

# Building Sustainable Capacity for Medical Oxygen Generation in Haiti

## SUCCESS STORY | DECEMBER 2024



To increase the availability and use of oxygen in Haiti, EpiC partnered with the Ministry of Health (MOH) to improve medical oxygen production at 14 health care facilities across the country. After conducting assessments at each facility, EpiC trained 50 technicians and personnel, including MOH biomedical technicians, in the operation and maintenance of oxygen generating plants.

Reliable, consistent oxygen therapy is the cornerstone of quality health care. Without access to oxygen therapy, countries are vulnerable to increased morbidity and mortality during times of crisis such as the COVID-19 pandemic. In Haiti, prior to the COVID-19 outbreak, only two hospitals outside the Port-au-Prince area had oxygen generating plants-both of which were pressure swing adsorption (PSA) plants—operating on a regular basis. Access to medical oxygen was limited to several distributors in areas with larger populations. The Meeting Targets and Maintaining Epidemic Control (EpiC) project, funded by USAID and PEPFAR and led by FHI 360, has been supporting the COVID-19 response in Haiti since 2021. According to World Health Organization (WHO) and Pan American Health Organization (PAHO) reports, 85% of patients requiring oxygen at the time did not have access to medical oxygen. In response, several agencies donated oxygen generation systems to Haiti. However, these donations were often made without a proper installation plan, consideration of electrical requirements, a maintenance plan and equipment, or training for facility-level technicians. In addition, the systems were also sourced from a variety of manufacturers, with each having different parts and maintenance requirements, which posed an additional challenge to EpiC's overall management of the oxygen ecosystem.

EpiC supported COVID-19 vaccine uptake in the southern region of Haiti as well as the training of health care workers in the management of COVID-19 cases. In addition, the project provided technical support to optimize the use of existing and newly installed oxygen generating plants essential to increase the availability and use of oxygen in Haiti. Haiti's Ministry of Health (MOH), in partnership with the EpiC project, worked to improve medical oxygen production at 14 facilities across the country and ensure that oxygen could be effectively administered to patients.

## Assessment

EpiC worked with project subpartner, the Dalton Foundation, to complete assessments of 15 oxygen generators at 14 facilities to better understand their capacity for oxygen production and identify operational bottlenecks hindering optimal production, areas for capacity improvement, and safety issues (see Table 1). Assessments began in July 2022 and were completed in February 2023 after delays caused by the deteriorating security situation in the country. The project team created an assessment tool to evaluate each facility's oxygen generator, production capacity, electrical system, internal and external oxygen distribution policies, procedures, safety, and staff training. These assessments were completed by trained biomedical technicians and engineers using an online application created specifically for this project, in partnership with members of the MOH and under the guidance of hospital administrators.





The assessments revealed that many locations had little experience operating an oxygen generator, and all had safety violations. Results showed the need for training on safety, operation, and maintenance; maintenance kits including spare parts and accessories; additional equipment for each generator; and proper documentation (i.e., logbook to record number of hours run per day to inform when next maintenance would be needed, number of cylinders produced per day, purity level, etc.). It was also suggested that the community of practice—which EpiC had already established to provide a platform for sharing information and best practices related to operating oxygen generators—would be more useful if it also built skills on safety, operations, and oxygen transportation, as well as providing a forum to ask questions and find solutions.

FACILITY NAME	VILLAGE	DEPARTMENT	FACILITY	ASSESSMENT LEADER	OXYGEN GENERATOR BRAND AND MODEL	TYPE OF PLANT*
Hôpital La Providence des Gonaïves	Gonaïves	ARTIBONITE	Public	DALTON	Hanbell - Model AA6-22A	PSA
Hôpital Sainte-Thérèse de Hinche	Hinche	CENTRE	Public	DALTON/ AYIMED	Hanbell - Model AA6-22A	PSA
Direction Departemental Grand'Anse/Château (Ministry of Public Health and Population [MSPP] Office)	Jeremie	GRAND ANSE	Public	AYIMED	Hanbell - Model AA6-22A	PSA
Centre de Santé de Paillant	Paillant	NIPPES	Public	AYIMED	Hanbell - Model AA6-22A	PSA
Hôpital Sacre Coeur De Milot	Milot	NORD	Private	DALTON	Atlas Copco	VSA
Hôpital Bienfaisance de Pignon	Pignon	NORD	Private	DALTON	(PCI) - Model DOCS 200-55	VSA
Hôpital Justinien du Cap	Cap Haitian	NORD	Public	DALTON/ AYIMED	Hanbell - Model AA6-22A	PSA
Direction Sanitaire Nord-Est (MSPP Office) Dr. Jean Denise	Fort Liberte	NORD-EST	Public	DALTON	Hanbell - Model AA6-22A	PSA
Centre Médical Beraca/ LaPointe	Port-de Paix	NORD-OUEST	Private	DALTON	Hanbell - Model AA6-22A	PSA
Hôpital Notre Dame de la Paix de Jean-Rabel	Jean- Rabel	NORD-OUEST	Public	DALTON	(PCI) - Model DOCS 200-55	VSA
Hôpital Universitaire d'Etat de Haiti (HUEH)	Port-au- Prince	OUEST	Public	DALTON	Ultra Controlo Model ULTRA CREW 22	PSA
Direction Sanitaire Sud	Les Cayes	SUD	Public	AYIMED	Hanbell - Model AA6-22A	PSA
St. Boniface Hospital	Fond Des Blancs	SUD	Public	AYIMED	Atlas Copco - Model GA5FF	PSA
Direction Departementale Sud-Est	Jacmel	SUD-EST	Public	AYIMED	Hanbell - Model AA6-22A	PSA
Hôpital Saint-Michel (Government Hospital)	Jacmel	SUD-EST	Public	AYIMED	Desran Air - Model: DSR-10A	PSA

#### Table 1. Oxygen generating facilities assessed by the EpiC project

\*PSA: Pressure swing adsorption (PSA) oxygen plant; VSA: Vacuum swing adsorption (VSA) oxygen plant

## FINDINGS FROM THE ASSESSMENT

Two locations had serious safety concerns. The oxygen plant at one hospital was not grounded and could have caused a major explosion. At another hospital, a high voltage wire was laying across the driveway with a partially open connection on the ground. This could have caused deadly electrocution to anyone passing by. Both locations have since resolved these issues.

### Box 1: Oxygen Generation Training Curriculum

- Module 1: General
  Overview and
  Pre-Installation
  Considerations
- Module 2: Overview of Oxygen Plant Operations
- Module 3: General Safety and Security
- Module 4: Oxygen Distribution
- **Module 5:** Policies and Procedures: Creation and Utilization of Documentation
- Module 6: Basic
  User Maintenance





An electrical hazard found during the assessment at one hospital. It has since been corrected.

Upon completion of the assessments, including an assessment of the number of oxygen cylinders needed at each site, the project team wrote graded reports indicating whether the site was capable of meeting oxygen production needs. Each facility also received individualized recommendations, including a list of needed repairs, items to purchase to safely transport filled tanks, and safety equipment and training topics to be covered. Many of these recommendations have been followed; others are still in progress.

## Building Capacity for Oxygen Generation

Assessment results also informed the development of a training curriculum. This curriculum was used to train 50 technicians and personnel from 14 facilities, including MOH biomedical technicians, in the operation and maintenance of oxygen generating equipment (including VSA and PSA plants) to strengthen health care system capacity to sustainably ensure optimal equipment use. The original plan was to hold four in-person workshops at different locations throughout Haiti. Due to the complex security situation in Port-au-Prince, only two in-person training events were held in Cap Haitien and Les Cayes. For the other training events, the project team created the six-module online course Oxygen Generation for Haiti: Operations and Distribution, which included a baseline test and final exam (Box 1). The course was posted to an open-source online learning platform.



Participants at biomedical training in Les Cayes, March 15–18, 2023. Photo credit: EpiC/Dalton Foundation



Participants at biomedical training in Cap Haitian, March 6–10, 2023. Photo credit: EpiC/Dalton Foundation

In-person training was conducted by EpiC project biomedical engineers in March 2023. Each technician was provided a workbook to follow as the training was conducted. The sessions were followed up with on-site maintenance visits by EpiC. Participants were encouraged to also complete the online course to deepen their understanding and to do so annually to refresh their skills.

Participants were eager to learn and highly engaged throughout the three-day training. The average final exam score increased from 69% at baseline to 85% after completing the training.

Online participation has been marginally successful. As of February 2024, 51 individuals had enrolled in the online course, and 19 had completed it. Five individuals are in progress, and 27 have not yet started. Technicians who participated in the in-person training may have felt they learned enough there and did not see the benefit of completing the online course.

Due to the drastic increase in political instability and widespread gang violence throughout the country, EpiC has had to carefully plan each visit to ensure the safety and security of staff. The violence has caused significant delays to some aspects of the project, but at the same time required new and innovative ways to continue the technical training when travel has not been possible. Some of the changes the project team was forced to make will benefit the oxygen ecosystem in the long term, as online training will always be available to technicians and new hires.



## Ensuring Ongoing Management of the Oxygen Ecosystem

To effectively manage the oxygen network and ensure the oxygen generators are performing at optimum capacity, EpiC and partners have prioritized a three-pronged approach:

- 1. Making regular technical visits to perform preventive maintenance, troubleshoot mechanical failures, and perform on-site repairs
- Conducting remote monitoring of the oxygen generators through video calls and collecting weekly production data
- 3. Operating a community of practice to provide technical training and best practices weekly, with project biomedical technicians available to answer questions

#### Technical visits to sites

Since March 2023, EpiC has visited all the sites to perform maintenance and repairs. As of June 2024, each site has received at least two visits. Six sites in the southern region received repairs in March 2023 and were revisited in October and November 2023. The eight sites in the northern region have received at least two maintenance and repair visits from July 2023 through January 2024, with some locations receiving additional visits as necessary.

In addition to routine maintenance, EpiC made special visits to Gonaïves and Beraca, as these sites had serious or unexpected mechanical issues. The technical team travelled twice to Gonaïves in January 2024 to assist with the installation of a new transformer to replace a damaged one. After this successful installation, EpiC organized a second visit to Gonaïves in March 2024 to perform maintenance and repair work, which finally restored this site to full capacity.

Thanks to this successful intervention in Gonaïves, the health department of Artibonite can now produce oxygen to respond to the oxygen needs of the entire Artibonite department and the Hôpital Immaculee Conception of Port-de-Paix in Nord-Ouest, a neighboring department.

#### Reinforcement and expansion of the oxygen generator network

In the second half of 2024, the EpiC team installed two new oxygen generators to reinforce and expand the network of oxygen generators in the country. These oxygen generators were donated to Haiti's MOH by the U.S. Department of Defense (DOD) through the USAID local mission.

After being requested by the MOH to install these generators at Hôpital Beraca and Hôpital Lapaix, the EpiC project quickly mobilized its financial and technical resources to complete the installation at each of these hospitals. The installation of the oxygen generator at Hôpital Beraca was finalized in July 2024, and that at Hôpital Lapaix was finalized in September 2024. Both of these machines are currently fully operational and can supply up to 10 cylinders of oxygen per day; these facilities no longer need to rely on external oxygen supply to cover their needs.

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**EpiC** and its partners will continue to provide maintenance and repair support for the generators over the next several months and will work to transition all aspects of their support to the MOH, allowing the oxygen network in Haiti to thrive beyond the life of the project.

#### Installation of additional oxygen compressors at Pignon and Jean-Rabel

Hôpital Bienfaisance de Pignon and Hôpital Notre Dame de la Paix de Jean-Rabel each welcomed the installation of an oxygen generator that was donated by USAID to the MOH. These new oxygen generation units were intended to satisfy the needs of the host hospitals and those of nearby health facilities. Unfortunately, contrary to expectations, these oxygen generators were able to produce only half of the required amount. EpiC biomedical technicians determined that this issue could be resolved through the addition of a second compressor at each site. The additional compressor was installed at Hôpital Notre Dame de la Paix de Jean-Rabel in July 2024 and at Hôpital Bienfaisance de Pignon in October 2024. Anticipated oxygen output at the Jean-Rabel and Pignon sites increased after the installation of the compressors, and these sites are currently in a better position to meet their own oxygen needs and those of nearby health facilities.

#### Remote monitoring and support

Weekly remote monitoring of oxygen sites and video calls to alleviate mechanical issues has become critical in the face of the security crisis in Haiti. It is the sole technical support available for the southern region during times of increased instability. In early April 2024, Paillant site reported a motor compressor issue, causing a breakdown. EpiC spoke with the site operators to diagnose the problem and provide recommendations on how to fix the issue. Due to the skills of the operators in Paillant and remote support from EpiC, the oxygen generator was successfully repaired remotely. Now Paillant is the main provider of oxygen for the whole southern region, including Nippes, the Southeast, and Grand-Anse.

#### Community of practice

The community of practice is maintained through a WhatsApp group. The MOH biomedical technicians, operators, and technicians at all oxygen generator sites along with the EpiC technical team discuss technical issues that impact the proper functioning of the oxygen generators. Participation levels have increased significantly over the last three months, with more than 50 individuals now active. Virtual training sessions are provided weekly along with the posting of training videos, links, and other oxygen-related content.

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#### Breathing Life into Haiti's Health Care: A Vision for Sustainable Oxygen Production

EpiC activities in Haiti will conclude in December 2024. In order to ensure sustainability beyond the end of the project, EpiC worked with the Dalton Foundation to train two biomedical apprentices to strengthen the in-country knowledge and expertise on how to maintain oxygen generators in Haiti. In addition to training these apprentices, EpiC's observations revealed that public oxygen production sites often lack essential tracking and monitoring tools, prompting the selection of two facilities—Nippes and Artibonite—to pilot a comprehensive site management model and develop a sustainable business plan. At these sites, transformative change is taking root. The site management model, already presented to the MOH and the health directorates, is being implemented to streamline daily and weekly operations, enforce robust maintenance schedules, and ensure the accurate tracking of oxygen production and distribution. These practices reduce downtime and maximize resource use, bringing much-needed stability to operations.

Additionally, an innovative business plan has been presented, offering a financial framework that integrates a cost-recovery system, diversified funding sources, and client base expansion strategies. While its implementation hinges on future collaborations with known partners under other projects, the plan holds the promise of long-term financial resilience.

Together, these efforts form a scalable blueprint for other facilities, paving the way for consistent oxygen availability and a stronger health care infrastructure. This work is about more than machines and strategies—it is about the mother in Miragoâne who can now watch her child recover and the nurse in Gonaïves who no longer faces the heartbreak of running out of oxygen during a critical moment. These initiatives are breathing life into Haiti today and building hope for a more sustainable tomorrow.

## **Reflections and Lessons Learned**

- To expedite the procurement process and ensure correct parts and consumables were purchased, photographs of each piece of equipment, including both modality number and data plate were vitally important. To successfully maintain equipment the team determined that a large procurement would be necessary. Having photographs of the equipment ensured the project could check which parts were needed to save time and give the procurement team confidence in purchasing the correct parts for maintenance.
- To address the safety concerns identified in the assessment and minimize risk to staff and equipment, fire extinguishers and proper oxygen tank transportation carts were delivered to health facilities. Information on how to use and manage this equipment was included in the training delivered in March 2023. Security and safety are also reinforced during site visits.
- To address the need for improved documentation, a logbook was developed and distributed to facilities. The logbook contains a daily preventive maintenance checklist, a daily safety and security checklist, a daily production log, and a maintenance and repair log for documentation over 12 months. A training video was developed to orient staff on proper use of each of the forms included as well as a detailed explanation of the importance and future use of the data being collected. Each site's technician completed an in-person logbook training when logbooks were delivered.
- Training programs should be tailored to each site. Understanding each location's production, processes, safety protocols, and training and maintenance plans helped inform the outline of the training curriculum. The project tailored the material specifically to the needs of the technicians involved. Further, in-person training provides excellent opportunities to ask questions, meet peers, and create camaraderie and lasting support among participants. In-person training was preferred by participants, with higher attendance, completion rates, and knowledge gain compared to the online training.
- Technicians and operators are highly motivated to do their job despite facing challenging working conditions.
- Leadership is key to the success of each oxygen generator. Locations with engaged and supportive leadership are much more successful, and oxygen generators have much less down time. Stakeholder engagement and leadership at each site is also key in ensuring that safety violations are corrected, and safety remains a top priority.

### Please send any inquiries to 🔀 epicproject@fhi360.org

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