Vietnam Respiratory Care Equipment Supplier Landscape

January 2022

PATH

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Abbreviations

BiPAP	bilevel positive airway pressure
COVID-19	coronavirus disease 2019
CPAP	continuous positive airway pressure
ECG	electrocardiogram
FiO2	fraction of inspired oxygen
HFNC	high-flow nasal cannula
ICU	intensive care unit
LPM	liters per minute
MOH	Ministry of Health
NIBP	noninvasive blood pressure
PO	pulse oximeter
PSA	pressure swing adsorption
RC	respiratory care
RR	respiratory rate
SpO2	oxygen saturation
SRA	stringent regulatory authority
TEMP	temperature
UNICEF	United Nations Children’s Fund
WHO	World Health Organization

Document guide

Objective

The key objective of this document is to provide an overview of the respiratory care (RC) equipment supplier landscape in Vietnam. This document was jointly produced by PATH and the Vietnam Ministry of Health (MOH) Cabinet Office to provide buyers with a preliminary assessment of RC equipment availability in Vietnam's domestic market. For each type of product, the document includes a list of suppliers, general and specification considerations, and product price range.

Products covered in this report are equipment and consumables necessary for the provision of medical oxygen, such as oxygen concentrators, ventilators, patient monitors, pulse oximeters, and delivery interfaces.

Audiences who may find this report useful include local government decision-makers, such as ministries of health; health facility procurement officers; and global organizations, such as multilateral agencies. Information in this report could offer insights into product offerings, pricing information, and supplier capacity. The document may also benefit distributors and wholesalers of RC equipment who can derive a deeper knowledge of the competitive landscape for their services and potential market opportunities.

This market report focuses primarily on Vietnam distributors and manufacturers of RC equipment. The information was collected between July and November 2021. Any information should be taken as indicative only and should be verified with individual suppliers by the buyers at the relevant stage in the procurement process.

For additional references on developing procurement criteria, see the World Health Organization's guidance for purchasing oxygen therapy devices in *Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications* (WHO, November 2020).

Data sources

Data presented in this report were gathered from quantitative and qualitative surveys of suppliers, stakeholder interviews, desk reviews, and data analysis of public databases. Further details of sources for analysis included in this document are described below.

Respiratory equipment supplier survey

An RC equipment survey was jointly conducted by PATH and the MOH Cabinet Office to understand the availability of brands, local stocks, sale services, and typical lead time for RC equipment. RC equipment included in the survey was chosen from the World Health Organization (WHO) Priority Medical Devices list and MOH Decision 2626, which provide guidance about the number and type of respiratory equipment each COVID-19 treatment facility should have.

Companies are selected based on two criteria: (1) must be either a manufacturer or distributor of RC equipment and (2) preferably a company that sells multiple product categories included in the survey. From this list, companies were selected to ensure suppliers from all three regions of Vietnam were represented in the survey. In total, 45 companies were surveyed, among which 11 are manufacturers or manufacturers' representative offices and the remaining are distributors. The first paper-based survey was distributed to 27 companies on July 1, 2021. To collect additional information, a second survey was

sent to an additional 18 companies on November 5, 2021. Eighty percent of companies (22/27) responded to the first survey and thirty-nine percent (7/18) responded to the second survey. Two companies surveyed reported that they no longer sell products included in the list, and thus were excluded from the result analysis.

In addition, 12 companies (10 of which did not reply to the paper survey) were interviewed face-to-face in a semi-structured process. During the interview, information similar to that in the paper survey was collected and additional questions were asked to gain qualitative data regarding the local market for RC equipment.

Please refer to the appendices for the complete list of products included in the surveys and the participating companies.

Medical equipment list price e-portal

Suppliers in Vietnam are encouraged to publicize their product offerings and pricing data on an e-portal managed by the MOH. This e-system has been officially operational since November 2020 [1] and has over 50,000 data entries of medical equipment and consumables as of November 2021. The data published on the portal is accessible by everyone and can be used by procurers as a mean to make purchase decisions. Data from this portal was retrieved from https://congkhaigiadmec.moh.gov.vn/ on November 11, 2021 and serves as a guide to understand the pricing range and brand availability for each technology examined in this report.

Database of financial disclosure and winning bid result e-portal

According to Circular No. 14/2020/TT-BYT,[2] Department of Finance and Planning, the MOH is responsible for updating the approved contractor selection results for medical equipment to the public e-portal within 10 working days from the approval date by the authority. This e-portal was officially operational in November 2020 and contains historical procurement data of medical devices, consumables, and medicines dated from 2019 to present. Data from this portal (from here on referred to as the financial disclosure e-portal) was retrieved from https://congkhaiketquathau.moh.gov.vn/ on November 11, 2021, to analyze procurement trends for each technology examined in the report between 2019 and 2021.

Sectional guide

Each product landscape in this report follows the same structure, with five primary headers: product overview, overview of Vietnam market, considerations for product selection, identified suppliers, and aggregated price range.

Product overview

For each technology, we outline the potential uses for the product, how the product fits into the continuum of respiratory care, and the common subtypes within a specific product category.

Generally, when considering how a product will be deployed, it is critical to consider the context in which it will be introduced. Buyers should carefully devise required product specifications and options based on the intended use of each product, the requirements of existing diagnostic and treatment delivery systems, and the current state of infrastructure. Buyers should also require suppliers to provide documentation of conformity.

Buyers are also encouraged to plan for how the product will be used in a post-pandemic setting, particularly for equipment with a long lifespan.

Overview of Vietnam market

For each equipment, this report provides a brief analysis of the trend in procurement activity between 2019 and 2021, the degree of competition, and the brands that are widely procured by health facilities.

This section includes procurement data compiled mainly from public health facility purchases reported on the financial disclosure e-portal. Where possible, equipment donated to hospitals by private, multilateral, or nongovernment organizations is listed by summarizing figures from public local news. Since the e-portal was only activated in 2020, procurement data from 2019 to 2020 described may not be the full figure. In addition, procurements for private hospitals (182 out of 1,332 hospitals)[3] were not included.

Due to the complex and constantly evolving procurement landscape, any analyses presented in this section should be taken as indicative only and may not reflect the most recent picture of the Vietnam market.

Considerations for product selection

For each equipment, the study team established criteria for selection according to five categories: quality, ability to service the market, functional requirements, operational requirements, and price. Although these categories remain consistent across the range of products in the report, the selection criteria in each section are tailored to each product, primarily based on WHO specification guidelines. An assessment of identified products procured from 2019 to 2021 in Vietnam against the established criteria for selection was also provided to give an overview of the local procurement practices. This examination was performed by reviewing the detailed technical and quality certification documents of the products against WHO specifications. Due to the large number of suppliers available for each technology, previously procured and locally manufactured brands are prioritized for assessment.

Buyers are advised to use the selection criteria only as a starting point and determine features most relevant to their context and local standards. Additionally, specification thresholds should be taken as indicative. Many companies may not have completed testing to the requested specifications because the markets and customers they typically serve do not require them, and they may be able to claim compliance if they arrange suitable testing.

Identified suppliers

For each equipment, identified suppliers are presented according to quality standards, production capacity, inventory, lead time and, in some cases, product design and specification considerations. Specific data such as inventory and lead time should be taken as indicative only as these parameters may vary depending on the time of order. Additionally, due to the large variability of brands presented for specific technologies, not all qualified products may be included. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Aggregated price range

For each equipment, the report provides anonymized price ranges for the available suppliers in the market based on the survey results and the data retrieved from the listing price e-portal. Where possible,

comparisons are made according to equipment subtypes, brand origins, and so on. Additionally, an aggregated price range of products procured in the last 3 years was provided based on the data from the financial disclosure e-portal. The median price for procured products of each equipment type is compared to the WHO indicative price[i] for reference.

Prices should be taken as indicative only and may be highly variable depending on the urgency of the order, volume required, requirements for international regulatory specifications or certifications, and other contextual factors. In individual scenarios, there may be significant room to maximize value-for-money and adjust an initial quote from a supplier depending on these factors. It is also important to note that the prices reported are applicable in Vietnam solely and may not reflect broader pricing trends globally. As many product features may be optional, care should be taken when seeking price quotations or comparing prices to ensure the price is for the right configuration.

[i] World Health Organization (WHO). *Emergency Global Supply Chain System (COVID-19). Catalogue as of 17.12.2021.*[10]

Oxygen concentrator

Product overview

An oxygen concentrator is a medical device designed to produce oxygen from ambient air, using pressure swing absorption (PSA) technology.[4] The device is powered by electricity and the life span is often 5 years or more. Oxygen concentrators can deliver oxygen directly to patients, at the bedside or in proximity to a patient's bed. The oxygen can be continuously produced and is often of 90 percent to 96 percent purity. Oxygen concentrator maximum flow rate ranges from 3–12 liters per minute (LPM), but 5 LPM, 8 LPM, and 10 LPM units are the most common. This document focuses on exploring 5–10 LPM units.

According to Decision 2626 by the MOH, 5 oxygen concentrators will be needed for each 20-bed unit treating COVID-19 patients with light symptoms and 10 for each 20-bed unit for moderate symptoms.[5]

For more information regarding oxygen concentrator specifications, please refer to the WHO *Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications*.[6]

Overview of Vietnam market

In Vietnam, 100 percent of oxygen concentrators are imported—mostly from China, Turkey, or the United States—and sold via local distributors. A survey of facilities in Vietnam in January 2021 showed that 993 health facilities have in total 1,995 functioning oxygen concentrators.[7] Based on data from the financial disclosure e-portal, in 2019 and 2020, only 10 concentrators were procured each year by health facilities; in the first 10 months of 2021, 116 concentrators were procured. In addition, it was noted that over 11,000 oxygen concentrators were purchased by private corporations and donated to health facilities between August and September 2021 to support treatment for COVID-19 patients.[8,9]

The public listing price database indicated that 30 different concentrators from 17 brands are offered in Vietnam. Among the models procured in the past 3 years by hospitals, Longfian (China) and Kare Medical (Turkey) are the most commonly purchased brands (accounting for 57 percent of 134 total purchases); and 90 percent of oxygen concentrators are 5 LPM units. However, as many concentrators are purchased by households and private organizations, it is difficult to quantify the exact market share for brands and concentrator types in Vietnam.

Consideration for product selection

Selection criteria for oxygen concentrators that could be used to inform product procurement decisions are summarized in Table 1.

Table 1. Procurement considerations for oxygen concentrators.

Considerations	Critical attributes	Overview of models procured in Vietnam between 2019–2021
Quality standard	ISO 13485 certification or equivalent. Registration in SRA market (FDA, CE…). Free sales certificate (FSC) or certificate for exportation from manufacturing country's authority.	All models have CE/ISO13485 certification.

Price	Competitive pricing with regard to provided features/configurations.	See “Aggregated price range” section.
Ability to service the market	• Inventory readily available at local distributors or acceptable order lead time (depending on order urgency) if product is not stocked locally. • Availability of after sales services (maintenance, installation, and warranty for minimum 2 years). • Payment requirements. • Options for bundled accessories and consumables and individual spare parts.	• Selected models, mostly from China, are stocked. • Order time ranges from 1–2 weeks if inventory is available or 4–8 weeks if not. • Payment options range from partially prepaid to fully postpaid. • Warranty offered by distributors often covers only 1 year. • Training and installation are included in the initial contract. • Repair and maintenance packages are offered by all distributors surveyed that sell oxygen concentrators.
Functional requirements	Prioritization of critical elements for the context of use, including but not limited to: • Oxygen purity >82%. • Flowmeter continuously adjustable, with minimum markings at 0.5 L/min intervals (or lower for pediatrics). • Output pressure greater than 55 kPa. • Power efficiency: ratio of power consumption/LPM ≤70 W/LPM preferred. • Filter system. • Necessary features for usability (e.g., monitor, outlets, wheels, and alarms).	• Oxygen purity: most often between 87%–93%, 2/10 models assessed could produce oxygen with purity of up to 96%. • Output pressure: varies greatly between models. 7/10 models assessed could offer output pressure >55 kPa at all levels. • Adjustable flowmeters. • Critical alarm features are available (e.g., low oxygen concentration, low output pressure, and low power). • All models weight 27 kg or less.
Operational requirements	Based on technical specification: • Capability to operate within an ambient temperature between 10°C–40°C and relative humidity between 15%–85% (up to 95% highly desirable). • Capability to operate with basic power sources. • Inclusion of accessories for full functionality.	• Most models (8/10) could operate at ambient temperatures between 10°C–40°C. • Selected models (4/10 assessed) could operate at relative humidity up to 95%. • Accessories such as filters, humidifiers, nasal cannulas are often included in the initial package.

Abbreviations: CE, certification mark for European Union; FDA, US Food and Drug Administration; FSC, free sales certificate; ISO, International Standards Organization; kPa, kilopascal; LPM, liters per minute; SRA, stringent regulating authority; W, watts.

Identified suppliers

Based on the analysis, a list of prioritized suppliers is presented in Table 2. Due to the high number of suppliers in the market, not all qualified suppliers may have been included in this list. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Table 2. Identified suppliers offering concentrators in Vietnam.

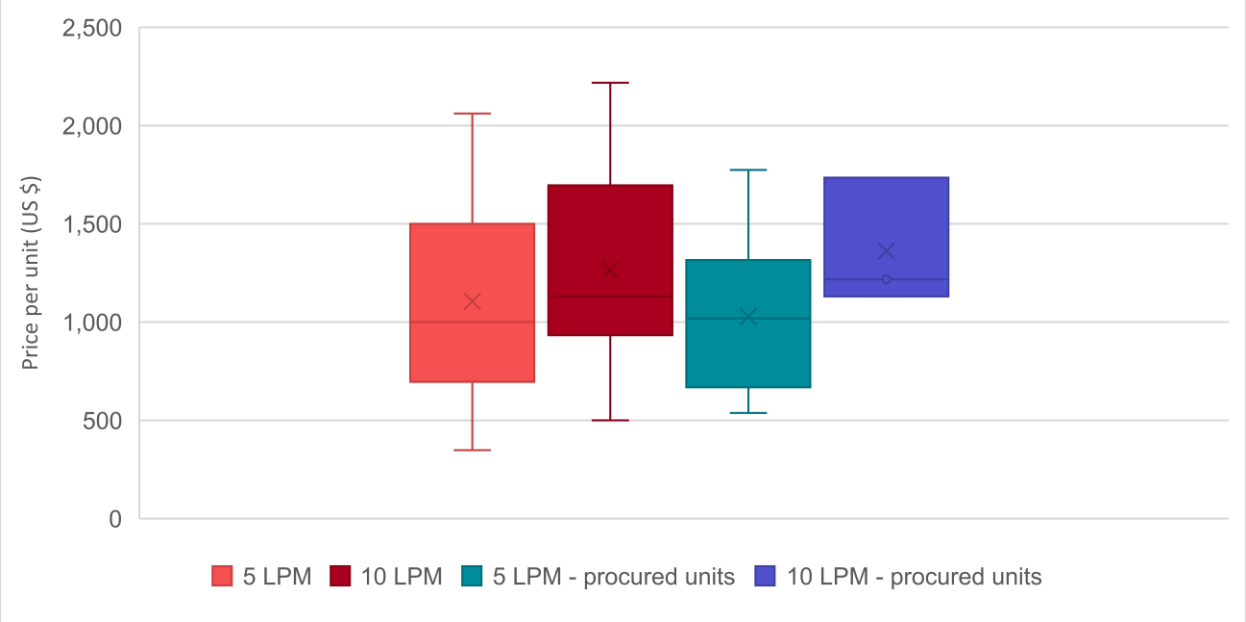
Brand and model (Brand origins)	Type	CE/FDA approved	Oxygen concentration	Output pressure	Power efficiency (W/LPM ≤70)	Stock	Lead time	Distributor
Caire (United States)								
Companion 5	5 LPM	Yes	87%–95%	30	No (77)	NA	NA	Viet Tan Medical Equipment and Technology Co Ltd
AirSep Vision Aire	5 LPM	Yes	87%–95%	30	Yes (58)	NA	NA	Minh Phu Investment and Technology Co Ltd
Jiangsu Yuyue (China)								
7F-5W	5LPM	Yes	87%–95.5%	40–70	No (100)	NA	NA	Hanoi Medical Equipment Trading and Production JSC
8F-5AW	5LPM	Yes	87%–95.5%	40–70	No (80)	NA	NA	
7F-10W	10 LPM	Yes	87%–95.5%	40–70	No (85)	NA	NA	
Kare (Turkey)								
Oxybreath Mini 5	5 LPM	Yes	90%–96%	70–90	Yes (66)	NA	NA	VMED Trading and Services Co Ltd
Longfian (China)								
JAY -5BW*	5 LPM	Yes	90%–93%	40–70	No (108)	1,029	1–2 weeks if order < stock level 4–8 weeks if order > stock level	Western Medical Devices Ltd; An Loi Medical Trading & Service Co, Ltd; Bac Ha Investment and Technology; Tay Bac A
JAY-10BW*	10 LPM	Yes	90%–93%	40–70	No (88)	219		
Nidek Medical (United States)								
Mark 5 Nuvo Lite	5 LPM	Yes	87%–96.5%	50	Yes (66)	NA	NA	Anh Ngoc Medical Equipment Co Ltd
Mark 5 Nuvo 8	8 LPM	Yes	87%–95%	115	Yes (61)	NA	NA	
Philips (Holland)								
EverFlo	5 LPM	Yes	90%–96%	40	Yes (70)	NA	NA	Viet Medical Technology Co Ltd

**Local inventory availability was last updated in November 2021. For the remaining suppliers, please verify with the local distributors for stock availability.*

Aggregated price range

Prices should be taken as indicative only and will be highly variable depending on distributors, urgency, volumes required, and other contextual factors. The price range listed in Figure 1 often includes full accessories for operation. According to the listing price database, the price of a 5 LPM concentrator is between $348 and $2,061 and that of a 10 LPM concentrator is between $739 and $2,217. The median prices of procured 5 LPM and 10 LPM units are $1,017 and $1,217, respectively. On average, the 5 LPM concentrators from Chinese brands are cheaper than those from Turkish and US (by $600 and $800, respectively).

Figure 1. Aggregated price range and purchase price for oxygen concentrators.



**WHO Catalogue indicative price: 10 LPM concentrator is $579.80 per unit (including spare parts).*[10]

Ventilator

Product overview

A ventilator is a device used to mechanically deliver oxygen and air in and out of a patient's lungs. A ventilator is a critical device for patients experiencing respiratory failure, and therefore is used in many settings, such as the intensive care unit (ICU), emergency, and anesthesiology.[6] There are two broad types of ventilators:

- Invasive ventilators, including of three subtypes:
    - Ventilators for ICU – used to provide ventilatory assistance for intubated patients in ICU and need to be connected to a 345 kPa gas source.
    - Transport ventilators – portable, designed to provide temporary ventilation support.
    - Ventilators for subacute care – mostly used for noninvasive ventilation but can also provide temporary invasive ventilation; lower cost and often come with less advanced features compared to ventilators for ICU.
- Noninvasive ventilators: designed to provide short-term mechanical assistance to patients who are not intubated. Noninvasive ventilators consist of 3 subtypes:
    - Continuous positive airway pressure (CPAP) – deliver air or a mixture of air and oxygen at high flow rates and a single set pressure.
    - Bilevel positive airway pressure (BiPAP) – deliver air or a mixture of air and oxygen at high flow rates at two different pressures.
    - High-flow nasal cannula (HFNC) – deliver high flow rate gas with heated humidification.

According to Decision 2626 by the MOH, each 20-bed unit to treat medium COVID-19 patients will need 1 transport ventilator, and each 20-bed unit to treat critical patients will need 8 ICU ventilators, 5 noninvasive or subacute ventilators, 3 HFNC ventilators, and 1 transport ventilator.[5]

For additional information regarding ventilator specifications, please refer to the WHO Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications.[6]

Overview of Vietnam market

Based on analysis of the listing price e-portal, five Vietnamese companies have the capacity to manufacture ventilators. However, analysis of the procurement portal data showed that the majority of the purchases made were for imported products. According to the health facility survey in January 2021, 993 health facilities own 12,511 functional invasive and noninvasive ventilators.[7] In 2019 and 2020, approximately 80 and 129 ventilators were procured, respectively. However, by November 2021, the number of ventilators procured has increased significantly to 834. Additionally, over 600 ventilators were donated to health facilities by private corporations.[9,11,12] Among the procurements made between 2019 and 2021, 70 percent are ICU ventilators and 20 percent are HFNC systems. The four brands most commonly bought are Medtronic, Hunan Beyond Medical Technology Co Ltd, GE, and Drägerwerk AG & Co. KGaA, accounting for 66 percent of all the models procured in the last 3 years. In total, it was estimated that over 70 brands of ventilators are being offered in the market.

Considerations for product selection

Selection criteria for ventilators that could be used to inform product procurement decisions are summarized in Table 3.

Table 3. Selection considerations for ventilator procurement.

Considerations	Critical attributes	Overview of procured models between 2019 and 2021
Quality standard	ISO 13485 certification or equivalent. Registration in SRA market (FDA, CE…). Free sales certificate (FSC) or certificate for exportation from manufacturing country's authority.	Most manufacturers have ISO 13485 certification. Not all locally manufactured models are SRA approved.
Price	Competitive pricing with regard to provided features/configurations.	See "Aggregated price range" section.
Ability to service the market	• Production capacity and capability to either scale or allocate required volumes for procurement, or inventory readily available or acceptable order lead time (depending on order urgency), if product is not stocked locally. • Availability of after sales services (maintenance, installation, and warranty for minimum 2 years). • Options for bundled accessories and consumables and individual spare parts. • Payment requirements.	• Local inventory is often available. If order quantity exceeds local stock, a lead time of 8 weeks or longer may incur. • Local distributors only offer 1 year warranty. • Payment required ranges from 30% to 100% prepaid. • Accessories and consumables such as cannulas, masks, cables, filters, sensors, humidifiers, air mixers, and batteries are available for selected models. • All distributors selling ventilators offer training, installation, and maintenance services.
Functional requirements	Prioritization of critical elements for the context of use, including but not limited to: • Suitable ventilation mode with features relating to the ability to measure the desired parameters to the requisite performance. • Suitable adjustable audio and visual alarms for patient monitoring. • Appropriate display features. • Compatible with existing oxygen connectors, sources, and humidifying system (preferable).	Models available in the market vary in configurations and features.

Considerations	Critical attributes	Overview of procured models between 2019 and 2021
Operational requirements	Based on technical specification: • Capability to operate within an ambient temperature between 10°C–40°C and relative humidity from 15%–95% (noncondensing). • Possess replaceable or rechargeable battery power (220V input power). • Accessories and consumables necessary for full functionality are included in the bid.	Products often comes with tubing, heated humidifier, breathing circuit, sensors, and standard accessory package.

Abbreviations: CE, certification mark for European Union; FDA, US Food and Drug Administration; FSC, free sales certificate; ISO, International Standards Organization; SRA, stringent regulating authority.

Based on the collected information, the number of available models for these ventilator subtypes may depend on the following product requirements.

Ventilator subtype	Product features
Invasive – ICU	• Possibility to use the ventilator with a low-pressure source of oxygen. • Availability of pressure-regulated volume control (PRVC) ventilation mode. • Continuous battery-operated mode more than 1 hour and recharge time less than 6 hours.
Invasive – transport	• Possibility to use with a low-pressure source of oxygen. • Oxygen conservation features.
Noninvasive – CPAP/BiPAP	• Built-in air compressor or turbine. • Ingress protection of 21 or higher. • Compatibility with an active humidifying system. • Pressure-assisted control or automatic positive airway pressure mode in BiPAP ventilators.

Abbreviations: BiPAP, bilevel positive airway pressure; CPAP, continuous positive airway pressure; ICU, intensive care unit.

Identified suppliers

Based on the analysis, a list of prioritized suppliers is presented in Table 4. Due to the high number of suppliers in the market, not all qualified suppliers may have been included in this list. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Table 4. Identified suppliers offering ventilators.

Brand/Model (Brand Origins)	Manufacturing country	Type	CE/FDA approved	Production capacity (monthly)	Inventory	Order lead time (days)	Distributor
MTTS (Vietnam)							
Impala*	Vietnam	Invasive - ICU	Yes	NA	200	60	MTTS
Dolphin*	Vietnam	CPAP	Yes	NA	20	60	
Vietnam Medical Equipment Corporation Vinamed (Vietnam)							
BKVM - HF1	Vietnam	HFNC	No	NA	NA	NA	VMED
Viet Thai Trading and Technical Services Co. Ltd (Vietnam)							
BCPAP.v1.1	Vietnam	CPAP	No	NA	NA	NA	Viet Thai Trading and Technical Services Co. Ltd
Meiko Automation (Japan)							
MMD-V1, MMD-V2	Vietnam	CPAP	No	NA	NA	NA	Meiko Automation JSC
MBi-V1	Vietnam	BiPAP	No	NA	NA	NA	
Metran (Japan)							
Eliciae MV20*	Vietnam	Invasive-subacute	No	1,000	0	5–10	Metran Vitec
JPAP*	Japan	CPAP	Yes	500	0	14	
Drägerwerk AG & Co. KGaA (Germany)							
Oxylog VE300*	Germany	Invasive - travel	Yes	150	7	84–100	Nhat Minh Medical JSC

Savina 300*	Germany	Invasive- ICU	Yes	500	5	84–100	
Savina*	Germany	Invasive - subacute	Yes	500	30	84–100	
Evita V300/V600*	Germany	Invasive- ICU	Yes	300	0	50	
Covidien/Medtronic (United States)							
Puritan Bennet 980*	US	Invasive - ICU	Yes	NA	10	45	Trang Thi Medical Services, Bac Ha Investment and Technology
Puritan Bennett 840*	US	Invasive - ICU	Yes	NA	100	14–120	
Puritan Bennett 560*	US	Invasive - travel	Yes	NA	6	30–60	
GE Healthcare (United States)							
Carescape R860*	US	Invasive - ICU	Yes	200	20	NA	Vietmedical
ResMed (Australia)							
Astral 150*	Australia	Invasive- travel	Yes	NA	15	90	Dinh Giang Trading and Medical Services Co
Stellar 105*	Australia	BiPAP	Yes	NA	20	90	
Hunan Beyond Medical Technology Co.,Ltd (China)							
HF7, HF8	China	HFNC	Yes	NA	NA	NA	Trivina Ltd Co, An Phuc Technology Ltd
Zhejiang Lifemed Technology Co., Ltd. (China)							
HFO-1*	China	HFNC	Yes	NA	50	15–40	Tay Bac A Co
Masimo (United States)							
TNI softFlow 50	Germany	HFNC	Yes	NA	NA	NA	Viet Phan Ltd Co

** All local inventory availability was last updated in November 2021. For products without inventory information, please verify with local distributors to obtain more information.*

Abbreviations: BiPAP, bilevel positive airway pressure; CE, certification mark for European Union; CPAP, continuous positive airway pressure; FDA, US Food and Drug Administration; HFNC, high-flow nasal cannula; ICU, intensive care unit.

Aggregated price range

Prices should be taken as indicative only and will be highly variable depending on urgency, volumes required, and other contextual factors. Based on analysis of the survey results, the initial contract often includes product installation and training as well as a warranty of 12–18 months. The price range for each ventilator subtype is listed below and illustrated in Figure 2 and Figure 3:

- Invasive - ICU: $19,000–$42,000, with a median procured price of $32,000.
- Invasive - transport: $15,000–$23,000, with a median procured price of $19,600.
- Invasive - subacute: $18,000–$28,000, with a median procured price of $20,870.
- BiPAP/CPAP: $3,342–$10,978, with a median procured price of $3,000.
- HFNC: $3,471–$8,500, with a median procured price of $3,400.

The WHO Catalogue indicative prices are $4,990 for BiPAP; $4,169 for HFNC; $26,644 for invasive - ICU; and $19,788 for invasive - transport.[10]

Figure 2. Aggregated price range and purchase price for invasive ventilators.

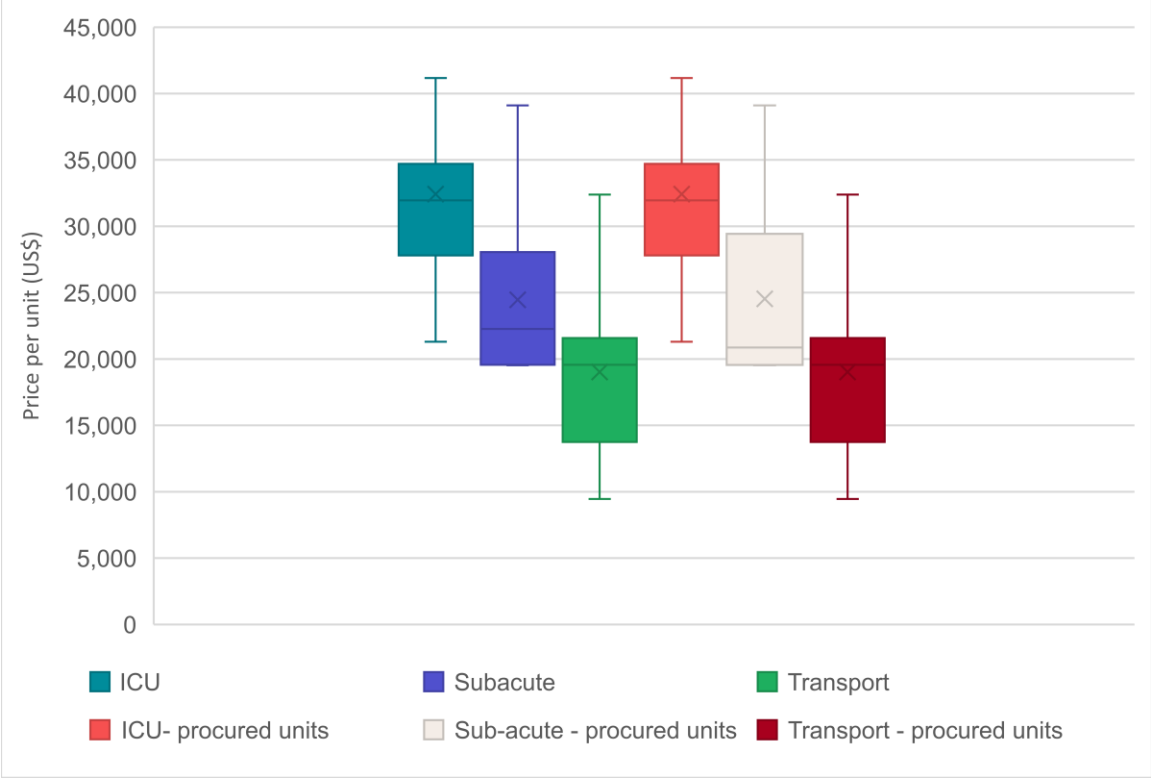
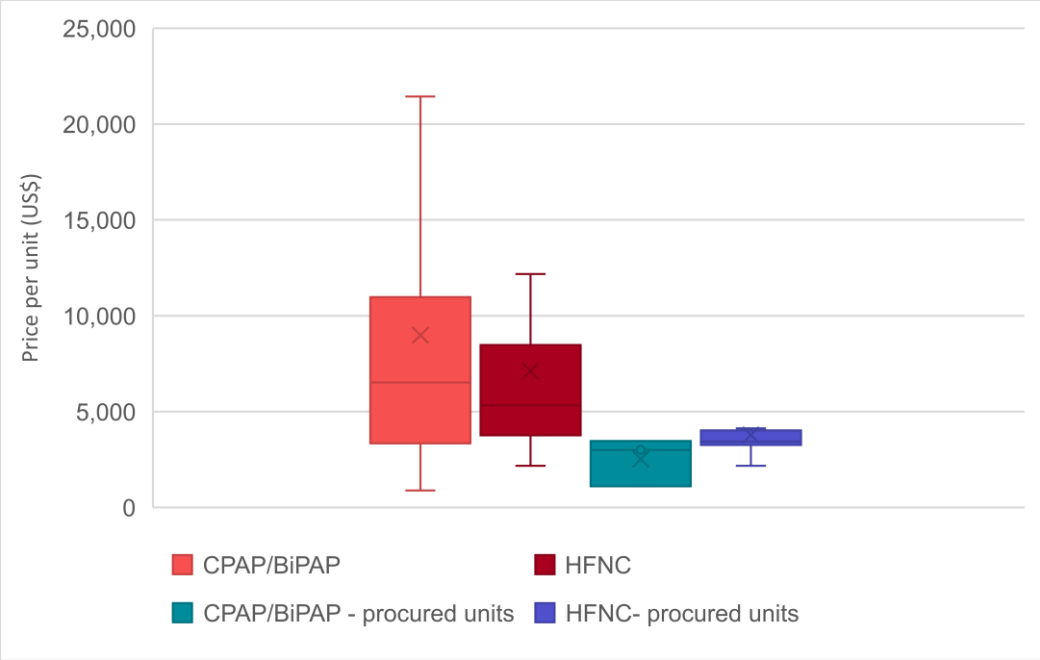


Figure 3. Aggregated price range and purchase price for noninvasive ventilators.



Patient monitor

Product overview

A patient monitor is a medical device used to monitor a patient's vital signs. The device is often found in ICU or emergency room (ER) settings and has been placed on the WHO priority medical device list for clinical care of severe and critical COVID-19 patients.[6] In Vietnam, the patient monitor was also highlighted as an essential medical device for COVID-19 treatment by the MOH according to Decision 2626.[5] COVID-19 treatment centers in Vietnam are recommended to have 5 patient monitors per 20 beds for light/no symptom patients, 5 monitors per 20 beds for medium patients, and 1 per each bed for critical patients. Patient monitors come in many different configurations and are usually classified by the number/type of parameters that the device offers. In the WHO specifications,[6] patient monitors are divided into three categories:

- Basic – includes measurement parameters such as noninvasive blood pressure (NIBP) and oxygen saturation (SpO2), but not electrocardiogram (ECG) (with accessories).
- Intermediate – includes 5 measurement parameters: NIBP, SpO2, ECG, respiratory rate (RR), and temperature (TEMP) (with accessories).
- Advanced – includes 7 measurement parameters: NIBP, SpO2, ECG, RR, TEMP, carbon dioxide (CO2), and invasive blood pressure (IBP) (with accessories)

Similarly, in Vietnam, patient monitors are categorized by the number of parameters. Most common types are as follow:

- Patient monitor with 5 measuring parameters
    - Without ECG, includes SpO2, RR, TEMP, NIBP, pulse rate (equivalent to WHO "Basic" model).
    - With ECG, includes SpO2, RR, TEMP, NIBP (equivalent to WHO "intermediate" model).
- Patient monitor with 6 measuring parameters – includes ECG, SpO2, RR, TEMP, NIBP, and IBP/CO2.
- Patient monitor with 7 measuring parameters (equivalent to WHO "advanced" model).

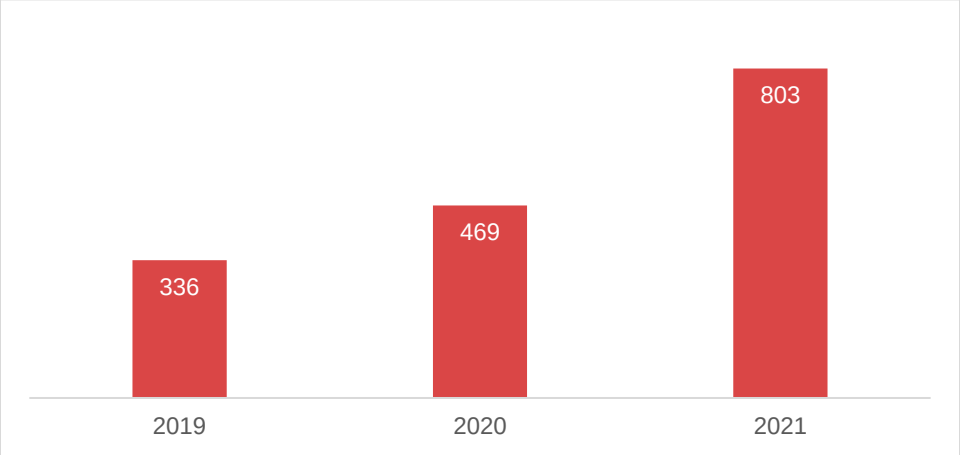
For additional information regarding patient monitor specification, please refer to the WHO Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications.[6]

Overview of Vietnam market

In Vietnam, 100 percent of patient monitors used are currently imported from overseas and sold via local distributors. Survey results from 993 health facilities in Vietnam demonstrated that there are 18,804 functioning patient monitors.[7] According to the MOH financial disclosure e-portal, approximately 336 patient monitors were procured in 2019 by health facilities, 469 monitors in 2020 (50 percent increase comparing to 2019), and 803 monitors in the first 11 months of 2021 (71 percent increase comparing to

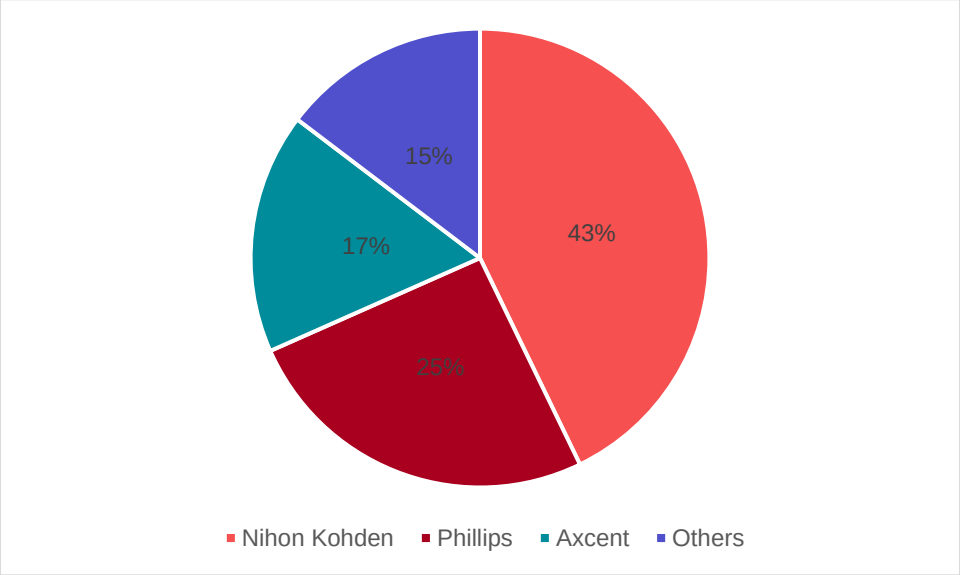
2020), as shown in Figure 4. In addition, in 2021, it is estimated that over 150 patient monitors were procured and donated to hospitals by private companies.[12,13,14,15]

Figure 4. Patient monitors procured by health facilities between 2019–2021.



In total, as per the listing price database, there are approximately 60 distributors offering over 100 patient monitor models from 50 different brands. However, between 2019 and 2021, 85 percent of 1,609 patient monitors procured by health facilities are models from three companies—Nihon Kohden, Phillips, and Axcent Medical, as shown in Figure 5. Patient monitors with 5 parameters with ECG (equivalent to WHO "intermediate" models) are the most common, accounting for 71 percent of the total procured devices.

Figure 5. Procurement by patient monitor brand (2019–2021).



**Based on statistics of 1,609 patient monitors procured.*
**Other brands include Edan, Draegerwerk Co, GE, Shenzhen Mindray, WelchAllyn, etc.*

Considerations for product selection

In this document, we will focus on patient monitors with 5 or 7 parameters including ECG (WHO intermediate and advanced models equivalent), due to the large ratio of these devices procured in the last 2 years and offered in the market. Key considerations when procuring patient monitors are summarized in Table 5. It should be noted that, depending on the context and functional and operational need in each hospital/province, considerations when procuring patient monitors may vary.

Table 5. Procurement considerations for patient monitors.

Considerations	Critical attributes	Overview of models procured between 2019 and 2021
Quality standard	ISO 13485 certification or equivalent. Registration in SRA market (FDA, CE…). Free sales certificate (FSC) or certificate for exportation from manufacturing country's authority.	All models have ISO 13485 certification and are SRA approved.
Price	Competitive pricing with regard to provided features/configurations.	See "Aggregated price range" section.
Ability to service the market	• Inventory readily available locally or acceptable order lead time (depending on order urgency) if product is not stocked locally. • Availability of after-sales services (maintenance, installation, and warranty for minimum 2 years). • Options for bundled accessories and consumables and individual spare parts. • Payment requirements.	• Most suppliers only offer warranty for 1 year (less than the minimum 2 years recommended period by WHO). • Selected models are stocked by local distributors. If order quantity exceeds the inventory stock, a longer lead time will apply (2–3 months). • Consumables and spare parts such as SpO2 probes, blood pressure cuffs, and ECG cables are available from selected brands. • A prepayment ranging from 30%–50% of the contract value is often required. • All distributors surveyed that sell patient monitors offer after-sales services such as installation, training, repair, and maintenance.
Functional requirements	Prioritization of critical elements for the context of use, including but not limited to: • Have all desired parameters: ECG, NIBP, SpO2, PR, RR, TEMP, and IBP/EtCO2 if required.	• Model screen size: Most of the devices have 12" LCD/TFT screens. However, models with 10" or 15" screens are also available. Touch screen is available in selected models.

	• Suitable measurement range, resolution, and accuracy for the desired parameters, for example:
	  ○ NIBP/IBP: measurement range between 30–300 mmHg, minimum gradation 1 mmHg.
	  ○ TEMP: Temperature range at least between 30°C to 40°C, minimum gradation 1°C.
	  ○ Pulse rate detection to include the range: 30–250 bpm; resolution 1 bpm or less; accuracy within ± 5 bpm.
	  ○ Respiration rate measurement range at least 0–100 bpm, minimum gradation 1 bpm.
	• Suitable adjustable audio and visual alarms for patient monitoring.
	• Appropriate display features: continuous measurement and display on screen of all parameters with trend displayed of each parameter.
		• NIBP range: All models can measure NIBP up to 270 mmHg. Selected models (9/12) can measure up to 300 mmHg.
		• Advanced features such as pacemaker detection are available in selected models as an option.

Operational requirements	Based on technical specifications: • Capability to operate within an ambient temperature between 10°C–40°C and relative humidity between 15%–85% (up to 90% highly desirable). • Possess replaceable or rechargeable battery power, 220V input power, and protections against defibrillator discharges and electrosurgical units. • Accessories and consumables necessary for full functionality are included in the bid.	• Most models can operate in humidity range up to 80% and temperature range up to 40°C. Selected models (4/12) can operate in higher humidity range, up to 90% or higher. • Accessories for ECG, SpO2, temperature, NIBP, and PR measurements (and chargers) are included in the initial package.

Abbreviations: bpm, beats per minute; CE, certification mark for European Union; ECG, electrocardiogram; EtCO2, end-tidal carbon dioxide; FDA, US Food and Drug Administration; FSC, free sales certificate; IBP, invasive blood pressure; ISO, International Standards Organization; LCD/TFT, liquid crystal display/thin film transistor; NIBP, noninvasive blood pressure; PR, pulse rate; RR, respiratory rate; SpO2, oxygen saturation; SRA, stringent regulating authority; TEMP, temperature; WHO, World Health Organization.

Identified suppliers

Based on the analysis, a list of prioritized suppliers is presented in Table 6. Due to the high number of suppliers in the market, not all qualified suppliers may have been included in this list. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Table 6. Identified suppliers for patient monitors.

Brand and model (Brand origins)	Certification		Features/options				Stock			
	ISO 13485	CE/ FDA	ECG	IBP	EtCO2	Screen size (")	Monthly production capacity	Inventory*	Lead time	Distributor
Nihon Kohden (Japan)										
BSM-3562*	Yes	Yes	Yes	Yes	Yes	12	NA	20	12–14 weeks if order >20 pieces	Nipon Vietnam
PVM-2701	Yes	Yes	Yes	No	No	10	NA	NA	NA	
SVM-7623	Yes	Yes	Yes	No	No	10	NA	NA	NA	
Philips (Holland)										
Efficia CM10*	Yes	Yes	Yes	Yes	Yes	10	2,000	130	7–35 days for 100 pieces	Nhat Minh Medical JSC, TNT Commerce and Technology
Efficia CM120*	Yes	Yes	Yes	Yes	Yes	12	2,000	80		
IntelliVue MX450*	Yes	Yes	Yes	Yes	Yes	12	500	500		
IntelliVue MX430*	Yes	Yes	Yes	Yes	Yes	12	500	100		
GE (United States)										
B20i	Yes	Yes	Yes	Yes	Yes	10	NA	NA		Viet Medical
B105*	Yes	Yes	Yes	Yes	Yes	10	100	10	Depending on the order time	
B125*	Yes	Yes	Yes	Yes	Yes	12	100	20		
Advanced Instrumentations Inc (United States)										
PM-2000XL PRO	Yes	Yes	Yes	Yes	Yes	15	NA	NA	NA	Vimedimex Pharmaceutical Ltd

Trismed (Korea)										
Vitapia 7000K	Yes	Yes	Yes	Yes	Yes	12	NA	NA	NA	Medical Equipment and Technology Vietnam Ltd
aXcent medical GmbH (Germany)										
CETUS x 12	Yes	Yes	Yes	Yes	Yes	12	NA	NA	NA	Nhat Nam Medical Equipment Ltd
Infinium Medical (USA)										
OMNI III	Yes	Yes	Yes	Yes	Yes	15	NA	NA	NA	Meditronic, TPCOM

Abbreviations: CE, certification mark for European Union; ECG, electrocardiogram; EtCO2, end-tidal carbon dioxide; FDA, US Food and Drug Administration; IBP, invasive blood pressure; ISO, International Standards Organization; NA, not applicable.
**Inventory was last updated in November 2021.*

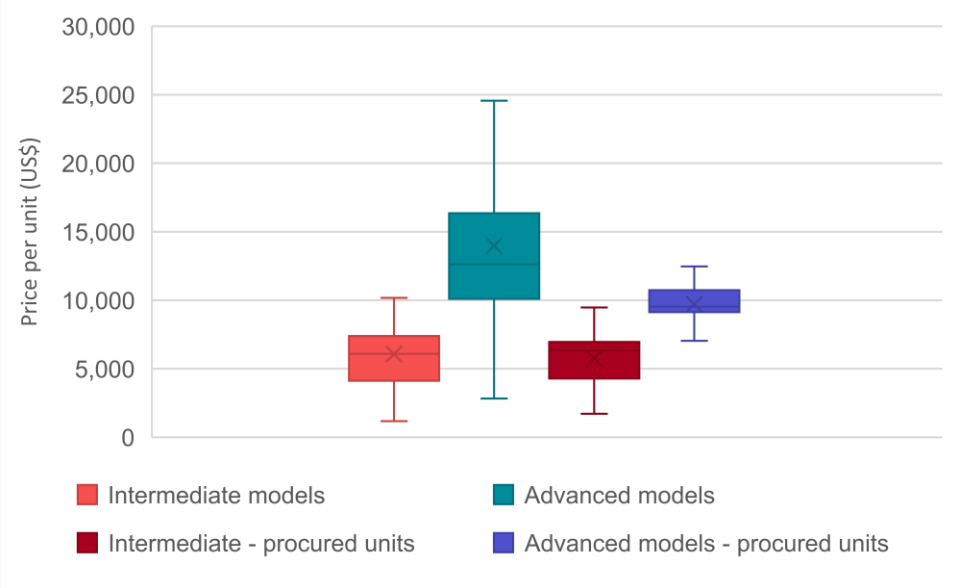
For the remaining models, please contact local distributors for inventory availability.

Aggregated price range

Prices should be taken as indicative only and will be highly variable depending on urgency, volumes required, and other contextual factors. Figure 6 shows the anonymized pricing data of all models in the market against that of procured models.

According to the MOH list price database, prices for intermediate models mostly ranged from $4,100 to $7,300, and advanced models from $10,000 to $16,000. The median procured price for an intermediate model is $6,350 and for an advanced model is $9,540. All prices are retail price, inclusive of value-added tax (VAT), import tax, and spares and accessories (the exact quantity and type may vary between suppliers). The initial contract often includes product installation and training as well as a warranty of 12 months. Accessories (such as ECG cables; SpO2, temperature, and EtCO2 probes; NIBP cuffs; chargers, etc.) are often also provided.

Figure 6. Aggregated price range and purchase price for patient monitors, by subtype.



**WHO Catalogue indicative price – intermediate ($2,062); advanced ($4,006).*[10]

Overall, patient monitor prices may vary greatly by configuration, accessories, spare part options, country of origin, brand reputation, etc. According to the analysis, the following factors may result in price differences among the models:

- Screen size: For intermediate models of the same brands, units with a 12" screen will be approximately $283 higher in price (median value) than those with a 10" screen and $1,450 lower in price (median value) than those with a 15" screen.
- Manufacturing country: Intermediate models manufactured in Korea have the lowest price, followed by China ($780 higher), US ($2,100 higher), Germany ($3,700 higher), and Japan ($5,100 higher).
- Brand origins: Intermediate models by Chinese and Korean brands are the cheapest, followed by US, German, and Japanese brands.

Pulse oximeter

Product overview

Pulse oximeters (PO) are designed to monitor blood oxygen saturation (SpO2) levels through the principle of differential light absorptions.[16] Pulse oximeters can be used to detect hypoxemia as well as to provide continuous monitoring of patients' SpO2 levels.

Pulse oximeters can be divided into three broad categories:

- Fingertip oximeters: the most compact size and lowest price oximeter type. Operate on battery. SpO2 is measured by clipping the device onto a patient's fingertip. Only suitable for spot check. According to Decision 2626 by the MOH, COVID-19 treatment centers are recommended to have 10 fingertip POs per 20 beds for light/no symptom or medium patients.[5]
- Handheld oximeters: portable pulse oximeter with display screen, cables, and probes of various size. Could be used for both spot check and continuous monitoring (alarm function must be activated).
- Tabletop – stationary device: May include other parameters such as temperature or blood pressure. Mostly use for continuous monitoring.

For additional information regarding pulse oximeter specification, please refer to the WHO Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications.[6]

Overview of Vietnam market

In Vietnam, 100 percent of pulse oximeters are imported and sold via distributors. Pulse oximeters were not frequently purchased by hospitals, as the device's function overlaps with that of patient monitors. The survey results of 993 health facilities demonstrated that approximately 9,049 functioning POs are available. Between 2019 and 2020, according to the data from the MOH financial disclosure e-portal, only 24 POs were procured by health facilities, but this may not be the full figure of the total purchases. In 2021, there was a significant increase in demand for POs due to the fourth COVID-19 outbreak, which started on April 27. By November 2021, 2,054 POs had already been procured by health facilities, a 20-fold increase compared to the previous 2 years. In addition, 18,900 POs were donated to hospitals between June and September 2021 by private corporations.[8,9]

Among all the POs procured in the last 3 years, 96 percent are the fingertip type. Based on the listing price database, in Vietnam there are 25 brands, with 50 different POs models of all types. Based on the previous years' procurement data, Heal Force Bio-Meditech Holdings Limited, Shenzhen Medical Technology, Nonin, and Suzhou Yong Kang are the four brands that are most frequently purchased by health facilities.

Considerations for product selection

Selection criteria to inform product procurement decisions are summarized in Table 7. It should be noted that, depending on the context and functional and operational need in each hospital/province, considerations when procuring pulse oximeters may vary.

Table 7. Procurement considerations for pulse oximeters.

Considerations	Critical attributes	Overview of models procured in Vietnam between 2019–2021
Quality standard	ISO 13485 certification or equivalent. Registration in SRA market (FDA, CE…). Free sales certificate (FSC) or certificate for exportation from manufacturing country's authority.	All models have CE/ISO13485 certification.
Price	Competitive pricing with regard to provided features/configurations.	See "Aggregated price range" section.
Ability to service the market	**Applicable to all types:** • Inventory readily available or acceptable order lead time (depending on order urgency) if product is stocked locally. • Suitable payment requirement. **Applicable to handheld and tabletop POs:** • Availability of after-sales services (maintenance, installation, and warranty for minimum 2 years). • Options for bundled accessories and consumables and individual spare parts (probes, cables…).	• Selected models are stocked locally. • Order lead time will be between 2–4 weeks if inventory is available; and 2 months or more if local stock is not available. • Most handheld and tabletop POs have 2-year manufacturer warranty and 3-year warranty for selected brands. However, most distributors only offer a 1-year warranty.

Functional requirements	Prioritization of critical elements for the context of use, including but not limited to:
	Applicable to all types
	• Features relating to SpO2 and pulse rate measurement range and accuracy:
	  ○ SpO2: detection range to include 70%–100%, resolution of 1% or less and accuracy within ± 3% in the measurement range.
	  ○ PR: detection to include the range: 30–240 bpm, resolution 1 bpm or less, and accuracy within ± 3 bpm in the measurement range.
	Applicable to handheld and tabletop
	• Display with main parameters: % SpO2, pulse rate, plethysmography waveform, and alarm messages.
	• Ability to be used with different-sized probes for adult and pediatric patients.
	• Audio and visual alarm for high/low threshold of the measured parameters and for operational errors.
		Fingertip POs
		• All models offer SpO2 detection including 70%–100% range and PR detection between at least 30–240 bpm.
		• Selected models (5/9) have ingress protection degree of IP22–IP32.
		Handheld and tabletop POs
		• All models offer PR detection between 30–250 bpm and SpO2 detection including 70%–100% range.
		• Most models (6/11) are suitable for detection in low-perfusion conditions.
		• Selected models (5/11) have IPX2 ingress protection.

Operational requirements	Based on technical specification: • Capability to operate within an ambient temperature between 10°C–40°C and relative humidity between 15%–85% (up to 90% highly desirable). • Possess replaceable or rechargeable battery power of at least 12 hours running time on battery for fingertip and handheld POs and at least 6 hours on battery for tabletop POs. • Inclusion of accessories such as battery, probes, cables, etc.	Most can operate in humidity up to 80%. Selected models (13/20) could operate in humidity up to 95%. **Fingertip POs** • All can operate for at least 12 hours on battery. Selected models (5/9) can operate for 30 hours or more. **Handheld POs** • Models purchased could operate for at least 8–14 hours on battery. Selected models could operate continuously for 80 hours with battery upgrade. **Tabletop POs** • Only selected models (3/5) could operate continuously on battery for 6 hours or more.

Abbreviations: bpm, beats per minute; CE, certification mark for European Union; FDA, US Food and Drug Administration; FSC, free sales certificate; IP, ingress protection; ISO, International Standards Organization; PO, pulse oximeter; PR, pulse rate; SpO2, oxygen saturation; SRA, stringent regulating authority.

Identified suppliers

Based on the analysis, a list of prioritized suppliers is presented in Table 8. Due to the high number of suppliers in the market, not all qualified suppliers may have been included in this list. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Table 8. Identified suppliers for pulse oximeters.

Company/Model (Brand origin)	Type	CE/FDA approved	Battery continuous running times	Distributor
Acare Technology Co., Ltd. (Taiwan)				
AE-02	Fingertip	Yes	30 hours	DMED Medical Equipment Ltd; Viet Tan Medical Equipment & Sciences Ltd
AH-MX	Handheld	Yes	14 hours	
Advanced Instrumentations, Inc. (United States)				
PO-100B	Handheld	Yes	36–48 hours	Thanh An Trading and Technology Investment Co Ltd
Beurer (Germany)				
PO-30	Fingertip	Yes	36.5 hours	Linh Son Trading and Investment Co Ltd, AT&T Co Ltd
PO-40	Fingertip	Yes	12 hours	
Bistos Co., Ltd. (Korea)				
BT-710	Handheld	Yes	8 hours	Thinh Phat Medical Device and Consumable Ltd Co
Infinium Medical Inc. (United States)				
CLEO	Tabletop	Yes	3 hours	Cuu Long Medical Equipment Trading Co Ltd

Mediana Co., Ltd (Korea)				
10005941-SG	Tabletop	Yes	5–10 hours	IDS MEDICAL SYSTEMS Vietnam
Mediblu Medical LLC (United States)				
MO1	Handheld	Yes	10 hours	Eastern Trading and Medical Services
Nonin Medical Inc (United States)				
9590	Fingertip	Yes	36 hours	Dinh Giang Medical Services Ltd
2500, 2500A*	Handheld	Yes	40–80 hours	
7500, 7500 FO	Tabletop	Yes	16 hours	
9700	Tabletop	Yes	12 hours	
Shenzhen Aeon Technology Co., Ltd (China)				
Kaneko	Fingertip	Yes	30 hours	Thai Hung Export and Import Co
Shenzhen IMDK Medical Technology Co., Ltd. (China)				
A2	Fingertip	Yes	20 hours	Nam Dinh Pharmaceutical Devices and Medical Services JSC
Shenzhen Jumper Medical Equipment Co., Ltd (China)				
Oxy200	Fingertip	Yes	30 hours	Ha An Phat Medical Devices Trading Co Ltd
Shenzhen Yimi Life Technology (China)				
YM103*	Fingertip	Yes	NA	Tay Bac A
Heal Force Bio-meditech Holdings Limited (China)				
Prince-100A	Fingertip	Yes	50 hours	Biomedical Equipment Co Ltd

Abbreviations: CE, certification mark for European Union; FDA, US Food and Drug Administration; NA, not applicable.
**Local inventory available (last updated in November 2021).*

For the remaining models, please verify with local distributors for local inventory availability.

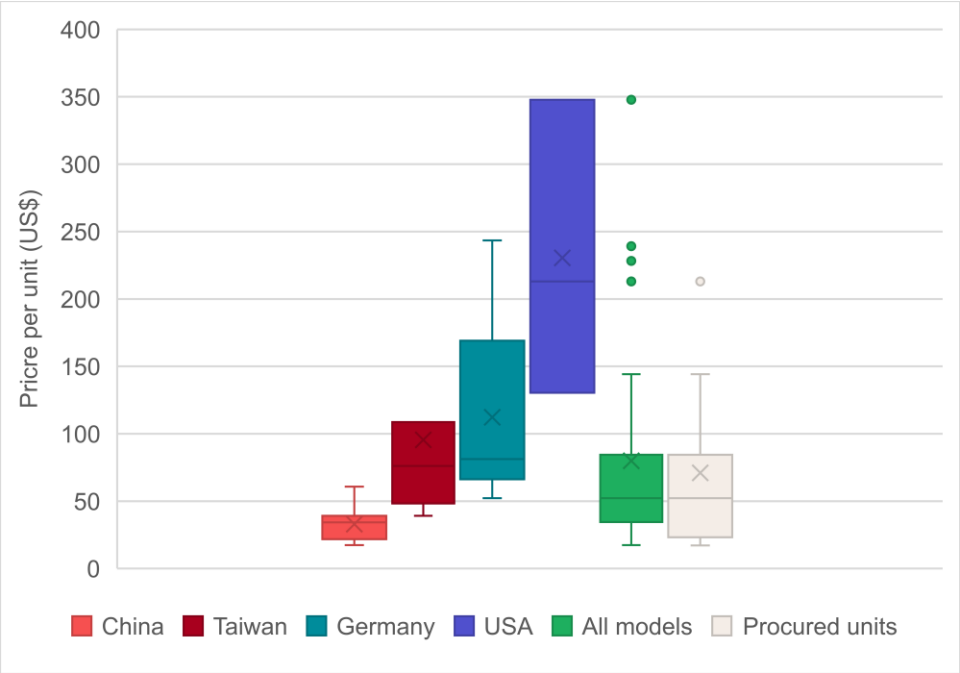
Aggregated price range

Prices should be taken as indicative only and will be highly variable depending on branding, configuration, urgency, volume required, and other contextual factors.

Fingertip pulse oximeters

Fingertip PO price mostly falls within $34 to $82, with a median procured price of $52. Figure 7 shows the aggregated price range of different fingertip POs, by brand origins. It was found that fingertip POs from Chinese brands are often of the lowest price range and US brands of the highest price range.

Figure 7. Aggregated price range and purchase price for fingertip pulse oximeters, by brand origin.

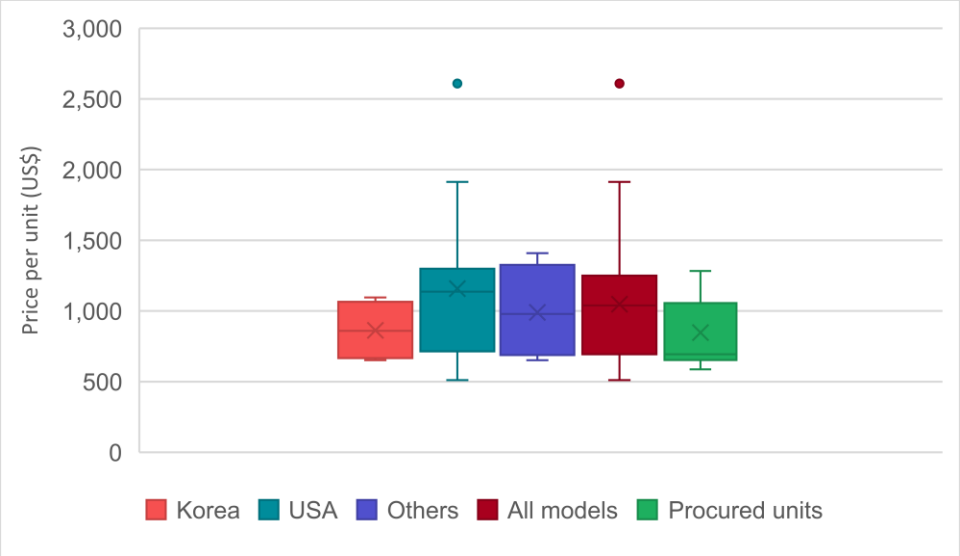


**WHO Catalogue indicative price is $21.20.*[10]

Handheld pulse oximeters

Aggregated price range for handheld POs are summarized in Figure 8. Handheld PO prices are mostly between $700 and $1,200, with a median procured price of $650. Prices from Korean brands on average are of lower range compared to those from the US.

Figure 8. Aggregated price range for handheld pulse oximeters, by brand origin and purchase price.

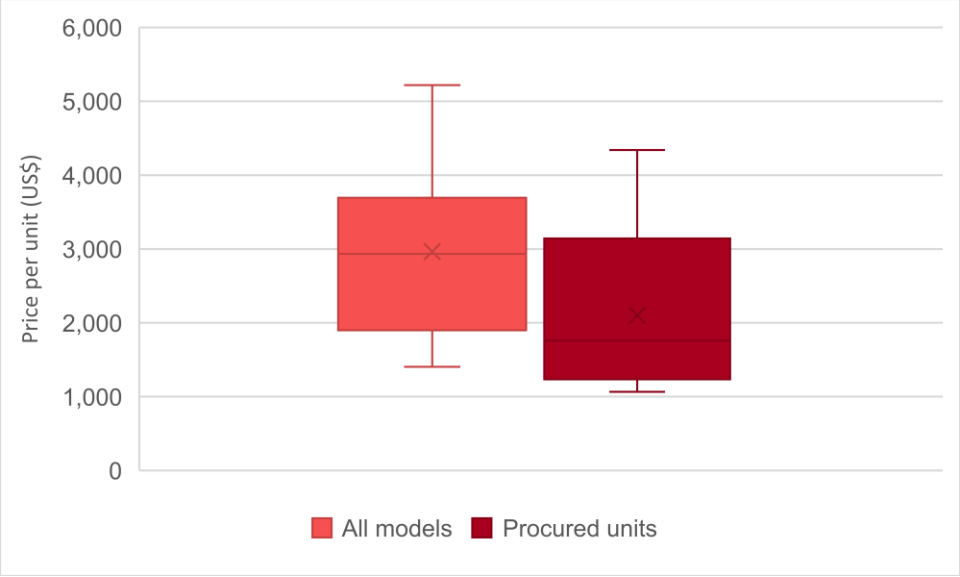


**WHO Catalogue indicative price is $317.17.*[10]

Tabletop pulse oximeters

All tabletop POs found in the listing price database are from American brands. Prices mostly range between $1,700 and $3,400, and the median procured price is $1,760, as shown in Figure 9.

Figure 9. Aggregated price range and purchase price for tabletop pulse oximeters.



**WHO Catalogue indicative price is $1,650.*[10]

Delivery interface consumables

Product overview

Three oxygen delivery interfaces have been indicated as priority medical devices in the treatment of severe COVID-19 patients: nasal oxygen cannula (nasal prongs), venturi masks, and masks with reservoir bag.[6] These consumables are used to deliver oxygen to patients in different ways:[16]

- Nasal cannulas are single-use, nonsterile devices used to deliver air/oxygen mixtures through the nasal cavity when connected to an oxygen source. Nasal cannulas are often the preferred options for neonates and children under 5 years old. Typical flow rate ranges from 1 to 6 LPM and fraction of inspired oxygen (FiO2) ranges from 24 to 44 percent.
- Venturi masks allows oxygen to be delivered to patients with precise measurement of FiO2. Flow rate ranges from 2 to 15 LPM with the FiO2 reach 24 to 60 percent.**Error! Bookmark not defined.**
- Masks with reservoir bags deliver higher concentrations of oxygen directly to the upper airway of the patient. When using this delivery method, the flow rate must be over 10 LPM at all times to avoid reservoir bag deflation, and FiO2 could reach 80 to 95 percent.

This landscape provides a market overview of all three product types as outlined in the WHO technical specifications.

For more information regarding the specification of delivery interfaces, please refer to the WHO Priority Medical Devices List for the COVID-19 Response and Associated Technical Specifications.[6]

Overview of Vietnam market

Four local manufacturers that possess capacity to manufacture delivery interface consumables were identified. There are also imported products, mostly from Chinese manufacturers. In total, over 31 manufacturers were found based on the listing price database and our survey results.

Consideration for product selection

Selection criteria to inform product procurement decisions are summarized in Table 9.

Table 9. Procurement selection criteria for delivery Interface consumables.

Considerations	Critical attributes	Overview of models procured in Vietnam between 2019–2021
Quality standard	• ISO 13485 certification or equivalent. • Registration in SRA market (FDA, CE, etc.). • Free sales certificate (FSC) or certificate for exportation from manufacturing country's authority	All models have ISO 13485 certification. Imported models often have CE/FDA certificate; most Vietnamese manufacturers do not hold a CE/FDA certificate.
Price	Competitive pricing with regard to provided features/configurations.	See "Aggregated price range" section.
Ability to service the market	• Production capacity and capability to either scale or allocate required	• Local manufacturers could often complete orders within 1 weeks.

	volumes for procurement, or inventory readily available or acceptable order lead time (depending on order urgency), if product is stocked locally. • Suitable payment requirement.	• For most imported models, inventory is available locally. However, if local stock is not available, order lead time may be 4–8 weeks. • Postpaid is accepted by selected manufacturers/distributors.
Functional requirements	Prioritization of critical elements for the context of use—specifically, for delivery interfaces—include but are not limited to: • Compatibility with standard connections. • Low-resistance design. • Flow capacity. • Malleability.	Functional specifications are often not listed in supplier's website or catalogue.
Operational requirements	Capability to be used within a specific temperature range and range of relative humidity and elevation; with appropriate sizing, materials, and components (including valves, connectors, etc.) and with oxygen concentration / oxygen-to-air mixture compatibility. These should be based on specific geography and context of use.	Multiple sizing, both for adults and children, are often available. Products are made of medical PVC.

Abbreviations: CE, certification mark for European Union; FDA, US Food and Drug Administration; FSC, free sales certificate; ISO, International Standards Organization; PVC, polyvinyl chloride.

Identified suppliers

Based on the analysis, a list of prioritized suppliers is presented in Table 10. Due to the high number of suppliers in the market, not all qualified suppliers may have been included in this list. Brands that are prioritized are those that were previously procured in the last 3 years, locally manufactured brands, and those that were identified via our supplier survey/interviews.

Table 10. Identified suppliers for delivery interfaces.

Company (Brand origin)	Products	ISO 13485	CE/ FDA	Monthly production capacity	Inventory	Order lead time	Distributors
Vietnam Medical Plastic JSC (Vietnam)	Cannula - adult and pediatric*	Yes	No	260,000	86,000	2 days	Vietnam Medical Plastic JSC, Thanh Hoa Medical Equipment and Consumables JSC
	Oxygen mask with reservoir*	Yes	No	390,000	90,000	7 days	
Khang Nguyen Medical Consumables JSC (Vietnam)	Cannula	Yes	No	NA	NA	NA	
An Phu Pharmaceutical and Medical Devices JSC (Vietnam)	Cannula	Yes	No	NA	NA	NA	
Omiga Medical Consumables JSC (Vietnam)	Cannula*	Yes	No	100,000	20,000	1 day	Same as manufacturers
ZIBO EASTMED HEALTHCARE (China)	Cannula*	Yes	Yes	NA	30,000	60 days	Hung Phat Medical Devices Ltd Co
	Oxygen mask with reservoir*	Yes	Yes	NA	5,000	60 days	
Ningbo Great Mountain Medical Instruments Co., Ltd (China)	Oxygen mask with reservoir*	Yes	Yes	NA	14	7 days	Bao Chau Medical Devices Ltd Co
Ningbo Foyomed Medical Instruments Co., Ltd (China)	Cannula*	Yes	Yes	NA	1,500	4–8 weeks (if not available locally)	An Loi Trading and Medical Devices Ltd Co
	Oxygen mask with reservoir*	Yes	Yes	NA	10,000		
Ningbo Greetmed Medical Instruments Co., Ltd. (China)	Cannula	Yes	Yes	NA	NA	NA	Hoang Loc Trading and Technical Services Ltd Co
	Oxygen mask with reservoir	Yes	Yes	NA	NA	NA	
Hitec Medical Co., Ltd (China)	Oxygen mask with reservoir	Yes	Yes	NA	NA	NA	Dat Viet Thanh JSC
	Venturi mask	Yes	Yes	NA	NA	NA	
Flexicare (Group) Limited (United Kingdom)	Oxygen mask with reservoir	Yes	Yes				Hoang Viet Long Medical Devices and Consumables Ltd Co
	Venturi mask	Yes	Yes	NA	NA	NA	
Intersurgical (United Kingdom)	Oxygen mask with reservoir	Yes	Yes	NA	NA	NA	Viet Medical Materials Ltd Co
	Venturi mask	Yes	Yes	NA	NA	NA	
Besmed Health Business Corp (Taiwan)	Oxygen mask with reservoir	Yes	Yes	NA	NA	NA	Dang Bao Medical Devices Ltd Co
	Venturi mask	Yes	Yes	NA	NA	NA	

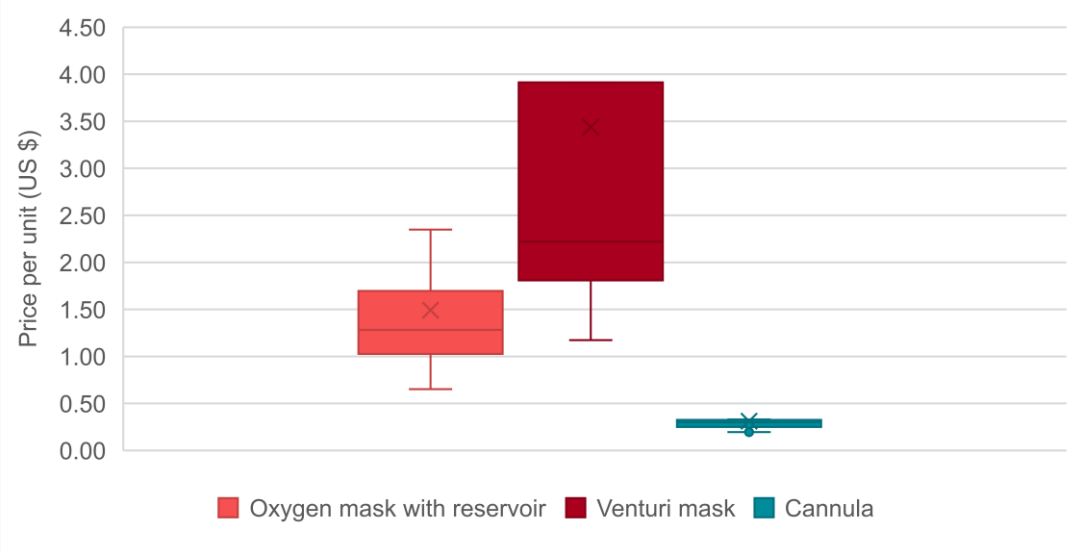
Abbreviations: CE, certification mark for European Union; FDA, US Food and Drug Administration; ISO, International Standards Organization; NA, not applicable.
**Local inventory available (last updated in November 2021). For the remaining models, please verify with local distributors for local inventory availability*.

Aggregated price range

Prices are indicative and could vary depending on many factors. Based on the analysis of the listing price database and the survey results, price ranges for delivery interface consumables are as below (and illustrated in Figure 10):

- Cannula: $0.20–$0.33, with a median price of $0.30 per unit.
- Oxygen mask with reservoir: $0.65–$2.35, with a median price of $1.28 per unit.
- Venturi mask: $1.17–$3.90, with a median price of $2.22 per unit.

Figure 10. Aggregated price range for delivery interface consumables.



**WHO Catalogue indicative price per unit: oxygen mask with reservoir is $0.78; Venturi mask is $1.20; cannula is $0.20–$0.21.*[10]

Discussion and recommendations

Overall, only a few local manufacturers were present in the market but a diverse range of imported respiratory care equipment was still offered in Vietnam. Most products procured are approved by stringent regulatory authorities such as CE or US FDA and are sold via local distributors. The landscape of local distributors in Vietnam is quite fragmented, with a large number of local distributors present. All local distributors offer a wide range of product types and services (such as installation, maintenance, and repair) and often represent many brands. With regard to the procurement management system, the two recently launched e-portals (for listing price and financial disclosure results) managed by MOH are useful tools that allow better understanding of health facilities' procurement patterns and the price range of available products. Nevertheless, these analyses demonstrated that there are still opportunities to address the following observations that may lead to inefficient purchasing:

Medical equipment may be procured at facility, provincial, or national level. Purchase quantity may vary significantly between each procurement order and, thus, there are instances where medical equipment is purchased in small quantities (1 to 2 items).

- There is a wide range in the prices of procured products within the same technology. In comparison to WHO Catalogue indicative prices, the median procured prices of specific equipment such as patient monitors and oxygen concentrators are considerably higher.
- As most products are imported and sold via distributors, in comparison to the ex-factory price, there may be high markup on selected items by the distributors (up to 100 percent of the ex-factory price).
- A large amount of equipment is donated via private and multilateral organizations, particularly during the COVID-19 pandemic.

Based on the above analysis and observations, the survey team has the following recommendations regarding RC equipment in Vietnam:

- Continue to develop and utilize the listing price and financial disclosure e-portals:
    - Integrate an equipment management system with the financial disclosure e-portal to (1) track equipment availability across facilities and (2) enable the forecasting of future medical equipment needs, which could also help with annual budgeting.
    - Proactively assist health facilities and provinces in meeting e-portal reporting requirements so these platforms capture all public-sector medical device procurement in Vietnam.
- Consolidate orders among health facilities or provinces with low demand to enable better price negotiation power through large quantity orders.
- Collect international pricing data and conduct cross-country price comparisons to ensure in-country prices are not inflated, and if they are, determine the causes of these relatively high prices.
- Develop clear procurement criteria to facilitate selection of products with competitive prices and suitable features.

- Encourage local manufacturers to perform international standard testing to widen local as well as international market share.
- Have a mechanism to effectively distribute and track equipment donated by external organizations. Data on donated equipment should also be entered into the financial disclosure e-portal.

Limitations of analysis

There are several limitations to keep in mind when considering the report's key analysis:

- As there are many distributors in Vietnam, not all have been surveyed.
- Many products and brands are offered in the market. Not all have been assessed and thus, it is possible that some high-quality suppliers may not be included in the list.
- Prices of equipment vary significantly based on features and configurations. As such, it is challenging to make apple-to-apple comparison between products.
- Procurement data from the e-portals may not be up-to-date due to delays in entering data, missing data from previous years, etc. and thus the procurement quantities in reality may be different.
- Medical equipment donations from individuals and private, multilateral, and nonprofit organizations are not well tracked and thus may not be fully included in the report.
- Market share analysis mostly considered purchases made by health facilities. In reality, specific products may also be bought by households, organizations, and other care-center facilities.

Appendix

Tables 11, 12, and 13 list the equipment, consumables, and companies surveyed, respectively.

Table 11. List of equipment surveyed.

Equipment type	Equipment subtype
Ventilator	Invasive ventilator
	Invasive ventilator - transport
	CPAP/BiPAP
	HFNC
Oxygen concentrator	Oxygen concentrator, 5 LPM
	Oxygen concentrator, 8 LPM
	Oxygen concentrator, 10 LPM
Pulse oximeter	Fingertip pulse oximeter
	Handheld pulse oximeter
	Tabletop pulse oximeter
Patient monitor	Patient monitors with ECG
	Patient monitor without ECG
Laryngoscope	Laryngoscope (direct or video type)
Suction unit	Electrical suction unit
	Manual suction unit
Oxygen conditioning device	Flowmeter, Thorpe tube, for pipe oxygen 0–15 L/min
	Flow splitter, 5 flowmeters 0–2 L/min, for pediatric use
Oxygen system	Liquid storage tank
	Gas cylinder
	Central gas system
	PSA plant

Abbreviations: BiPAP, bilevel positive airway pressure; CPAP, continuous positive airway pressure; ECG, electrocardiogram; HFNC, high-flow nasal cannula, LPM, liters per minute; PSA, pressure swing adsorption.

Table 12. List of consumables surveyed.

Consumable name
Catheter, nasal, 40 cm, with lateral eyes, sterile, single use; different sizes: 10 Fr, 12 Fr, 14 Fr, 16 Fr, 18 Fr
Nasal oxygen cannula, with prongs, adult and pediatric
High-flow nasal cannula (HFNC)
Oxygen mask, with connection tube, reservoir bag and valve, high-concentration single use (adult)
Venturi mask, with percent O2 lock and tubing (adult)
Compressible self-refilling ventilation bag, capacity > 1,500 mL, with masks (small, medium, large)
Airway, nasopharyngeal, sterile, single use, set with sizes of 20 Fr, 22 Fr, 24 Fr, 26 Fr, 28 Fr, 30 Fr, 32 Fr, 34 Fr, 36 Fr
Airway, oropharyngeal, Guedel, set with sizes of No. 2 (70 mm), No. 3 (80 mm), No. 4 (90 mm), No. 5 (100 mm)
Laryngeal mask airway (LMA)
Colorimetric end-tidal CO2 detector, single use (adult)

Table 13. List of companies surveyed.

No.	Company	Type	Surveyed	Interviewed	Note
1	Công ty TNHH Chuyển giao công nghệ và dịch vụ y tế	Manufacturer	Yes	Yes	
2	Công ty Cổ phần Dược phẩm và Thiết bị Y tế An Phú	Manufacturer	Yes	Yes	*
3	Công ty Cổ phần Thương mại Cổng Vàng	Distributor	Yes	No	**
4	Công ty TNHH Vật tư Khoa học Kỹ thuật Đông Dương	Distributor	Yes	Yes	
5	Công ty Cổ phần Công nghệ Tân Cương	Distributor	Yes	Yes	*
6	Công ty Cổ phần Thiết bị Y tế Đông Á	Distributor	Yes	Yes	
7	Công ty TNHH Đầu tư Công nghệ Minh Phú	Distributor	Yes	Yes	*
8	Công ty Cổ phần Y tế Nhất Minh	Distributor	Yes	Yes	
9	Công ty TNHH Thiết bị Y tế Hương Sơn	Distributor	Yes	No	**
10	Công ty TNHH Thiết bị Y tế Tràng Thi	Distributor	Yes	No	
11	Công ty TNHH Phú Thái	Distributor	Yes	No	*
12	Công ty Cổ phần đầu tư và công nghệ Bắc Hà	Distributor	Yes	No	
13	Công ty Cổ phần Vietmedical	Distributor	Yes	Yes	*
14	Công ty TNHH Vật tư Y tế Omiga	Manufacturer	Yes	No	
15	Công ty Cổ phần Nhựa Y tế Việt Nam	Manufacturer	Yes	No	
16	Công ty Cổ phần Dịch vụ Công nghiệp Hàng Hải	Distributor	Yes	Yes	
17	Công ty Cổ phần Dược và Vật tư Y tế Bình Thuận	Distributor	Yes	No	
18	Văn phòng Đại diện Nipon Corporation tại TP. Hồ Chí Minh	Manufacturer (representative office)	Yes	No	
19	Công ty TNHH Thương mại - Dịch vụ Trang thiết bị Y tế Sài Gòn AST	Distributor	Yes	No	
20	Công ty TNHH Thương mại – Dịch vụ Y tế Định Giang	Distributor	Yes	No	
21	Công ty TNHH Thiết bị Y tế Thiên Nam	Distributor	Yes	No	
22	Công ty TNHH Kỹ thuật Và Thương mại Metran	Manufacturer (representative office)	Yes	No	
23	Công ty TNHH Trang thiết bị Y tế Hưng Phát	Distributor	Yes	No	
24	Công ty TNHH Philips Việt Nam	Manufacturer (representative office)	Yes	No	
25	Công ty TNHH Y tế Việt Tiến	Distributor	Yes	No	*
26	Mega Lifesciences (Việt Nam)	Distributor	Yes	No	
27	Công ty Cổ phần Thiết bị Y tế Wemed	Distributor	Yes	Yes	*
28	Công ty cổ phần công nghệ Tây Bắc Á	Distributor	Yes	No	
29	Công ty TNHH Khoa học và Kỹ thuật Olympic	Distributor	Yes	No	*
30	Công ty TNHH Thương mại và Công nghệ kỹ thuật TNT	Distributor	Yes	No	*
31	Công ty TNHH Thiết bị y tế DMED	Distributor	Yes	No	
32	Công ty TNHH TM Thiết bị y tế An Lợi	Distributor	Yes	No	
33	Công ty TNHH Trang thiết bị y tế miền Tây	Distributor	Yes	Yes	

34	Công ty TNHH đầu tư và phát triển Tùng Bách	Distributor	Yes	No	*
35	Công ty TNHH một thành viên trang thiết bị y tế Toàn Thư	Distributor	Yes	Yes	*
36	Công ty TNHH Thương mại và dịch vụ kỹ thuật Tài Lộc	Distributor	Yes	No	*
37	Công ty cổ phần trang thiết bị y tế Nguyễn Quốc	Distributor	Yes	No	*
38	Công Ty Tnhh Thiết Bị Y Tế Bảo Châu	Distributor	Yes	No	
39	Công Ty Tnhh Thiết Bị Y Tế Anh Khôi	Distributor	Yes	No	*
40	Công Ty Tnhh Thiết Bị Y Tế Nguyên Khang	Distributor	Yes	No	*
41	Công ty TNHH Draeger Việt Nam	Manufacturer (representative office)	Yes	No	
42	GE Vietnam	Manufacturer (representative office)	Yes	No	
43	Medtronic Vietnam	Manufacturer (representative office)	Yes	No	*
44	Becton, Dickinson and Company	Manufacturer (representative office)	Yes	No	*
45	Công ty TNHH Điện tử Meiko Vietnam	Manufacturer (representative office)	Yes	No	*

**Did not respond to the survey.*

***No longer sell the surveyed products.*

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