

BỘ Y TẾ

CỘNG HOÀ XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Số: 4308/QĐ-BYT

Hà Nội, ngày 07 tháng 9 năm 2021

QUYẾT ĐỊNH

**Phê duyệt đề án Tăng cường khả năng cung ứng,
sử dụng Oxy y tế cho các cơ sở điều trị bệnh nhân COVID-19**

BỘ TRƯỞNG BỘ Y TẾ

Căn cứ Nghị định số 75/2017/NĐ-CP ngày 20/6/2017 quy định chức năng, nhiệm vụ, quyền hạn và cơ cấu tổ chức của Bộ Y tế;

Căn cứ Luật khám bệnh, chữa bệnh ngày 23/11/2009;

Căn cứ Luật phòng, chống bệnh truyền nhiễm ngày 21/11/2007;

Căn cứ Nghị quyết 86/NQ-CP ngày 06/8/2021 của Chính phủ Về các giải pháp cấp bách phòng, chống dịch bệnh COVID-19 để thực hiện Nghị quyết số 30/2021/QH15 ngày 28 tháng 7 năm 2021 của Quốc hội khóa XV.

Căn cứ Quyết định số 3616/QĐ-BYT ngày 29/7/2021 của Bộ Y tế về việc phê duyệt Đề án “Tăng cường năng lực cấp cứu, hồi sức tích cực cho các bệnh viện điều trị người bệnh COVID-19 nặng”;

Căn cứ Quyết định số: 4111/QĐ-BYT ngày 26/8/2021 của Bộ trưởng Bộ Y tế về việc ban hành tài liệu Hướng dẫn thiết lập cơ sở thu dung, điều trị COVID-19 theo mô hình tháp 3 tầng;

Xét đề nghị của Vụ trưởng Vụ Trang thiết bị và Công trình y tế.

QUYẾT ĐỊNH:

Điều 1. Phê duyệt đề án Tăng cường khả năng cung ứng, sử dụng Oxy y tế cho các cơ sở điều trị bệnh nhân COVID-19.

Điều 2. Quyết định này có hiệu lực kể từ ngày ký ban hành.

Điều 3. Các Ông, Bà: Chánh Văn phòng Bộ; Chánh Thanh tra Bộ; Vụ trưởng, Cục trưởng các Vụ, Cục thuộc Bộ Y tế; Tổng Cục trưởng thuộc Bộ Y tế; Thủ trưởng các đơn vị trực thuộc Bộ Y tế; Giám đốc Sở Y tế các tỉnh thành phố trực thuộc trung ương; Thủ trưởng y tế ngành và thủ trưởng các đơn vị có liên quan chịu trách nhiệm thi hành Quyết định này./.

Nơi nhận:

- Như điều 3;
- TTg Phạm Minh Chính, Trưởng BCĐQG phòng chống dịch COVID-19 (để báo cáo);
- Các thành viên BCĐQG;
- Bộ trưởng (để báo cáo);
- Các đ/c Thứ trưởng Bộ y tế;
- Công TTĐT Bộ y tế;
- Lưu: VT; TB-CT.

KT. BỘ TRƯỞNG
THỨ TRƯỞNG



Trần Văn Thuận

MINISTRY OF HEALTH

**SOCIALIST REPUBLIC OF VIETNAM Independence – Freedom –
Happiness**

SCHEME

**INCREASE THE SUPPLY CAPACITY, USING MEDICAL OXYGEN
FOR FACILITIES TREATMENT OF COVID-19 PATIENTS**

*(Issued together with Decision No...../ QD-BYT dated May 2021
of the Minister of Health)*

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PART I: PROJECT BUILDING BACKGROUND

1. The necessity to develop the project: 1.1. Epidemic

situation: The situation of the COVID-19 epidemic in the world is very complicated. Worldwide, more than 220 million people have been infected with COVID-19, including over 4.5 million deaths. Since the end of March 2021, the world recorded a strong outbreak of epidemics in many countries and regions around the world, especially in Asian countries.

From April 27, 2021 to now, Vietnam is facing the "fourth wave" of the COVID-19 epidemic that attacks and causes serious consequences, the number of COVID-19 cases across the country has increased dramatically. rapidly with over 480 thousand new infections (accounting for 99% of cases since the outbreak in our country). The epidemic broke out on a large scale, with a large scale and complex nature, with many sources of infection, outbreaks, and variations, especially the appearance of the Delta variant, which spread very quickly and dangerously, increasing the risk of disease. severe cases compared to the previous 3 outbreaks. The number of critical illnesses and deaths has increased, so far there have been more than 13,000 deaths. The medical examination and treatment system is facing unprecedented challenges in history.

Through the time of implementing social distancing according to Directive No. 16/CT-TTg in the southern provinces and cities and some localities across the country, the epidemic situation has been gradually controlled in one area. local and regional numbers. However, the epidemic is still complicated, especially in Ho Chi Minh City. Ho Chi Minh City and some neighboring localities (Binh Duong, Long An, Dong Nai). In some localities in the central region (Da Nang, Khanh Hoa, Phu Yen) the epidemic has not been thoroughly controlled, there is still the possibility of outbreaks and the risk of large outbreaks, because the epidemic has spread widely. communities, in factories, enterprises and densely populated areas.

1.2. Treatment of COVID patients and oxygen systems at medical facilities: Faced with a very serious situation, the Government and Prime Minister have directed localities to strictly implement the motto "4 on the spot" (command on-site, on-site forces, on-site vehicles and supplies, on-site logistics), ensuring the availability of resources for epidemic situations.

The Government and the Ministry of Health have directed many localities to strengthen the capacity of active resuscitation, focus on treating severe cases, and minimizing deaths. However, the organization and implementation of the directions, administration and regulations on epidemic prevention and control in some localities are still not strict, confused and inconsistent; The work of ensuring logistics under the motto "4 on the spot" in most localities has not been prepared in advance, leading to a lack of necessary supplies, equipment, medical gas and oxygen for epidemic prevention and control.

The intensive care unit (HSTC) is generally dispersed by size, accounting for 8 to 10% of hospital beds in medical facilities. According to the results of a recent study

Here, it is estimated that in 2021, the whole country will have over 16,000 HSTC hospital beds. However, the number of hospital beds and the HSTC's capacity are currently unable to meet the increasing demand for treatment of COVID-19 patients. Many localities are lacking in equipment to treat severe patients. Many hospitals have HSTC beds but do not have a central oxygen system or a compressed air system, so ventilators cannot be used.

Hospitals and medical facilities are not interested in investing in additional procurement of central liquid oxygen systems, especially tanks, liquid oxygen tanks and gas oxygen bottles and terminals for COVID-19 patients. Therefore, it greatly affects the treatment of COVID-19 patients, because these patients must use a large amount of medical oxygen.

1.3. Situation of supply and production of medical

oxygen: On the side of oxygen supply and production, according to the report of the Vietnam Gas Association (AIGA Vietnam), the total production of oxygen in Vietnam of the units of the association. Under normal conditions today is 1,115 tons/day, increasing to full capacity is about 1,430 tons/day. Not counting the amount of Oxygen used in industrial production (larger than the current medical oxygen output) that can be converted into medical oxygen in an emergency situation.

However, currently, for the production and supply of medical oxygen, there are some difficulties: transportation (logistics) because of the implementation of social distancing in epidemic provinces; Vaccination has not been carried out for officials and workers to maintain production; supporting policies to help enterprises import tanks, containers, copper pipes and oxygen guns for storage.

The system of agents and oxygen filling stations in the localities managed by the Departments of Industry and Trade should be connected to medical facilities using Oxygen to ensure no breakage. Information of suppliers and filling stations is required for regulation during the supply process to medical facilities and the Ministry of Health (via an information technology platform).

Currently, the source of oxygen used in industry is very large, it is necessary to develop a production plan to convert to medical oxygen and the process of converting tanks and tanks of industrial gases to proactively ensure the source of oxygen in the water. emergency situation.

Therefore, the development of the Project "Strengthening the supply and use of medical oxygen for treatment facilities for COVID-19 patients" is a very necessary and urgent task, requiring the participation of many people. Not only the health sector, the Government, ministries and agencies, but also the responsibility of local authorities and the whole society.

2. Some concepts: Some

terms in this scheme are understood as follows: - Central oxygen system: Tank, evaporator, pressure reducing valve, gas supply line, zone valve,... jack head quick connection to the hospital bed; - Compressed oxygen:

Oxygen contained in compressed air cylinders for medical use.

- Liquid oxygen: Oxygen contained in tanks is in liquid form.


- Conversion formula: 01 ton of liquid oxygen = 777 m³ Oxygen gas at a temperature of 30oC;

- 1st floor, 2nd floor, 3rd floor: A 3-storey treatment tower model of COVID-19 collection and treatment facilities according to the instructions for setting up COVID-19 collection and treatment facilities according to the tower model 3 floors 1 .



Model of 3-storey tower for COVID-19 treatment

- Popular portable liquid oxygen tank and gas bottle:

No.	Categories	Liquid volume	Weight (kg)	Gas conversion capacity	Illustrating images
1	Portable 1 liquid oxygen tank	1m ³ /1000 liters	1,080 kg	926 m ³ /154 bottles Oxygen 40liters of pressure 150bar	
2	Portable liquid oxygen tank	0.5m ³ /500 liters	525 kg	450 m ³ /75 bottles Oxygen 40liter pressure 150bar	
3	Portable Oxygen 3 Liquid Bottle	0.175m ³ /175 liters	175 kg	150 m ³ /25 Oxygen bottles 40 liters pressure 150bar	
4	4 Gas Oxygen Bottle	40 liters		6 m ³ pressure gas 150bar	
5	Gas Oxygen Bottle	8-10 liters		1.2 m ³ - 1.5 m ³ gas pressure 150bar	

3. Legal grounds: -

Pursuant to the November 23, 2009 Law on medical examination and treatment; -

Pursuant to the November 21, 2007 Law on Prevention and Control of Infectious Diseases; -

Pursuant to Decree No. 75/2017/ND-CP dated June 20, 2017 of the Government

the Government shall prescribe the functions, tasks, powers and organizational structure of the Ministry of Health;

- Pursuant to Decree No. 155/ND-CP dated November 12, 2018 amending and supplementing a number of regulations related to business investment conditions under the state management of the Ministry of Health; - Decree 36/2016/ND-

CP dated May 15, 2016 of the Government on management of medical equipment.

- Resolution No. 30/2021/QH15 dated July 28, 2021.

- Resolution 86/NQ-CP dated August 6, 2021 of the Government on urgent measures to prevent and control the COVID-19 epidemic to implement Resolution No. 30/2021/QH15 dated July 28, 2021 of the National Assembly. XV session.

- Decision No. 447/QD-TTg dated April 1, 2020 on epidemic announcement
COVID-19.

- Public telegram No: 1068/CD-TTg dated August 5, 2021 and Public telegram number: 1102/CD-TTg dated August 23, 2021 of the Prime Minister on strengthening measures to prevent and control the COVID-19 epidemic. 19, -

Dispatch No. 1168/CD-BYT dated August 7, 2021 of the Ministry of Health on strengthening the implementation of measures to prevent and control the COVID-19 epidemic.

- Decision 3616/QD-BYT dated July 29, 2021 approving the project "strengthening emergency and intensive care capacity for hospitals treating severe COVID-19 patients".

- Decision No: 4042/QD-BYT dated August 21, 2021 of the Minister of Health on the issuance of temporary guidance on mobile medical station model in the context of COVID-19 epidemic.

- Decision No. 4111/QD-BYT dated August 26, 2021 of the Minister of Health on promulgating documents guiding the establishment of COVID-19 collection and treatment facilities according to the 3-storey tower model.

PART II: OBJECTIVES AND SCOPE OF THE PROJECT

1. General objective:

Actively develop a plan and organize a close connection between supply and demand in order to exploit and use most effectively resources for producing medical oxygen in the country.

Prepare medical oxygen infrastructure to treat COVID-19 patients according to scenarios and epidemic developments with the motto "**4 on the spot**".

2. Specific objectives:

To guide localities and facilities to treat COVID-19 patients; Calculating demand for use, investing in means of ensuring the plan is one level higher in terms of Medical oxygen for the treatment of COVID-19.

Synthesize the capacity of production, supply, transport and storage of medical oxygen in the country, prepare medical oxygen infrastructure according to scenarios and developments of the COVID-19 epidemic. Develop contingency plans for production, supply and storage systems.

Connecting the network of oxygen production and supply nationwide, developing a plan to coordinate and support policies for the network of production, supply, transport and storage of medical oxygen.

3. Scope of the project: The project is implemented nationwide.

4. Deployment time: Phase 1:

Localities where there is a complicated epidemic situation: City. Ho Chi Minh City, Binh Duong, Dong Nai, Long An... to plan and immediately implement urgent and focused activities within a maximum of one month and other localities to complete their local plan within two months. after the Project is signed and promulgated.

Phase 2: Continue to implement incomplete activities, expand scale, upgrade oxygen infrastructure, purchase oxygen-containing equipment..., increase production, and effectively coordinate production network Export and supply oxygen nationwide.

PART III: SOLUTIONS

1. Establishment of Medical Oxygen Coordination Units in the localities: - The

provinces and centrally-run cities (provinces and cities) set up Medical Oxygen Coordination Units in their localities² and assign a Deputy Comrade. Chairpersons of People's Committees of provinces and cities act as department heads, leaders of Departments of Health act as permanent deputy heads of sections, and members of relevant departments, branches and units to direct and administer oxygen preparation. The economy is proactive in epidemic prevention and control in the area with the following solutions:

+ Monitor and evaluate the use and demand of medical oxygen according to the situations of the number of COVID-19 cases in the area to promptly advise provincial and city leaders to direct the implementation of the Scheme.

+ Direct and coordinate with production and supply units to ensure medical oxygen supply capacity to meet demand. Support local manufacturers (if any) in ensuring stable production and supply.

+ Directing the organization of connection and information exchange between patient treatment facilities COVID-19 for manufacturers, suppliers of Oxygen and for system administration.

+ Propose and report to the People's Council, the People's Committee of the province and city to decide on the arrangement of investment funds for the construction of facilities, procurement of medical oxygen system equipment according to the approved case scenarios in the locality. .

+ Strengthen the application of information technology to monitor and administer the use of medical oxygen at hospitals and medical facilities in the province and city. Connect and update information with the Oxygen Coordination Working Group - Ministry of Health.

2. Calculation of medical oxygen demand: Based on

statistics and calculations of the Ministry of Health³ for the , demand for medical oxygen use treatment of specific COVID-19 patients: Table of

medical oxygen demand⁴ according to regulations Tissue and treatment layer:

Stt	Size (hospital bed)	1st floor		2nd floor		3rd floor		Liquid tons	
			Liters of gas		Liters of gas		Liters of gas	Liquid	Liters of gas
1	20							ton	1.249.128
2	50							1.6	3.122,820
3	100	0.02	18,000	1.2	967,680	4.0	8.0		6.245.640
4	200	0.04	36,000	2.5	1,935,360	16.1			12,491,280
5	300	0.07	54,000	3.7	2,903,040	24.0			18,736.920

² Official Dispatch No: 6976/BYT-TB-CT dated August 24, 2021 of the Ministry of Health on ensuring medical oxygen for COVID-19 emergency and treatment.

³ The plan to calculate the oxygen demand for treatment of COVID-19 patients of the Department of Medical Examination and Treatment from statistics, calculation and classification of 2359 patients in Vietnam.

⁴ When designing medical oxygen systems at COVID-19 treatment facilities, additional backups should be included to ensure operation.

Stt	Size (hospital bed)	1st floor		2nd floor		Floor 3	
		Liquid	Liters of gas	Tons of liquid liquid Liters of gas	Liters of gas	Liters of gas	Liters of gas
6	500	ton 0.12		90,000	6.2 4,838.400	40.2	31,228,200
7	1000	0.23	180,000 won				
8	3000	0.69	540,000 won				

3. Consolidation and upgrading of medical gas systems at COVID-19 treatment facilities: 3.1.

General requirements:

3.1.1. Medical gases for treatment floors: COVID-19

treatment facilities need the following medical gases: - Mobile medical station: Compressed air oxygen.

- Floor 1: Oxygen compressed air.

- Level 2: Pneumatic oxygen combined with liquid oxygen, medical compressed air 4 bar.

- 3rd floor: Liquid oxygen, 4 bar medical compressed air, vacuum gas.

3.1.2. Requirements for central oxygen system: - System model:

Central gas source - transmission - control system - terminal system.

- There is a backup source to ensure the system's continuous supply.

- Supplying adequate and continuous medical gases to the place of use with standard quality for medical use.

- Outputs: convenient for operation, safe.

- Convenient for checking and repairing the system. -

Ensure safety in terms of medical hygiene, fire safety, electrical safety.

- The system can be upgraded and expanded as needed.

- The quantity and type of gas are suitable for each hospital's treatment stratification for COVID-19 patients. - For facilities that

collect and treat severe and critical levels, the number of air outlets is guaranteed to be 100% of the number of beds.

3.2. Medical gas solutions for treatment floors: 3.2.1. Mobile

commune and ward health stations: Medical gas

solution 5 has at least 02 5-liter bottles, oxygen bags and 02 oxygen pressure gauges; 02 oxygen masks and other necessary accessories to use oxygen for patients.

3.2.2. Floor 1: Asymptomatic and mild treatment facility: At this treatment floor, only

using oxygen in the eyeglass frame, breathing through a breathing mask, does not require setting up a central system. Calculation of oxygen demand based on

the size of the number of beds of each collection facility (see *Table of Medical Oxygen Demand by Treatment Scales and Floors*).

Recommended selection of bottles for this treatment stage: - 40L bottles.

- Bottle type 8L-10L.

3.2.3. Level 2: Moderate and severe treatment and collection facilities: a.

Oxygen: At

this treatment floor, oxygen glasses are used, mask breathing and HFNC breathing are used. It is recommended to upgrade and expand the central medical oxygen system for facilities that already have a central oxygen system, and for facilities that do not have a central medical gas system, which need to be built new. The number is calculated based on the bed size of each treatment facility (see *Table of Medical Oxygen Demand by Treatment Sizes and Floors*).

Recommended selection of tanks, bottles and bottles for the Oxygen

system: - Liquid Oxygen tank type $\dot{\gamma}$ 6 m³ recommended for provincial hospitals, district hospitals, and large-scale district hospitals. liquid⁶, recommended for

- Portable oxygen tank type $\dot{\gamma}$ 0.175m³ at district³ diseases level, small-scale district hospital without central oxygen system.

- Bottles of 8L - 40L for mixed use.

It is recommended to choose the capacity of the evaporator and the pressure reducing valve in accordance with the flow rate used at the same time at 100%, use 2 evaporators to work alternately to avoid the reduction of heat exchange efficiency when operating continuously. customary.

b. Pneumatic:

Based on the technical features of high current oxygen machine (HFNC) to calculate compressed air capacity of the treatment facility.

Recommended selection of central compressed air system (if any): -

Central compressed air system of air compressors: Quantity of 02 screw or helical air compressors.

- Central controller: Controls power, alarms, and alternate running settings for the compressor.

Compressed air tank capacity $\dot{\gamma}$ total capacity within 1 minute.

3.2.4. 3rd floor: Hospital for treatment and treatment of severe and critical levels: a.

Oxygen: This

is the highest level of treatment in the system to treat COVID-19 patients, at these facilities, oxygen is used for non-invasive mechanical ventilation, invasive mechanical ventilation, and ECMO that requires a large flow of oxygen, starting with oxygen. forced to build a central oxygen supply system. The number of calculations is based on the bed size of each treatment facility to establish the appropriate system.

It is recommended to choose the type of liquid oxygen tank for the central oxygen system 10 m³.

⁶ The smallest liquid oxygen tank available on the market

It is recommended to choose the capacity of the evaporator and the pressure reducing valve in accordance with the flow of use at the same time at 100%, use 2 evaporators to work alternately to avoid the reduction of heat exchange efficiency when operating continuously. customary.

b. Pneumatic:

Used for ventilators with calculated capacity based on the number of beds in each treatment facility.

Recommended selection of central compressed air system: -

Central compressed air system: Quantity used \dot{V} O₂ air compressors running alternately.

- Central controller: Controls power, alarms, and alternate running settings for the compressor.

Compressed air storage tank total capacity \dot{V} total capacity within 1 minute.

c. Suction gas:

Used for suction machines with capacity calculated based on the number of beds in each treatment facility.

Recommended selection of central suction air system: - Central medical suction system has O₂ suction pumps running alternately.

- The controller runs alternately the suction machines. Bacterial filtration & separation system.

Suction gas storage tank.

4. Improve domestic production and supply capacity of medical oxygen: 4.1

Medical oxygen production and supply group: -

Production and supply units should contact the Department of Health for early vaccination for all. All employees carry out the production and supply of medical oxygen to ensure that it is not broken in an emergency.

- Making plans and production plans to ensure epidemic prevention and control measures under the support of authorities to operate continuously (*including cases of F0, F1 cases*).

- Solution for priority issuance, green channel for tankers, medical oxygen transport vehicles to go in/out of blocked areas and prohibited roads on the supply route to medical facilities. - Ensure a stable power supply, and have a preferential

electricity price mechanism for medical oxygen production to ensure throughout the supply chain.

- There is a mechanism for preferential loan interest rates, shortening the loan procedures of banks and creating favorable conditions for early payment for enterprises producing and supplying medical oxygen.

- Prioritize customs clearance procedures for imported products: tanks/tanks/bottles, central oxygen system and related terminals and auxiliary equipment.

- Medical oxygen supply units need to actively survey and prepare supply and reception plans (with backup plans) for treatment facilities.

4.2. Solution to convert using industrial oxygen: Standard industrial

oxygen has similar properties to medical oxygen due to the same production technology and equipment, but some factories only directly produce transmitted oxygen. pipelines for direct use in billet smelting do not have a liquefaction system.

A relatively large quantity of industrial inert gas cylinders can also be conversion used in the current urgent conditions.

Solution: -

Through the Ministry of Industry and Trade, request steel and synthetic industrial gas production units to provide production data, provide maximum oxygen and when required, switch to supply for the medical field.

- Coordinate with the Ministry of Labor, War Invalids and Social Affairs to issue a process to guide the conversion of industrial inert gas bottles (Nito, Argon, Oxygen) to medical oxygen bottles to increase the number of medical oxygen cylinders in case of medical emergencies. necessary.

- Report to the Government leaders, the National Steering Committee for Disease Prevention and Control to decide to expropriate and confiscate industrial oxygen products in urgent situations.

5. Strengthening the application of information technology in operation management, coordination and supply: The

Ministry of Health deployed the software for management, coordination and supply of medical oxygen nationwide with the participation of the Ministry of Health. Update oxygen usage data of treatment facilities, update oxygen production and supply status of production and supply units in the system.

- Facilities treating COVID-19 patients: The staff in charge of operating the oxygen supply system, daily updating the data on medical oxygen use to the general management software system. At treatment facilities that use liquid oxygen tanks with large volumes, automatic monitoring devices connected to information technology systems and specialized staff should be used to ensure continuous oxygen supply.

- Production and supply units: update production and supply data; reserves; The ability of existing vessels, tanks, and equipment to be provided and installed for treatment facilities on the system.

- Departments of Health in localities, Health of Ministries and sectors: monitor, manage and coordinate the supply of oxygen for treatment facilities in the area.

- Ministry of Health: Synthesize reports, monitor the production, supply and use of medical oxygen nationwide.

6. Safety of production and use:

Safety of fire prevention, fire and explosion in transportation, extraction/loading and storage of medical oxygen, testing of medical oxygen standards, pressure testing according to current regulations on.

7. Reserve and backup:

Localities take the initiative in purchasing and estimating medical oxygen and necessary supplies and equipment to meet and exceed one level of medical oxygen for the scenarios, developments of the COVID-19 pandemic.

The Ministry of Health plans to purchase a part of equipment for the Oxygen system to proactively deal with the situation of 300,000 COVID-19 cases.

PART IV: FINANCE IMPLEMENTATION OF THE PROJECT

1. Estimated funding for the implementation of

the project: - Funding for construction and completion of the medical oxygen supply system for treatment
COVID-19

- Funding to support interest on imported bank loans, equipment reserves, oxygen tanks
medical.

- Funding for the implementation of the project at the central level, provinces, hospitals and
implementation of activities in accordance with the objectives of the Scheme.

2. Funding sources: -

State budget, ODA, donor contributions and other lawful capital sources.

- The central budget ensures funding for the intensive care centers under the management of the
Ministry of Health.

- Local budgets follow the principle of "4 on the spot" to ensure funding for treatment facilities and
intensive care centers under local management. The Ministry of Health will provide support according to its
capacity to regional Intensive Care Centers managed by localities to implement epidemic prevention and
control measures.

- Hospitals can mobilize funding from organizations, individuals, and institutes
grants and other lawful funding sources.

PART V: ORGANIZATION OF IMPLEMENTATION

1. Departments and Departments under

the Ministry of Health: 1.1. Department of Medical

Equipment and Construction: - Acting as a permanent focal point to assist the Minister of Health in directing the

implementation of the Scheme; - Responsible for directing and guiding centrally-affiliated hospitals to develop projects (or plans); - Monitoring

statistics, coordinating the oxygen supply system for treatment COVID-19 patient.

- Proposing to the National Steering Committee for COVID-19 Prevention and Control, requesting ministries and branches⁷ to implement contents related to supporting the production, supply and backup of medical oxygen.

1.2. Department of Medical Examination and

Treatment: - Guidelines for calculating the need for oxygen for patient treatment COVID-19.

- Monitor statistics on the use of medical oxygen for the treatment of COVID-19 patients at facilities.

1.3. Department of Planning and

Finance: - To assume the prime responsibility for summarizing, allocating funds, and guiding financial activities of the Project in accordance

with law. - The focal point to organize the procurement and import of liquid oxygen tanks and gas oxygen bottles for the treatment of COVID-19 patients.

- The focal point for formulating preferential policies in the production, supply and import of medical oxygen.

1.4. The Office of the

Ministry: - To closely coordinate with the Department of Medical Equipment and Works to direct and organize the

implementation of the Scheme; - Summarize funding sources to serve the Project.

1.5. Department of Information

Technology: - Coordinating in deploying information technology applications for monitoring and administration the use of medical oxygen at hospitals and medical facilities nationwide;

- Synchronous connection of information data sources related to the COVID-19 epidemic.

1.6. Department of Communication and Emulation and Reward:

- Coordinate with Department of Medical Equipment and Construction, Central Center for Health Education and Communication, Health & Life Newspaper and related units to implement the implementation. communication and emulation and commendation contents of the Project.

⁷ The Ministry of Defense supports transportation; The Ministry of Industry and Trade supports imports, gives priority to ensuring production power sources, offers incentives on electricity prices and mobilizes industrial oxygen; The Ministry of Labour, Invalids and Social Affairs supports standards for converting bottles and containers; The Ministry of Transport supports the granting of green channels; The Ministry of Finance supports loan interest rates.

2. National and regional intensive care centers:

- Based on the contents of the scheme of the Ministry of Health, hospitals are responsible for urgently assessing the current state of the medical oxygen system, developing a project (or detailed implementation plan) and costing the construction investment. building, upgrading and expanding; review the number of existing bottles, breathing lines, oxygen terminals and additional purchases to ensure efficient operation of the equipment; report to competent authorities for consideration and approval; organize the implementation after the Project is approved.

- Report information, data, activities... fully and promptly to the Provincial Oxygen Coordination Working Group, the Ministry of Health upon request and perform other assigned tasks within the scope of the Scheme. **3. The People's**

Committees of the provinces/cities directly under the central

government: - Establishment of the Medical Oxygen Coordination Unit of the province and city to implement the

- Direct and urge the Department of Health, departments and hospitals to actively and expeditiously implement the Scheme, and at the same time allocate local budgets and other lawful funding sources to implement the plan/project in the province. local.

4. Departments of Health, Department of Military Medicine, Health of

Ministries and Sectors: - Formulate the scheme of the province, city or branch and submit it to the competent authorities for approval.

- Departments of Health act as a permanent member of the local oxygen coordination department to manage the use and supply of medical oxygen to treat COVID-19 at hospitals and medical facilities in the area.

PART VI: SOCIAL - ECONOMIC EFFICIENCY

The project "Strengthening the supply and use of medical oxygen for COVID-19 treatment facilities" nationwide is in line with the new strategic orientation of the World Health Organization and other countries. advanced, focusing on improving the capacity of treating COVID-19 cases, rescuing, reducing the number of critically ill patients, and treating severe and critical cases, minimizing mortality.

The project will strengthen the capacity to treat many patients, reduce the mortality rate, and limit referrals. Therefore, this project has a profound humanitarian meaning, contributing to the successful implementation of the "dual goal" of the Government and the health sector.

In particular, the project's investment is sustainable, long-term, economical, and not wasteful. The investment project helps to strengthen the active resuscitation capacity of the medical examination and treatment system and hospitals nationwide, not only treating COVID-19 patients but also contributing to the treatment of severe patients of the hospitals. other specialties in the future.

APPENDIX 1: LIST OF MEDICAL OXYGEN PRODUCERS AND SUPPLY UNITS NATIONWIDE

(List as of August 16, 2021 and plan to add additional updates)

1. NORTHERN

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
1.	Vietnam Industrial Gas Joint Stock Company (Thanhgas)	Ngo Gia Tu Duc Giang Street, Long Bien, Hanoi	TS9 Tien Son Industrial Park - Tien Du - Bac Ninh	Areas of Hanoi, Bac Ninh, Bac Giang, Hung Yen, Hai Duong, Yen Bai, Lao Cai, Thai Nguyen, Ninh Binh, Nam Dinh, Thanh Hoa,...	Mai Dinh Hop 0904010099
2.	Nippon Sanso Vietnam Joint Stock Company - Hung Yen Branch	Lot No. D6 & D7, Thang Long Industrial Park II	Lot No. D6 & D7, Thang Long Industrial Park II	All provinces from Da Nang to the North	Duong Van Dai 0916 232 716
3.	Messer Hai Phong Industrial Gas Company Limited- Hai Duong Branch	An Duong town, An Duong district, Hai Phong city	Hiep residential area Thuong, Hiep Ward Son, Kinh Mon town, Hai Duong province	Northern and Southern provinces Central	Nguyen Thi Viet Thuy 0903257851
4.	Air Liquide Vietnam Co., Ltd. Air Liquide Bac Ninh factory	Que Vo Industrial Park, Ward Van Duong, city Ninh, Bac Ninh city, province Bac Ninh	Que Vo Industrial Park, Ward Van Duong, city Bac Ninh	Bac Ninh, Bac Giang, Hanoi, Ha Nam, Hai Duong, Hung Bac Yen, Nam Dinh, Thai Binh, Hai Phong, Quang Ninh, Vinh Phuc, Phu Tho, Thai Nguyen, Ninh Binh, Lang Son	Pham Minh Tuan 0914389082
5.	Air Liquide Vietnam Co., Ltd.	Que Vo Industrial Park, Ward Van Duong, city	Yen Phong Industrial Park, Yen Phong District, Bac Ninh Province	Bac Ninh, Bac Giang, Hanoi, Ha Nam, Hai Duong, Hung Yen, Nam Dinh, Thai Binh,	Trinh Van Thang 0917294811

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
	Air Liquide Factory Yen Phong	Bac Ninh street, province Bac Ninh		Hai Phong, Quang Ninh, Vinh Phuc, Phu Tho, Thai Nguyen, Ninh Binh, Lang Son	
6.	Industrial Gas Trading Company Limited	264 Ton Duc Thang, Hang Powder, Dong Da, Hanoi	Dak So CN Point ,Hoai Duc ,Hanoi	Hanoi	Nguyen Minh Khoa 0913232323
7.	Vietnam Medical Gas Joint Stock Company	609 Truong Dinh, Giap Bat ward, Hoang Mai district, city Hanoi	Long-term contract with partners (Company Messer Hai Industrial Gas Limited Department- Hai Branch Positive)		Duong Duc Hoan 0978992228

2. CENTRAL CENTRAL

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
1.	Vietnam Industrial Gas Joint Stock Company (Thanhgas)	Ngo Gia Tu Duc Giang Street, Long Bien, Hanoi	No. 5A Hoa Cam Industrial - Cam Le - Da City Nang	Park Da Nang, Quang Nam, Quang Ngai	Mai Dinh Hop 0904010099
2.	Messer Hai Phong Industrial Gas Company Limited- Dung Quat Branch 3.	An Duong town, An Duong district, Hai Phong city	Tan Hy village, Binh Dong commune, Binh district Son, Quang Ngai province	Northern and Southern provinces Central	Nguyen Thi Viet Thuy 0903257851
	Nghe An Industrial Gas Joint Stock Company	No. 77 Phan Boi Chau, City. Vinh, Nghe An	No. 16, Street No. 1 VSIP Nghe An Industrial Park	Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Hue	Nguyen Hubei 0974947555

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number
4.	Long Phat Oxygen Gas Trading And Service Co., Ltd	No. 61 Dinh Tien Hoang Street, Tu An Ward, City. Buon Ma Thuot, Dak Lak Province, Road No. 2,	19/5 Street, Eatam Ward, Buon Ma Thuot City, Dak Lak Province	Buon Ma Thuot, Dak Nong	(Company leader) Mr. Bui Van H 0903583337
5.	Da Nang Oxygen Joint Stock Company	Industrial Park, Road No. 2, Hoa Khanh North, Lien Khanh Chieu, Danang city Service Joint Stock Company 01 A	Industrial Park Central region (Ha Tinh - to Binh Dinh and North Hoa Khanh North, Lien Nguyen) Chieu, Da Nang City 6.	(Ha Tinh - to Binh Dinh and North West of Hoa Khanh, Hoa Khanh,	Nguyen Anh Tuan - 0903515115
	Phan Chu Trinh, Lot CI-1 Long Qui Nhon, (Inseco)	Marine Industrial Park p. Hai Cang, City. Qui My, TP. Nhon, Binh Dinh Town, Binh Dinh Province			
7.	Service Joint Stock Company Marine Industry p. Hai Cang	01 A Phan Chu Trinh, City. Qui (Inseco) Nhon, Binh Dinh Ward	Lot A3 CCN Nhon Binh, City. Qui Nhon, Binh Dinh Province	Binh Dinh, Phu Yen, Quang Ngai	Nguyen Thi Kim Dung 0905203675
8.	Service Joint Stock Company Marine Industry p. Hai Cang	01 A Phan Chu Trinh, City. Qui (Inseco) Nhon, T. Binh	Lot C1 Tinh Phong Industrial Park, Son Tinh District, Quang Ngai Province		

Dinh SOUTH

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
1.	Nippon Sanso Vietnam Joint Stock Company	No. 33, Road 3A, Industrial Park Bien Hoa 2, An . Ward Binh, Bien Hoa City, Dong Nai Province	No. 33, Road 3A, Industrial Park Bien Hoa 2, An . Ward Binh, Bien Hoa City, Dong Nai Province	All provinces from Da Nang to the South	Le Buu Chau 0903 976 986

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
2.	Nippon Sanso Vietnam Joint Stock Company - Branch of Phu My Specialized Industrial Park 3	Lot C4, Road N2, Block C4, Industrial Park, Phu My 3 Ward, Phu Town Province, Ba Ria - Vung Tau Province Viet Tau, Vietnam.	Road N2, Phu My 3 Intensive Phuoc Phuoc Hoa Ward, Hoa, Phu My Town, My Province Ba Ria - Vung Tau, Male.	All provinces from Da Nang to the South	Bui Le Hung 0908 910 512
3.	Nippon Sanso Vietnam Joint Stock Company Phu My Branch 1	Road 2A, Phu Industrial Park My 1, Phu My Ward, Phu My Town, BRVT	Road 2A, Phu My Industrial Park 1, Phu My Ward, TX Phu My, BRVT	All provinces from Da Nang to the South	Le Phu Minh 0974900757
4.	Air . Co., Ltd Liquide Vietnam- Home industrial gas machines ALV (SHTP)	Que Vo Industrial Park, Ward Van Duong, city Bac Ninh, Bac Ninh province	Lot I-2a Dong Nai Cao, Thu Duc City, Hanoi, Minh City.	Ho Chi Minh City, Long An, Park, Binh Duong, Saigon Ba Ria Vung Tau, Binh Phuoc, Tay Ninh, Tien Giang,	Nguyen Van Nghia 0912404572
5.	Linde Gas Vietnam Co., Ltd	1B, Phu My 1 Industrial Park, Tx Phu My, Ba Ria Province Vung Tau	D3, Phu My Industrial Park, Phu My, Ba Ria Vung Tau Dong Province Ba Ria Vung Tau	Ho Chi Minh, Long An, Road Dong Nai, Binh Duong, 2, Tx. Tien Giang Dong Nai, Ho Chi	Nguyen Van Viet 0903366319
6.	Dong Nai Oxygen Co., Ltd	No. 2, Road 1A, Bien Hoa 2 Industrial Park, Long Binh Tan Ward, Bien Hoa City, Dong Nai Province	No.2, Road 1A, Bien Hoa 2 Industrial Park, Long Binh Tan Ward, Bien Hoa City, Dong Nai Province,	Minh City, Binh Duong, Long An	Nguyen Thanh Tam 0983744699
7.	Welding Rod Technology Joint Stock Company (Sovigaz)	1-3 Nguyen Truong To, Ward 13, District 4, HCMC	Block 4, Lot A, Road No.1, Dong An Industrial Park, Thi Xa Thuan An, Binh Duong Province	From Khanh Hoa province to the eastern and southwestern provinces and HCMC Area	Mr. Trinh Anh Phong 0908109016

No.	Company name	Office address	Factory address	Scope of ability to supply	Full name / Mobile phone number (Leader of the company)
8.	Airwater Vietnam Industrial Gas Co., Ltd	Phu My 1 Industrial Park, Ward Phu America, TX. Phu My, T.Mrs Ria-Vung Tau	Phu My 1 Industrial Park, Ward Phu America, TX. Phu My, T.Mrs Ria-Vung Tau	Ba Ria- Vung Tau, Ho Chi Minh, Long An, Dong Nai, Binh Duong, Binh Phuoc, Tay Ninh, Tien Giang Hue, Da Nang, Quang	Trinh Dinh Long 0969191561
9.	Oxygen Tuan Anh Gia Lai Co., Ltd	248C Phan Dinh Phung, Pleiku City, Gia Lai	Village 9, Nghia Hung commune, Chu Pah , Gia Lai	Ngai, Kon Tum, Nha Trang, Quy Nhon Binh Duong, Dong Nai, Vung Tau,	Pham Anh Khoa 0977227799
10.	Sing . Co., Ltd Industrial Gas Vietnam	Lot B-3B3-CN, My Industrial Park Phuoc 3, Ben Cat Town, Binh Duong	Lot B-3B3-CN, My Industrial Park Phuoc 3, Ben Cat Town, Binh Duong	Vinh Long, Tra Vinh, Kien Giang, HCMC, Long An, Tien Giang, Ben Tre, Tay Ninh, Hau Giang, An Giang, Binh Phuoc, Soc Trang, Bac Lieu, Dong Thap, Can Tho, Ca Mau, Ninh Thuan, Binh Thuan, Khanh Hoa, Dak Lak, Dak Nong, Gia Lai.	Mr Peh Chee Siong 0704463878
11.	Can Tho Electromechanical Joint Stock Company	103 Nguyen Trai, Lot 29, Tra An Hoi Ward, Ninh Kieu District, Can Tho City	Noc 1 Industrial Park, Dist. Binh Thuy, Can Tho City	Provinces in the Mekong Delta	Le Quang Sang 0986272525

APPENDIX 2: MEDICAL OXYGEN AND INDUSTRIAL OXYGEN PRODUCTION CAPACITY

1. Medical Oxygen Gas Production Capacity:

1.1 Production capacity:

Currently, through reviewing and requesting medical oxygen production and supply units to report. There are currently 26 . nationwide factory (Appendix attached), in which:

- **North: 07 factories**

+ Average total production capacity of liquid oxygen: 530.6 tons/day (Equivalent to 412,276.2 m³ + Total³ oxygen).

maximum production capacity of liquid oxygen: 592.08 tons/day (equivalent to 460,046 m³ + Total³ oxygen).

quantity) Liquid oxygen storage facilities: 3690.8 Tons (Equivalent to 2,867,715.6 m³ + Total capacity of bottle³ oxygen).

filling/extraction (40L type): 3,800 bottles/day.

+ Total capacity to convert/extract Bottles (type XL45): 280 bottles/day.

+ Total number of liquid oxygen tank trucks: 21 vehicles.

+ Total number of vehicles transporting Bottles / Bottles: 19 vehicles.

- **Central region: 08 factories +**

Average total production capacity of Liquid Oxygen: 100 Tons/day (Equivalent to 77,700 m³ + Maximum³ oxygen).

total production capacity of Liquid Oxygen: 152.4 Tons/day (Equivalent to 118,414.8 m³ + Total amount³ oxygen).

of liquid oxygen stored by facilities: 3,588 Tons (Equivalent to 2,787,876 m³ + Total capacity of bottle³ oxygen).

filling/extraction (40L type): 15,100 bottles/day.

+ Total capacity to convert/extract Bottles (type XL45): 340 bottles/day.

+ Total number of liquid oxygen tank trucks: 22 vehicles.

+ Total number of vehicles transporting Bottles / Bottles: 52 vehicles.

- **South: 11 factories**

+ Average total production capacity of Liquid Oxygen: 553.6 Tons/day (Equivalent to 430.147.2 m³ oxygen).

amount of liquid oxygen stored by the facilities: 7,025,315 Tons (Equivalent to 2,787,876 m³ oxygen).

capacity of bottle filling/extracting (40L type): 11,500 bottles/day. ³ oxygen).

+ Total capacity to transfer/extract Bottles (type XL45): 247 bottles/day.

+ Total number of liquid oxygen tank trucks: 48 vehicles.

+ Total number of vehicles transporting Bottles / Bottles: 78 vehicles.

1.2. Commitment of manufacturers and suppliers:

Units committed to the Ministry of Health are ready to increase by 50% - 100% of capacity in case the National Steering Committee for Prevention and Control of COVID-19 epidemic issues an order during an emergency.

2. Industrial Oxygen Production Capacity:

Currently, according to the Vietnam Steel Association's report, there are 13 large steel production units in Vietnam such as Hoa Phat Steel, Formosa Steel, etc., which use oxygen in natural form. producing Oxygen or buying directly from industrial gas production units such as MESSER, Air Liquide, etc. to smelting steel billets, the annual use needs of Oxy gas refineries, the Steel billet need about 744 million m³ Association is ready to participate in the call. Calling steel production units to switch to support production and supply oxygen for epidemic prevention and control.

APPENDIX 3: INSTRUCTIONS FOR CALCULATING OXY8 DEMAND

1. Estimated number of people with COVID-19 in each treatment tier according to cases number of cases

TT	Content	Percentage of total cases	Percentage in each floor	Number of people with COVID-19 in each floor by cases (= total number of patients x percentage of patients by clinical level)							
				1,000	5,000	10,000	50,000	100,000	200,000	300,000 VND	
1. Level 1: Mild, asymptomatic patient:		83.6%	100%	836			8,360	41,800	83,600	167,200	250,800
1.1	Patient is mild and does not require oxygen	79.4%	95%	794	3,971		7,942	39,710	79,420	158,840	238,260
1.2	Patients breathing oxygen with glasses	2.1%	2.5%	21	105		209	1,045	2,090	4,180	6,270
1.3	Breathe through the mass	2.1%	2.5%	21	105		209	1,045	2,090	4,180	6,270
2. Level 2: NB moderate, heavy		11.20%	100%	112	560		1,120	5,600	11,200	22,400	33,600
2.1	NB moderate	7.00%	62.5%	70	350		700	3,500	7,000 won	14,000 won	21,000 won
2.3	Patient with respiratory failure, Oxygen for glasses	0.60%	5.4%	6	30		60	300	600	1,200	1,800
2.2	Patients with respiratory failure, oxygen through mass	3.20%	28.6%	32	160		320	1,600	3,200	6,400	9,600
2.4	High Flow Oxygen HFNC	0.40%	3.6%	4	20		40	200	400	800	1,200
3. 3rd floor: Severe, critical patient		5.20%	100%	52	260		520	2,600	5,200	10,400	15,600
3.1	Non-invasive mechanical ventilation	1.45%	27.9%	15			145	725	1,450	2,900	4,350
3.2	Very Severe: Invasive mechanical ventilation	3.70%	71.2%	37	185		370	1,850	3,700	7,400	11,100
3.3	ECMO	0.05%	1.0%		3		5	25	50	100	150

2. How to estimate the oxygen demand at each treatment floor by the total number of cases and by the number of cases at a time

TT	Content	Explain how to calculate oxygen demand by total number of cases (liters of gas)	Explain how to calculate Oxygen demand according to the number of cases at a time (liter of gas)
1st.	Level 1: Mild, asymptomatic patient: 1.1 Mild		
	patient, no need for oxygen		
1.2	Patients breathing oxygen with glasses	If the frame oxygen level is 5 (litres/minute) x 60 (minutes) x number of hours/day x average number of treatment days x number of patients	If the frame oxygen level is 5 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
1.3	Breathe through the mass	If the oxygen mass is 15 (litres/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	If the oxygen level of the bag is 15 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
2.	Level 2: NB moderate, heavy		
2.1	NB moderate		
2.3	Patient with respiratory failure, Oxygen for glasses	If the frame oxygen level is 5 (litres/minute) x 60 (minutes) x number of hours/day x average number of treatment days x number of patients	If the frame oxygen level is 5 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
2.2	Patients with respiratory failure, oxygen through mass	If the oxygen mass is 15 (litres/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	If the oxygen level of the bag is 15 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
2.4	High Flow Oxygen HFNC	FiO2 100%, F 60l/min: 60 (liters/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	FiO2 100%, F 60l/min: 60 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
3.	3rd floor: Severe, critical patient		
3.1	Non-invasive mechanical ventilation	If the Oxygen level is 100%: (F35, Vt 500, PEEP 10 FiO2 100, Bias flow 10): 27.5 (liters/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	If 100% Oxygen level: (F35, Vt 500, PEEP 10 FiO2 100, Bias flow 10): 27.5 (litres/minute) x 60 (minutes) x number of hours/day x number of patients
3.2	Very Severe: Invasive mechanical ventilation	If the Oxygen level is 100%: (F35, Vt 500, PEEP 10 FiO2 100, Bias flow 10): 50 (liters/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	If 100% Oxygen level: (F35, Vt 500, PEEP 10 FiO2 100, Bias flow 10): 50 (liters/minute) x 60 (minutes) x number of hours/day x number of patients
3.3	ECMO	If Oxygen level 10 (litres/minute) x 60 (minutes) x number of hours/day x average number of days of treatment x number of patients	If Oxygen level 10 (litres/minute) x 60 (minutes) x number of hours/day x number of patients

3. Estimation of oxygen demand at each treatment tier by total number of cases and by number of cases at a time Table 1. Estimated oxygen demand in the scenario of 1000 cases and 5,000 cases

TT	Content	Percentage of total cases	Number of patients at each floor when there is 1000 shift get	Oxygen demand in the situation of 1000 cases of COVID-19				Number of patients on floors when there are 5000 cases	Oxygen demand in a 5000 case scenario COVID-19			
				At each layer of Oxygen	number of	In a day when the cases at a time (liters of gas)	Liquid oxygen (tons)		At each stage Liquid oxygen (tons)	Demand in a day when the number of cases at a time (liter of gas)	Convert to Liquid oxygen (tons)	
	1. Floor 1: Mild patient, no symptoms: 1.1 Patient mild, no need to breathe Oxygen 79.4% 1.2 Patient breathing oxygen with glasses 2.1% 1.3 Breathing through mass 2.1%	83.6%	836	151,200	0.2	151,200	0.2	4.180	756,000 won	1.0	756,000 won	1.0
	2. Floor 2: Level patient moderate, severe 2.1 patients moderate 7,00%		794					3,971				
	2.2 patients with respiratory failure, oxygen frames 0.60%		21	37,800		37,800		105	189,000 won		189,000 won	
	2.3 patients with respiratory failure, oxygen through 3.20%		21	113,400		113,400		105	567,000 won		567,000 won	
	2.4 High-flow HFNC		112	3,931,200	5.1	1,080,000 won	1.4	560	19,656,000 won	25.3	5,400,000 won	6.9
	3.1 Non-invasive ventilation		70					350				
	3.2 Invasive mechanical ventilation		6	129,600		43,200		30	648,000 won		216,000 won	
	3.3 ECMO		32	2,073,600		691,200		160	10,368,000 won		3,456,000 won	
	3. Level 3: Severe, critical patient 3.1 Non-invasive ventilation 3.2 Very severe: Invasive mechanical ventilation	0.40%	4	1,728,000 won		345,600		20	8,640,000 won		1,728,000 won	
	3.3 ECMO	5.20%	52	22,717,800	29.2	3,245,400	4.2	260	13,589,000	146.2	16,227,000 won	20.9
		1.45%	15	4,019,400		574,200			20,097,000 won		2,871,000 won	
		3.70%	37	18,648,000 won		2,664,000 won		185	93,240,000 won		13,320,000 won	
		0.05%	--	50,400		7,200		3	252,000 won		36,000 won	
	Total (liters)			26,800,200	34.5	26,800	5.8		134,001,000 won	172	22,383,000 won	29
	Convert to Oxygen gas (m liter/1000 3):					4.477			134.001		22,383	
	Convert to Liquid Oxygen (tons): m 3 /777			34.5		6			172.5		29	

4. Estimated Oxygen demand of COVID-19 treatment and collection facilities by hospital bed size according to 3 treatment floors

TT	Content	Ratio % in each floor	Estimated oxygen demand of COVID-19 treatment and collection facilities by hospital bed size								
			Size of hospital beds on each floor	Demand Oxygen for 1 day	Convert to Liquid Oxygen (tons)	Size of hospital beds on each floor	Demand Oxygen for 1 day	Convert to Liquid Oxygen (tons)	Scale GB at each floor	Demand Oxygen for 1 day	Convert to Liquid Oxygen (tons)
1. Floor 1: Mild, asymptomatic patient:	1.1 Mild patient, no need for oxygen	100%	100	18,000 won	0.02	500	90,000 won	0.12	3000	540,000 won	Oxygen (tons) 0.69
	1.2 Patient with glasses frame	95%									
	1.3 Breathe through mass	2.5%	2.5	4,500		13	22,500		75	135,000 won	
	2. Floor 2: Moderate patient, severe	2.5%	2.5	13,500		13	67,500		75	405,000 won	
2.1 Patient with moderate severity	2.1 Patient with moderate severity	100%	100	967,680	1.2	300	2,903,040	3.7	500	4,838,400	6.2
	2.2 NB in respiratory failure, oxygen	62.5%									
	2.3 Patient with impaired Respiration, Eyeglass	5.4%	5	38,880		16	116,640		27	194,400	
	2.4 High flow oxygen HFNC	28.6%	29	617,760		11	933,120		18	1,555,200	
	3. Floor 3: Severe, critical patient	3.6%	4	311,040		11	933,120		18	1,555,200	
3.1 Non-invasive ventilation	3.1 Non-invasive ventilation	100%	20	1,249,128	1.6	50	3,122,820	4.0	100	6,245,640	8.0
	3.2 Very severe: Invasive mechanical ventilation	27.9%	5.6	220,968		14	552,420		28	1,104,840	
	3.3 ECMO	71.2%	14.2	1,025,280		36	2,563,200		71	5,126,400	
		1.0%	0.2	2,880		0.5	7,200		1.0	14,400	

TT	Content	Percentage in each floor	Estimated Oxygen demand of COVID-19 collection and treatment facilities by hospital					
			Size of hospital beds on each floor	Oxygen demand in 1 day	bed size Converting into Liquid bed oxygen at (tons) per floor 1.16	Demand Oxygen for 1 day	Convert to Liquid	
1.	Level 1: Mild patient, asymptomatic: 1.1 Mild	100%	5,000 won	900,000 won	10,000	1,800,000 won	Oxygen (tons) 2	
	patient, no need for oxygen 1.2	95%						
	Patient oxygen with glasses	2.5%	125	225,000 won		250	450,000 won	
	1.3 Breathe through	2.5%	125	675,000 won		250	1,350,000 won	
mass	2. Level 2: NB moderate, heavy	100%	1,000 yen	9,676,800	12.5	2,000	19,353,600 won	24.9
	2.1 Patients with moderate	62.5%						
severity	2.3 Patients with respiratory failure,	5.4%	54	388,800		108	777,600	
Oxygen	frames with glasses 2.2 Patients with	28.6%	286	6,177,600		572	12,355,200	
respiratory	failure, breathing Oxygen	3.6%	36	3,110,400		72	6,220,800	
through	mass 2.4 High-flow oxygen HFNC 3.	100%	200	12,491,280	16.1	500	31,228,200	40.2
Level	3: Severe, critical patient 3.1 Non	27.9%	56	2,209,680		140	5,524,200	
-invasive	ventilation 3.2 Very severe: Intrusive mechanical ventilation	7.2%	142	10,252,800		356	25,632,000 won	
3.3	ECMO	1.0%	2.0	28,800		5.0	72,000 won	

APPENDIX 4: GUIDELINES FOR DESIGNING CENTRAL HEALTH GAS SYSTEMS

1. Design standards:

- Refer to NF S 90-155, HTM 2022 -

Documentation for design, installation and operation of medical gas systems: ISO 7396-1 (Medical gas pipeline systems – Part 1: Pipeline systems for compressed medical gases and vacuum) and ISO 7396-2 (Medical gas pipeline systems –Part 2: Anaesthetic gas scavenging disposal systems).

- Air Liquide Medical Systems design manual (Medical Gas Design Guide)

- Quality standards: EN ISO 9001, EN ISO 13485: - Fire safety standards: TCVN2622 - Occupational

safety standards: TCVN2287 - Clean gas

standards: ISO 8573 class 1 2. Calculation of

gas center **capacity Medical:** a. Formula for

calculating air source capacity : Outlet air

outlets for COVID-19 patient treatment facilities operate at **100% capacity (maximum air supply).**

possibility), so when calculating the power source based on the empirical formula HTM 2022:

Explain the symbols in the calculation formula for all gases: = number of

nB beds

T = number of operating rooms or main treatment rooms

QUOTE = Divided flow to the ICU bed

QT = Acute diversion flow to the operating room (if any)

b. Formula for oxygen source:

Area	TK flow per outlet (litre/min)	Split flow rate Q (liter/min)
Intensive treatment bed	ten	$QI = 10 + (nB-1)6$
Surgery room	100	$QT = 100 + 20(T-1)$

c. Formula for 4 bar compressed air source:

Area	TK flow per outlet (litre/min)	Split flow rate Q (liter/min)
Intensive treatment bed	80	$Q/nB \ 1 * 2 \ \frac{80}{—}$
Surgery room	40	$QT \ 40 \ (T \ddot{y}1) * 4 \ \frac{40}{—}$

d. Calculation formula for VAC suction air source:

Area	TK flow per outlet (litre/min)	Split flow rate Q (liter/min)
Surgery room	40	QT=80
Intensive treatment bed	40	$Q/40 \ddot{y} \ (nB \ \ddot{y}1) * 4 \ \frac{40}{—}$

3. Calculation of medical gas pipeline size:

The method of choosing the size of the medical gas pipeline is to ensure low pressure loss on the pipeline than the allowable threshold (*not more than 5% of the working pressure of the pipeline*).

Basically, the selection method can be summarized as follows: - Determine the

pipe size by experience - Calculate the pipeline flow -

Calculate the pressure loss

according to the formula:

$$\Delta p = \frac{\text{Measured length of pipe}}{\text{Nearest length of pipe from Table A1}} \times \left[\frac{\text{Design flow}}{\text{Nearest flow from Table A1}} \right]^2 \times \text{Pressure drop from Table A1}$$

In which: -

Measured length of pipe : The length of the pipe to calculate the pressure loss.

- *Nearest length of pipe from Table A1* : The nearest length according to table A1, Appendix G – HTM document 02-01 book A.

- *Design flow*: Design flow (that the pipe must carry).

- *Nearest flow from Table A1* : The nearest flow according to Appendix table A1.

- *G – document HTM 02-01 volume A*.

- *Pressure drop from Table A1* : Pressure according to table A1, Appendix G – document HTM 02-01 and A.

4. Solution for the system: The

medical gas system is designed according to the central gas supply model. The gas sources are concentrated in an area outside the COVID-19 hospital bed area (yellow area), which is convenient for monitoring supply status, safety, and noise avoidance. After that, the gas is led into the treatment bed area by a pipeline system. Outputs are boxes or combinations of automatic valve boxes, ensuring fast connection times.

The gas source includes a main source and a backup source. Ensure the continuous supply of medical gas to the COVID-19 hospital bed facility.

4.1. Medical gas supply: Location

outside buildings. The pipeline leading to the treatment buildings is the shortest. Convenient for loading and replace the power supply, ensure a safe distance, prevent fire and explosion. Medical gas sources include:



- Main source: Liquid oxygen tank, high working pressure 17 bar. The evaporator is under pressure up to 40 bar. Block flow valve, pressure relief valve and safety valve.

- Seamless gas bottles: including 2 bottles, with stop valve, exhaust valve, separate pressure gauge for checking and replacing new cylinders.

4.2. Medical compressed air supply: Ensure

system synchronization and meet TC HTM 2022 or NEPA 99 Equipment :

- The medical air compressor system is designed with at least 02 machines in parallel so that the system can still supply air when the main machine fails or is maintained. The system includes modules that can be flexibly installed in accordance with the machine room area.

- System control cabinet: has automatic and manual operation control functions (when maintaining).

- Accumulator to store compressed air ready for use, reducing the number of compressor starts. Pressure accumulator max. 10 bar, with safety (pressure) relief valve and pressure gauge.

- There is a dual oil filter system to calculate the oil in the compressed air. Each side ensures that the filter capacity is equal to the system capacity, ensuring that there is always enough air while 01 filter is being maintained. Dual drying system to separate water vapor in compressed air. Two filters are installed in parallel so that the system always supplies compressed air while one can be serviced.

- Dual filter system to filter bacteria in compressed air. Two filters are installed in parallel so that the system always supplies compressed air while one can be serviced.

- Pressure reducer 7bar - 4 bar. To reduce the pressure from the accumulator to 4 bar.

4.3. VAC suction air source:

Ensure system synchronization and meet TC HTM 2022, or NEPA 99 Equipment: - The

medical

center suction system is designed with two parallel machines, running alternately, and at the same time ensuring for repair and maintenance. The system includes modules that can be flexibly installed in accordance with the machine room area.

- System control cabinet: has automatic and manual control functions of air compressors.

- Accumulator to store suction gas ready for use, reducing the number of machine starts, increasing compressor durability. Jar pressure capacity max. 10 bar, with safety (pressure) relief valve and pressure gauge.

- There is a double-determined trap on the pipeline to separate the fluid from flowing through the pipe to the outside environment.

- Dual bacterial filter to filter bacteria before releasing air to the outside environment to avoid environmental pollution.

- Quality requirements of the suction air filter

o Pressure drop through the filter: ≤ 25 mmHg o

Bacterial filtration capacity: $\geq 99.995\%$ o Dust

filtration capacity: $0.02 \mu\text{m}$ 4.4 . **The transmission**

system:

- The transmission system is made of specialized medical-grade copper material, which is removed from toxic and heavy metals element, cleaning and degreasing to ensure arsenic-free.

- High pressure resistance: 10mm diameter pipes withstand 110 bar, - 54mm diameter pipes withstand 17 bar pressure. - The vertical pipeline is run in the technical box. Pipes on each floor run along the corridor above technical ceiling. Piping from the hallway enters the outlet locations (air drive or headboard box, ...).

- The medical gas pipeline system does not come into contact with electrical conductors, at least 50mm apart.

- Pipes must be grounded (ground) separately.

- The medical gas pipeline support system must be solid.

4.5. Output device -

Features a quick connection. When plugging in the end of the pipe of the equipment used, automatically open the one-way valve to supply air to the equipment used, remove the end of the pipe, and automatically lock the air.

The image shows the air outlet:

Is the outlet air outlet with automatic valve installed. Accumulated Suitable for bedside meeting Installed at places of use (hospital bed, operating room, ultrasound, ...).



4.6. Peripherals:

Basic means of supporting medical treatment. These devices use medical gas through connection to the terminal by quick disassembly. After being installed in the medical system, automatically supply gas to the device. After removing the terminal automatically cuts off the medical gas.

Peripheral devices can move from one location to another. Peripheral devices include: *Flowmeter 15*

l/p with humidifier : Helps the hospital

bed breathe oxygen-rich air The output

air flow can be adjusted from 0 ~ 15 L/p Pressure control

system back pressure, ensuring stable output flow when the pipeline pressure changes.

With Oxygen Humidifiers

Illustration of wall mounted suction flasks:

Liquid tank: Unbreakable, spill-proof material

Vacuum adjustment range: 0 ~ 200 mmHg

The knob to adjust the amount of suction

Suction/suction stop button



Illustration of mobile suction suction:



Illustration of pulmonary aspiration (low pressure):



Connector types:

Quickly connect medical gas devices to the gas outlet. When plugged in, open the valve automatically to let the gas enter the device bag. When removing the automatic valve (in the air outlet) automatically closes to keep the gas in the pipeline.