entrepreneurs interviewed considered that the management of the crisis by the state government has been poor, while 33% consider that it has been regular. On the other hand, 36% rate the overall management of the crisis by the municipal government as poor and 27% as regular. The majority of the entrepreneurs surveyed (67%) agrees that the economic situation of the country is poor.

Kishore et al. (2018) conducted a study with a representative stratified sample of more than 3,000 households across Puerto Rico from January to February 2018. On their study, 31% of the households surveyed reported considerable disruptions to medical services. Problems reported were: medicine access, respiration equipment access, roads damaged, facilities closed, doctors unavailable, unable to afford care, transport issues, emergency service (911) unavailable, and unable to have dialysis. Also, 3% of the sample have left households because of the hurricane, 52% of them moved elsewhere within Puerto Rico, and 41% of them migrated to the United States.

3. Methodology

3.1. Instrument

To carry out this exploratory research, a questionnaire with twenty-three (23) questions was designed to collect information about three aspects. First, participants were asked about the profile of the owners of the clinical laboratories. This included questions about age, sex, academic degree earned, and members of the family household. The second aspect was the profile of the laboratories. The part includes questions related to the year the laboratory was established, its legal structure, if the owner has another business or laboratories, and number of employees. Third, the questionnaire includes aspects related to Hurricane Maria. A relevant aspect was related to the insurances against atmospheric disasters. In addition, it has questions on how they handled the situation on the laboratory, immediately passed the hurricane and subsequently, the damages suffered, the future plans after Maria, and how do they evaluate the work of the Federal Emergency Management Agency, the municipalities, and the state government.

3.2. Sample

The sample consisted of clinical laboratories in Puerto Rico. Data was collected 4 to 5 months after the hurricane (January-February 2018). Participants were recruited face-to-face, by telephone, and email. Two hundred and fifty clinical labs owners were contacted and information about the research in progress was given. Response rate was relatively low, as only 26% of the questionnaires sent were answered, representing a sample of sixty-five labs. Two of the questionnaires were unable to be included in the final sample as some answers were invalid. The final sample is composed of sixty-three participants ($n = 63$). Thirty-six of the participants identified the municipality in which the laboratory is established, including: Aguada, Arecibo, Bayamón, Cabo Rojo, Camuy, Carolina, Cayey, Cidra, Coamo, Fajardo, Isla Verde, Lares, Mayaguez, Naguabo, Ponce, Quebradillas, Río Piedras, Salinas, San Juan, Toa Baja, and Villalba.

4. Results and Discussion

4.1. Clinical Lab's Profile

Clinical laboratories' owners profile was studied using several variables, including: age and gender, academic degree achieved by the owner, and family composition. Participants were asked if they own more than one laboratory, if they continue operations in other laboratories (in case they had more than one), and if they had additional businesses. These three questions were responded by participants in a dichotomous yes/no format. In addition, participants mentioned financing option used to establish their facilities.

Clinical lab owner's profile is presented in Table 1. Seventy-five percent (75%) of the sample corresponds to the female gender and twenty-five percent (25%) corresponds to the male gender. Participants are mainly of 49 years or more (71%). They have undergraduate studies (49%) and graduate studies (47%), which reflects the reality that the Census presents with respect to the composition of many families on the Island (Figueroa, 2014).

Characteristics	Distribution of the Sample
Gender	75%: Females 25%: Males
Age	0%: less than 31 years 13%: 37 to 42 years 10%: 43 to 48 years 18%: 49 to 54 years 54%: more than 55 years 5%: not answered
Education	41%: undergraduate studies 48%: graduate studies 11%: others (not answered, less than high school, associate degree)
Family Members	11%: composed of 1 member (participant) 49%: composed of 2-3 members 33%: composed of 4-5 members 2%: composed of more than 5 members 5%: not answered

Table 1: Owners Profile

In addition to the demographic data mentioned before, participants were asked to identify the reasons for establishing the laboratories, where they can select all options that applied. The main reasons identified were economic independence (55%), and desire to be their own boss (45%). Table 2 shows other reasons identified by the participants. Other reasons were: desire to have their own business, heritage, providing help and quality service for patients, opportunity to buy, and unemployment with 6%, 6%, 5%, 2% and 2% respectively.

Characteristics	Frequency	Percent (%)	"Pull / Push factors"
Economic independence	34	54	Pull factor
Desire to be your own boss	28	44	Pull factor
Not satisfied at previous employment	12	19	Push factor
Friends / Family	11	18	Push factor

Table 2: Reasons to Establishing Their Own Laboratory
Classified As Presented In Literature from Orhan and Schott (2001), As Factors of
Needs ('Push') and Selection ('Pull')

Participants were asked if they own more than one clinical lab and only 19% of them responded affirmatively (12 out of 63), while 81% (51 out of 63) responded that they own only one laboratory. From those who had more than one lab, 75% (9 out of 12) affirmed they were able to continue operations in the other labs. Only three participants (5%) have other businesses in addition to the clinical lab, which included restaurant and rental of facilities.

4.2. Organizational Time, Structure, and Size

Organizational time and structure of the clinical laboratory were operationalized with categorical variables. Organizational time includes the following categories: less than one year, one to five years, six to ten years, and more than ten years. Organizational structure was included with five categories: (1) individual owner, (2) society, (3) corporation, (4) franchise, and (5) other. Organizational size of the laboratories was operationalized using a categorical variable that ranges from 1 to 6, depending on the amount of employees. Participants indicated whether the organization had no employees in addition to the owner (size = 1), less than five employees (size = 2), five to eight employees (size = 3), nine to twelve employees (size = 4), thirteen to sixteen employees (size = 5), and more than sixteen employees (size = 6). Based on the findings, the laboratories studied are small businesses, with few employees, organized as corporations. The owners started their labs with personal loans (47%), Small Business Administration loans (30%) and personal capital (28%). Table 3 presents the profile of the laboratories.

Characteristics	Laboratories' Profile
Organization Structure	63%: Corporation 30%: One Owner 5%: Society 2%: DBA
Number of Employees	27%: 1 to 4 employees 51%: 5 to 8 employees 11%: 9 to 12 employees 6%: 13 to 16 employees 5%: more than 16 employees
Organization Time	5%: 1 to 5 years 8%: 6 to 10 years 87%: more than 10 years
Disaster Insurance	81%: Yes 16%: No 3%: Unanswered

Table 3: Laboratories' Profile

4.3. Organizational Performance

Organizational performance was operational zed in the questionnaire as a categorical variable. Participants must evaluate their situation pre-Maria, representing the performance status of the lab, using a number from 0 to 4 (0: Poor, 1: Regular, 2: Good, 3: Very Good, 4: Excellent). As shown in Figure 1, 27% consider their pre-Maria situation as Excellent, 22% consider it Very Good, 38% consider it Good and only 13% indicated their situation as Regular or Poor.

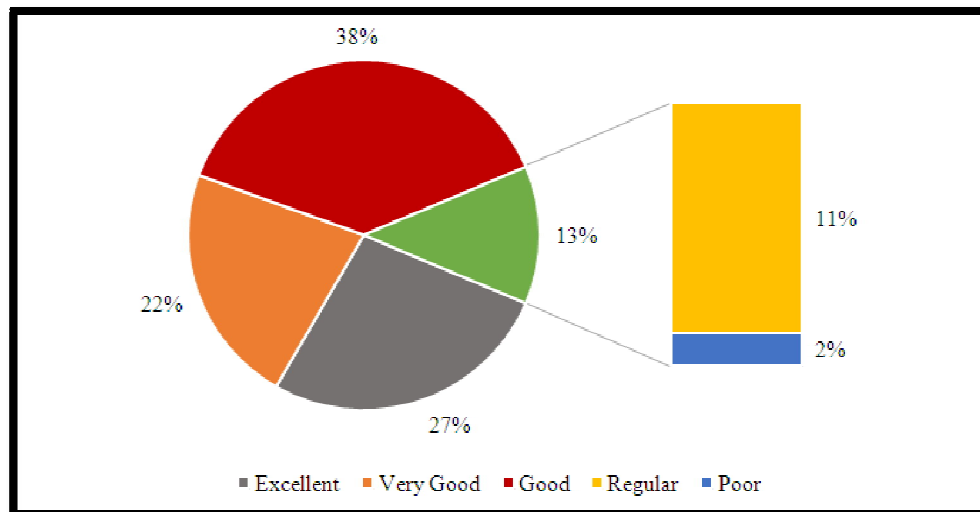


Figure 1: Performance of the Clinical Laboratory before Maria

4.4. Challenges Faced by Clinical Laboratories

Clinical laboratories could return to work, attempting to continue providing the service to patients, while dealing with the hurricane's impact on themselves. However, forty-eight (48%) of the laboratories did not open immediately after Hurricane Maria, 76% opened the facilities for less hours, and only 3% opened at the usual hours. Participants were asked if they had insurance before the hurricane, using a dichotomous yes/no format and 81% answered affirmatively (51 out of 63). Direct storm damage was assessed using a categorical variable with damage ranges, where participants indicated if there were physical damages to their facilities. Categories in this variable include the following: (1) no economic damages suffered, (2) less than \$1,000, (3) \$1,000 - \$5,000, (4) \$5,001 - \$10,000, (5) more than \$10,000. Most of the participants (86%) suffered damages in their laboratory, as follows: 37% indicated that the damages were more than \$10,000, 57% had damages between \$1,000 to \$10,000 and 6% had damages less than \$1,000. From those who suffered damage in the laboratory, 29% indicated having repaired them.

Even when the lab reopened, they still experienced difficulties. Fuel and diesel supply was critical to maintain operating the clinical labs. During the first days after the storm, it was also difficult to buy gasoline for employees, so they can travel to and from the workplace. Main challenges that clinical laboratories faced were identified by participants, including: communication problems, lack of electricity, lack of water, infrastructure damages, flood in facilities, robberies, shortage or lack of supplies, employee's problems, among others. These findings coincide with other researchers' findings (Kishore et al.,

2018; Cater and Chadwick, 2008). Figure 2 shows the main obstacles faced by the laboratories studied with the passage of this devastating atmospheric phenomenon, with telecommunications and electricity occupying the first two positions. Small business has limited resources to survive interruptions in their activities for extended period of time.

Cell phone service was disabled during and after the storm, as cell phone towers failed. Communication problems were one of the major challenges reported by clinical labs owners, which coincide with Cater and Chadwick (2008). Communication issues arise immediately the hurricane landfall Puerto Rico and it lasted for several weeks after the storm. It mainly depended on electricity, but no matter if the lab owner used a generator, they were unable to operate their information systems, billing medical insurances, and other critical transactions due to tower's failure.

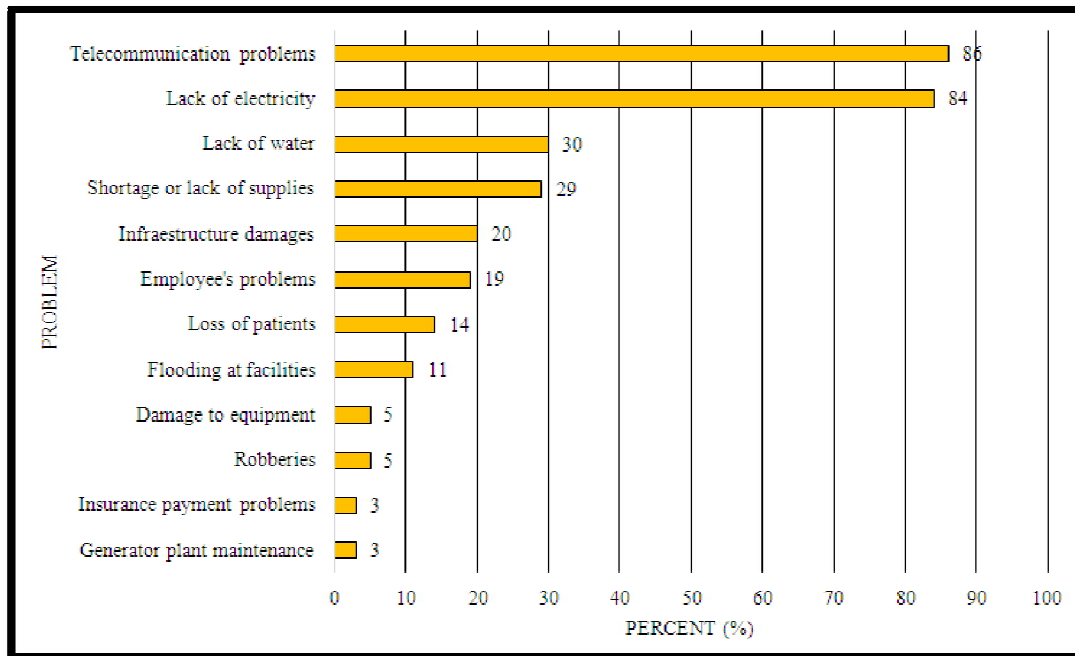


Figure 2: Problems Faced by Clinical Laboratories after Hurricane Maria

4.5. Help Offered by Laboratories

The owners of the laboratories offered help to their employees, patients, and those affected in the community in different ways. Seventy-nine percent (79%) of the owners of the laboratories were flexible with the working hours of the employees, 78% allowed them to charge the cell phones (both to the clients and the employees), 73% helped affected people or employees, and 78% attended particular needs of the patients. In addition, they indicated other specific help offered, including: turning the laboratory into a warehouse of medicines for patients, paying full time to employees even when they were not working, allowing use of the internet, providing ice, coffee and air conditioning, installation of washing machines for those who need it, allowing containers of water to be filled from laboratory facilities, and serving as a collection center to distribute goods.

Total amount of help provided by the clinical labs was computed by adding the number of actions taken during the disaster recovery period. The number ranges from 0 to 5. This variable includes the following actions: to be flexible with employee's working schedule, allow patient's and/or employees to charge their cell phones on the laboratory facilities, meet the particular needs of patients, help affected patient's and/or employees, and others in which the participant commented anything their organization did in addition to those activities listed. Average help ranges from 2 to 4 corresponding to 83%, while 14% scored 0 to 1, and 3% scored 5.

On the other hand, the owners of the laboratories studied reported several of the measures taken to deal with the situations confronted after the passage of Hurricane Maria. Eighty-six percent (86%) reduced service hours for patients, 73% reduced working hours for employees, 38% purchased a generator, while 29% suspended part-time employees. Other actions taken include: open a week after the hurricane to handle results only to patients that had performed lab tests previously, continue giving the service with generator, and continue operations on a temporary schedule and then on a regular schedule. Other participants indicated that they were not allowed to install a generator. Only one of the respondents indicated that their laboratory was 100% prepared for the emergency.

Finally, the respondents were asked to evaluate different matters of interest after the hurricane and the results are presented on Figure 3. The reactions and evaluations made by the owners of laboratories on matters of interest are similar to those found in entrepreneurs in the southern zone of Puerto Rico (López, 2018). They evaluated the municipal governments slightly better compared to the state government. In addition, 98% perceive the economic situation of the country as regular and poor.

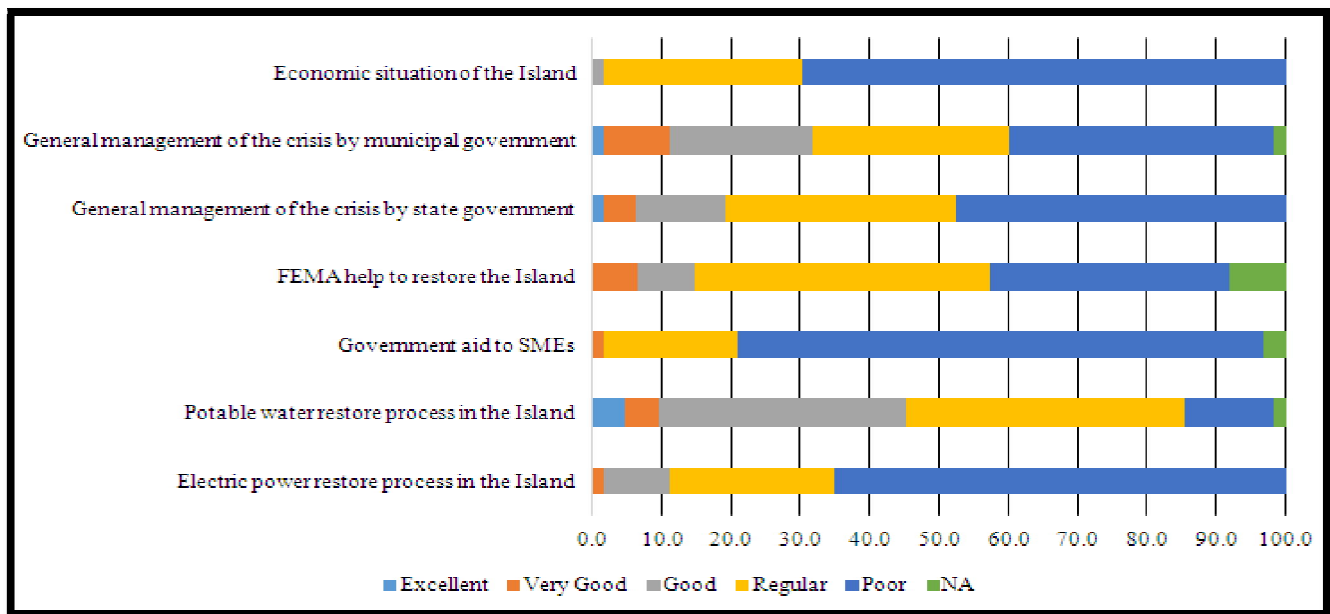


Figure 3: Perception of the Disaster Recovery in Puerto Rico after Hurricane Maria

A correlation analysis was performed for several variables of the study, to identify if any of the perceptions evaluated by the participants were somewhat related and to what extent. Variables used for this analysis include: total amount of measures taken by the lab owner, electric power restore process in the Island, help provided by government to SMEs, help provided by FEMA to help restore the Island, government management of the crisis by municipal government and state agencies, and general economic situation of the Island. Several correlations were found and are presented on Table 4. A very strong correlation was found between municipal government's management of the crisis and the state government's management of the crisis ($r = 0.825$; $p < .001$). Also, a strong correlation was found between help provided by FEMA and help provided to SMEs ($r = 0.751$; $p < .001$).

Variable	1	2	3	4	5	6	7
1 Total Measures	-						
2 Restore electric power	-.465**	-					
3 Help offered to SMEs	-.377**	.545**	-				
4 Help offered by FEMA	-.325*	.544**	.751**	-			
5 State Government	-.192	.317*	.011	.530**	-		
6 Municipal Government	-.187	.340*	.098	.560**	.825**	-	
7 Island's economy	-.311*	.315*	.026	.158	.351**	.326*	-

Table 4: Summary of Intercorrelations, Means, and Standard Deviations for Scores
 Correlation Is Significant at the 0.01 Level (2-Tailed)
 Correlation Is Significant at the 0.05 Level (2-Tailed)

4.6. Future Plans

Participants mentioned their future plans for their clinical laboratories facilities post-Maria. The results of the study suggest that the majority (98%) of the owners surveyed did not consider closing operations permanently, while one of the respondents indicated that they had closed their laboratory and it was for sale. Also, 68% will continue the regular operations with less expenses, some of the participants (19%) plans to fix the labs to mitigate the damages caused, 5% is considering moving from Puerto Rico, and 2% have not decided yet. Additional plans commented by the participants as "other" include the following: buy solar panels to be self-sustaining, buy a generator, work 5 hours a day, move the lab, continue with the provisional schedule and few employees to reduce expenses, small business administration (SBA) loan application, and laboratory sale.

4.7. Qualitative Questions

The questionnaire included one qualitative question at the end, in which participants provided additional comments regarding their experience on the disaster recovery on their clinical lab. As part of the study, the question was included because this helps to identify the biggest problems, possible solutions, and lessons learned. The owners are the ones who are talking about their experience and can help in the preparation of the clinical laboratories for future atmospheric events. The

answers of all were transcribed for 24 of 63 participants (n = 24) answered the question, corresponding 38% of the sample. For this specific question, an analysis was made using content analysis of the data, looking for patterns or consistencies, based upon careful reading of the transcribed answers. Several important comments about their experiences were related to the following topics: patients, employees, health plan, interruption of normal operations of the laboratory, preparation of the Island, telecommunications, and priority of health.

The largest number of comments in the open-ended question were related to the patients and reduced visits to the labs. Participants mentioned that "many patients were traveling to the United States", "doctors' offices were closed, and medical services were limited during the emergency", "the volume of patients decreased considerably, as patients were not attending appointments with their doctors". Other possibilities were that "patients did not have transportation", "they moved from Puerto Rico", "they were afraid of driving because there was no light in the streets and in traffic lights", or "they moved with relatives outside the laboratory area". Similarly, Kishore et al. (2018) found that 9% of the sample of their study faced problems with closed medical facilities and 6% with unavailable doctors. Their study revealed problems with roads damaged, transport issues, and hurricane-related migration.

The second main topic was related to employees. Lab owners were worried about their employees and "offered less working hours with full payment", "paid their salary without opening the lab". On the other hand, one participant mentioned that the lab was closed and "employees were left unemployed". One participant also helped employees by investigating about help that could be given to the employees while laboratory remain closed, including guidance in the municipality and the unemployment office.

Several participants made comments related to the medical plans, some of which were not directly related to the impact of the hurricane on the island. However, participants agree that "medical plans are not paying as usual". One of the participants mentioned that "specific billing practices were established that were very difficult to carry out during the time past the emergency, 5 months later we have many services that were offered during the emergency that were unpaid and we cannot rescue for the limit of time that establishes the billing rules".

Participants also commented on the economic impact due to reduced operations, while the laboratory was closed and after opening for limited time. They mentioned that "they were willing to work with generator but the problems of telecommunications did not allow invoicing", "getting diesel was extremely difficult", "we still have not recovered". Also, they mentioned that the lab could not be operated "until the electricity is reestablished".

Four participants pointed in the current study that Puerto Rico was not prepared for the hurricane, they stated "we are not prepared for these atmospheric disasters", "it caused a lot of emotional damage and damage to the properties that were not designed to withstand the force of the hurricane". One of the greatest problem faced was telecommunications. On this regard, three participants tackle the subject on the open-ended question, one of them stated "It was a very difficult time for all Puerto Ricans to communicate and not knowing what had happened in the Island, try to communicate with employees to see how they were and their family was difficult".

Comments related to insurance policies were given by three participants, mentioning: "insurance only covers flood and no employment interruption", "have received no payment yet" (six months after the hurricane), "as merchant they don't know what kind of insurance policy covers these situations" and "there is a lot of paperwork to pay". Two participants considered that "it was uncovered that, in Puerto Rico, health was no longer a priority".

Only three of the participants noted positive aspects as a result of Hurricane Maria when asked the final open-ended question. One participant mentioned that the laboratory was able to offer a Christmas bonus, not as usual, but they recognized they "have an excellent team and doctors nearby, which made possible to keep the business operating". Other participant suggested that "greater effort and dedication equals less dependence on the government and better service to patient and the community". Finally, one participant mentioned that the building's owner forgave the local rent for two months, after evaluating the damages caused by the hurricane.

5. Conclusions

Hurricane Maria caused devastation in different aspects. Clinical laboratories in the current research had more than 10 years in business and they had Good to Excellent situation pre-Maria. The research identified the main challenges faced by clinical laboratories in Puerto Rico, including: telecommunication problems, lack of electricity, lack of water, shortage or lack of supplies, damage of infrastructure, employee's problems, loss of patients, and flooding at facilities. The path to normal operations depends on the above-mentioned factors, which made it difficult to resume operations. However, most physicians were having similar situations at their facilities which made it difficult to continue operations. A decline in patient visit at physician's office result in a loss of patients at clinical laboratories.

Despite problems faced, the owners of the laboratories helped their employees, patients, and those affected in the community. It is important to recognize their care for the well-being of the community. Lab owners responded to the crisis in different ways, including: were flexible with working hours, allowed patients and employees to charge the cell phones, helped affected persons or employees, attended particular needs, turned the laboratory into a warehouse of medicines for patients, paid full time to employees even when they were not working, allowed use of the internet, provided ice, coffee and air conditioning, installed washing machines for those who need it, allowed containers of water to be filled from laboratory facilities, and served as a collection center to distribute goods. On the other hand, they reduced service hours for patients,

reduced working hours for employees, purchased a generator, suspended part-time employees, opened a week after the hurricane to handle results only to patients that had performed lab tests previously, and continued giving the service with generator.

Clinical labs, as well as other SMEs, in Puerto Rico need to overcome obstacles created by Hurricane Maria and mitigate similar situations on the future. Clinical lab tests are essential for patient's care, medical decisions, and treatments. Clinical laboratories provide continuous treatment care for patients, which supports primary and preventive care.

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