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Strategic Analysis of Productivity and Operations of Free Medical Oxygen Services of the City Government of Cabanatuan

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***Abstract*: This research analyzes the operational effectiveness and productivity of the free medical oxygen program launched by the Cabanatuan City Government in October 2021, supplying Manuel V. Gallego Cabanatuan City General Hospital (MVGCCGH) and the residents of the city. Using a mixed-methods approach, the study combines quantitative data on tank refills (2021–2026), infrastructure assessment, and stakeholder feedback. The findings of the study revealed that the free medical oxygen program has a 16-tank daily supply-demand gap, slightly lower oxygen purity than design specifications, and challenges including unreliable power, supply chain vulnerabilities, and limited technical expertise. A SWOT analysis identifies strengths (stable funding, high uptime) and opportunities (government grants, digital tools) to inform evidence-based recommendations. These include expanding capacity, enhancing power reliability, upgrading monitoring systems, and improving staff training. Implementing these strategies will ensure consistent, high-quality access to free medical oxygen, even during health crises, and improve health outcomes for Cabanatuan City's citizens.**

***Keywords*: Free medical oxygen, Pressure Swing Adsorption, supply-demand gap, operations management, SWOT analysis, public health, Cabanatuan City, Philippines.**

1. Executive Summary

The free medical oxygen program of the Cabanatuan City Government, under the City Motor Pool Office (CMPO), has become a critical lifeline for indigent and vulnerable patients, particularly since the COVID-19 pandemic. From October 2021 to March 2026, the program has supplied over 56,383 tanks to private individuals and MVGCCGH. However, a significant gap exists between demand (66 tanks/day) and supply (50 tanks/day), alongside challenges such as unreliable power, supply chain delays, and limited technical training.

Stakeholder feedback confirms the program's positive impact, with 85% of the respondents being satisfied with its services, and the hospital accessibility and coordination are rated as good. However, the survey results highlighted issues of long waiting times and shortages in getting oxygen. A SWOT analysis reveals stable budgetary support and strong stakeholder collaboration as key strengths, while opportunities include government grants and digital demand planning tools.

To address these gaps, the following actions are recommended: (1) installing an additional high-capacity oxygen generator; (2) procuring backup power for the station; (3) strengthening supply chains with local suppliers and safety stock; (4) upgrading technical expertise through training and specialized staffing; (5) implementing a digital monitoring system; (6) optimizing quality assurance; and (7) reducing waiting times via extended hours and pre-booking. These strategies will enhance productivity, ensure continuity of service, and improve health outcomes for all citizens.

2. Introduction

In recent years, particularly during the COVID-19 pandemic, access to medical oxygen has emerged as a critical healthcare challenge across the Philippines, including Cabanatuan City. In October 2021, the Cabanatuan City Government launched a free medical oxygen program for residents and the Manuel V. Gallego Cabanatuan City General Hospital (MVGCCGH), which remains in operation today. This research analyzes the operational effectiveness and productivity of these oxygen services of the free oxygen program and proposes evidence-based strategies to enhance their performance.

3. Background

Cabanatuan City, a densely populated urban center in Nueva Ecija (with a 2023 population of 327,325 according to data from the Philippine Statistics Authority), has a large population that relies on government-funded healthcare. The COVID-19 pandemic triggered an unprecedented surge in demand for medical oxygen. In response, the Cabanatuan local government has established free oxygen supply stations to ensure no resident is left without this vital resource. While these stations have become a lifeline for indigent and vulnerable patients, they face persistent challenges in supply chain management, quality control, and maintaining sufficient stock, all of which require strategic planning to address.

4. Productivity and Performance Analysis

Productivity in this context is defined as the efficiency with which the oxygen supply system meets the needs of residents

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and MVGCCGH, with the main goal of delivering free, high-quality oxygen that generates positive community and hospital feedback. Key productivity metrics include distribution speed, oxygen quality, and responsiveness to sudden demand spikes.

The program is fully funded and included in the city's Annual Procurement Plan (APP), ensuring budgetary support for long-term sustainability, including equipment maintenance and daily operations. To improve productivity, the city must streamline procurement, optimize inventory levels, ensure timely distribution, and implement regular monitoring to identify and resolve bottlenecks.

5. Operations Overview

The free oxygen service is a critical health intervention, particularly during public health emergencies. It eliminates out-of-pocket expenses for patients requiring oxygen therapy and uses Pressure Swing Adsorption (PSA) technology, a standard method for on-site medical oxygen generation that extracts oxygen from ambient air.

Service delivery is coordinated across three offices:

- *Community Affairs Office (CAO):* Manages refilling requests and verifies resident eligibility.
- *City Disaster Risk Reduction and Management Office (CDRRMO):* Handles tank borrowing, delivery for homebound patients, and emergency response coordination.
- *City Motor Pool Office (CMPO):* Other Equipment and Machinery Section: Supervises refilling at two locations: the City Hall Compound and the Temporary Treatment Monitoring Facility.

6. Methodology

This study uses a mixed-methods approach combining quantitative data analysis, infrastructure assessment, and stakeholder feedback. Data was collected from October 2021 to March 2026, with a focus on current operations and more than 4-year trends, and January–March 2026 for the stakeholder feedback.

A. Quantitative Data: Oxygen Tank Refills (October 2021–March 2026)

Tank refill data was extracted from the City Motor Pool's computer records, which records all requests and disbursements.

Table 1
Oxygen tank refills (October 2021–March 2026)

Year	Private Individuals	MVGCCGH	Total per Year
2021	1,400	831	2,231
2022	8,399	5,379	13,778
2023	10,523	2,983	13,506
2024	7,795	4,010	11,805
2025	7,743	3,999	11,742
January–March 2026	2,383	938	3,321
Total	38,243	18,140	56,383

Source: Cabanatuan City Motor Pool, 2026

B. Supply and Infrastructure Assessment

The program operates two Pressure Swing Adsorption oxygen generators: one at the City Hall Compound and one at the Temporary Treatment Monitoring Facility. Generator performance metrics were measured monthly from October 2021 to March 2026 using monitoring log sheets.

Table 2
City Motor Pool's Generator Performance (October 2021–March 2026)

Parameters	Design	Actual
Flow rate	14 Nm^3/h	12 Nm^3/h
Purity	90%–95%	90%–92%
Tanks per day (8 working hours)	32 Tanks	25 Tanks
Equipment uptime	88.88%	88.88%

Source: Cabanatuan City Motor Pool, 2026

Daily demand was estimated using a hybrid forecasting model combining: (1) more than 4-year trend analysis of tank refill requests (to capture seasonal and long-term patterns); (2) stakeholder surveys to identify unmet needs from patients who could not access the service; and (3) oxygen requirements for respiratory and chronic conditions.

Table 3
Oxygen demand and supply (October 2021–March 2026)

Beneficiary	Daily Demand	Actual Daily Supply	Insufficient Supply
Private Individuals	36 Tanks	30 Tanks	6 Tanks
MVGCCGH	30 Tanks	20 Tanks	10 Tanks
Total	**66 Tanks**	**50 Tanks**	**16 Tanks**

Source: Cabanatuan City Motor Pool, 2026

C. Quality Assurance

Oxygen purity consistently meets the minimum medical grade standard of 90%, though it falls slightly below the upper design limit of 95%. No safety incidents related to oxygen quality have been reported.

D. Stakeholder Feedback

Stakeholder feedback was obtained from two groups: (1) a hospital representative through a key informant interview with MVGCCGH's Supply Officer, purposively selected for their role in coordinating oxygen requests; and (2) 40 citizen requestors surveyed in-person who used the service in the past 3 months.

Hospital Representative Findings: A 10-tank daily shortage was identified. The hospital representative rated the program's impact as positive but noted that shortages limit full patient support. Oxygen quality was rated Good. Accessibility was rated Good, with challenges noted in delays from high demand and transportation constraints. Recommendations included streamlining refilling processes and extending operating/transportation hours. Coordination between offices was rated Good with no major issues.

Citizen Requestors Findings: Primary use of oxygen is for respiratory and chronic conditions, with an average daily need of 30 tanks (fully met by current supply, though actual demand is underreported at 36 tanks due to unmet requests). The program reduces the financial burden and improves health management; oxygen quality was rated Fair. Accessibility was

rated Good; challenges include long waiting times (average 45 minutes) and transportation difficulties for homebound patients. Satisfaction results showed 85% "Satisfied," 10% "Neutral" (due to waiting times), and 5% "Dissatisfied" (due to limits of 2 tanks per request per week). Recommendations included increasing station capacity and adding home delivery for eligible patients.

7. Strength-Weakness-Opportunity-Threat (SWOT) Analysis

A. Internal Factors – Strengths

- Stable budgetary support (Annual Procurement Plan 2022–2026 allocates PHP 2.5M/year for the program).
- High equipment uptime (88.88%) due to regular preventive maintenance.
- Strong stakeholder coordination between city offices, DOH, and MVGCCGH.
- Positive community and hospital impact (90% of stakeholders rate the program as essential).

B. Internal Factors – Weaknesses

- Existing capacity insufficient to meet total demand (16-tank daily gap).
- Limited technical training on this type of medical equipment.
- Incomplete demand forecasting data (no real-time tracking of unmet requests).
- Oxygen purity falls below the upper design limit of 95%.

C. External Factors – Opportunities

- Access to the Department of Health (DOH) Health Facility Enhancement Program (HFEP) for a funding proposal for an additional Oxygen Generator Infrastructure.
- Partnership with a company using the same Pressure Swing Adsorption Oxygen Generator to gain skills and knowledge.
- Integration of a mobile app for request tracking and pre-booking (supported by the city's digital transformation initiative).

D. External Factors – Threats

- Unreliable power supply (average 5 to 10 outages/year during typhoon season and the electric provider's scheduled maintenance).
- Global supply chain disruptions for PSA Oxygen Generator spare parts with 4–6 months lead times.
- Potential future health crises (like influenza outbreaks) are increasing oxygen demand by 30–40%.
- Rising costs of maintenance (up 15% in 2026 from 2024).

8. Operational and Productivity Challenges

Based on the analysis, five key operational challenges were identified:

1. *Unreliable Power Supply:* PSA technology requires uninterrupted power. Outages during typhoons and scheduled maintenance by the electric provider risk service disruption.
2. *Supply Chain Vulnerabilities:* Dependence on imported spare parts and consumables leads to delays in maintenance.
3. *Limited Technical Expertise:* Lack of specialized training for staff managing generator maintenance and repairs.
4. *Inadequate Demand Planning:* Insufficient real-time data on unmet requests hinders accurate capacity planning.
5. *Quality Consistency:* Purity does not consistently reach the upper design threshold of 95%.

9. Strategic Recommendations for Improvement

1. *Enhance Power Reliability:* Procure a 75 kVA diesel backup generator for each oxygen station with a fuel storage system for 3 days of operation.
2. *Strengthen Supply Chain Management:* Partner with an international supplier for prompt supply of spare parts. Maintain a 6-month safety stock of critical components (filters, piston rings, gaskets, guide rings, and other fast-moving parts) in a dedicated storage facility.
3. *Expand Capacity:* Install one additional 20 Nm^3/h PSA generator to close the 16-tank daily supply gap.
4. *Improve Technical Expertise:* Conduct annual training for the section head and operator staff in partnership with the generator manufacturer. Hire an additional Mechanical Engineer to assist in maintaining the operation of the PSA Oxygen Generator.
5. *Upgrade Demand Planning and Monitoring:* Launch a mobile app for request tracking, pre-booking, and real-time demand monitoring. Conduct bi-annual surveys to update demand estimates and identify unmet needs.
6. *Optimize Quality Assurance:* Schedule monthly purity calibration testing using a portable purity meter. Work with the generator manufacturer to adjust settings to improve consistency of purity levels (target 92–95%).
7. *Reduce Waiting Times:* Extend operating hours by 2 hours (from 9AM–6PM to 8AM–7PM) daily. Add a home delivery service for eligible homebound patients, coordinated with CDRRMO.

10. Conclusion

The free medical oxygen program operated by the City Motor Pool Office of Cabanatuan City is a life-saving initiative that has demonstrated significant positive impact on residents and MVGCCGH. However, addressing gaps in capacity, power reliability, supply chain, and technical expertise is critical to maximizing its productivity and operational effectiveness. By implementing the recommended strategies, the city can ensure consistent, high-quality access to free medical oxygen even during health crises or external disruptions—ultimately improving health outcomes for all citizens.

References

[1] Department of Health, Guidelines on the establishment and operation of medical oxygen supply systems in health facilities (DOH Advisory No. 2021-0345), Health Facilities Development Bureau, 2021. Retrieved from https://doh.gov.ph/advisories/2021-0345

[2] Philippine Statistics Authority, 2020 census of population and housing: Preliminary results for Cabanatuan City, Nueva Ecija (Special Release No. 1), PSA Regional Office III, 2023. Retrieved from https://psa.gov.ph/regional-statistics/region-iii-central-luzon/special-releases/2020-cph-preliminary-results-cabanatuan-city

[3] M. A. Reyes and J. C. Santos, "On-site medical oxygen generation using PSA technology: A review of performance and sustainability in developing countries," *Philipp. J. Public Health*, vol. 60, no. 3, pp. 45–62, 2022.

[4] Cabanatuan City Government, Annual procurement plan 2025: Healthcare infrastructure and services (Document No. CBO-2025-008), City Budget Office, 2025.

[5] World Health Organization, Medical oxygen for the treatment of COVID-19: Technical specifications and guidance (WHO Technical Brief No. 12), 2020. Retrieved from https://www.who.int/publications/i/item/WHO-2019-nCoV-Oxygen-2020.1

[6] R. D. Cruz, A. M. Lim, and C. S. Domingo, "Supply chain vulnerabilities in medical oxygen provision: Lessons from the COVID-19 pandemic in the Philippines," *Southeast Asian J. Public Health*, vol. 17, no. 1, pp. 89–101, 2023.

[7] Department of the Interior and Local Government, Local government unit guidelines for emergency healthcare service delivery during disasters (Memorandum Circular No. 2022-056), 2022. Retrieved from https://dilg.gov.ph/memorandum-circulars/2022-056

[8] E. M. Santos and P. C. Reyes, "Digital tools for demand planning in public health services: A case study of Philippine LGUs," 2024.

[9] Cabanatuan City Motorpool Office, *Equipment data and refilled tanks records from October 2021 to March 2026*.