

# Safe Intra-hospital Transportation of Patients on Oxygen Therapy in the Context of the COVID-19 Pandemic

Transporte Seguro Intra-hospitalar de Paciente em Oxigenoterapia no Contexto da Pandemia de COVID-19  
Transporte Intrahospitalario Seguro de Pacientes en Oxigenoterapia en el Contexto de la Pandemia COVID-19

## RESUMO

**Objetivo:** Descrever as ações realizadas para promoção do transporte seguro intra-hospitalar de pacientes em oxigenoterapia em um grupo hospitalar público do sul do Brasil durante a pandemia do coronavírus. **Método:** Relato de experiência com apresentação das ações realizadas diante do déficit no fornecimento de oxigênio durante a pandemia do coronavírus. **Resultados:** Foi realizada reorganização dos processos de trabalho, orientação das equipes assistenciais sobre o manuseio dos cilindros de oxigênio para o transporte seguro dos pacientes e para redução do desperdício de insumos. A partir das ações implementadas obteve-se redução de 34,95% no número de recargas de oxigênio na instituição do 1º para o 2º trimestre de 2021 e de 14,86% do ano 2019 para 2022. **Conclusão:** As ações realizadas foram fundamentais para redução de eventos adversos no transporte intra-hospitalar de pacientes, além de reduzir o desperdício de insumos, com redução de custos em saúde e melhoria da segurança dos pacientes.

**DESCRIPTORIOS:** Enfermagem; Gestão de riscos; Oxigenoterapia; Segurança do paciente; Transporte de pacientes.

## ABSTRACT

**Objective:** To describe the actions taken to promote safe intra-hospital transport of patients on oxygen therapy in a public hospital group in southern Brazil during the coronavirus pandemic. **Method:** Experience report presenting the actions taken in view of the deficit in the supply of oxygen during the coronavirus pandemic. **Results:** Work processes were reorganized, and care teams were instructed on how to handle oxygen cylinders for the safe transport of patients and to reduce waste of supplies. The actions implemented resulted in a 34.95% reduction in the number of oxygen refills at the institution from the first to the second quarter of 2021 and a 14.86% reduction from 2019 to 2022. **Conclusion:** The actions taken were essential to reduce adverse events in the intra-hospital transport of patients, in addition to reducing waste of supplies, reducing healthcare costs and improving patient safety.

**DESCRIPTORS:** Nursing; Risk management; Oxygen inhalation therapy; Patient safety; Transportation of patients.

## RESUMEN

**Objetivo:** Describir las acciones tomadas para promover el transporte intrahospitalario seguro de pacientes sometidos a oxigenoterapia en un grupo hospitalario público del sur de Brasil durante la pandemia de coronavirus. **Método:** Informe de experiencia que presenta las acciones tomadas frente al déficit de suministro de oxígeno durante la pandemia de coronavirus. **Resultados:** Se reorganizaron los procesos de trabajo y se orientó a los equipos de salud sobre el manejo de los cilindros de oxígeno para el transporte seguro de los pacientes y la reducción del desperdicio de insumos. Las acciones implementadas dieron como resultado una reducción del 34,95% en el número de recargas de oxígeno en la institución del 1º al 2º trimestre de 2021 y del 14,86% del 2019 al 2022. **Conclusión:** Las acciones realizadas fueron fundamentales para reducir los eventos adversos en el transporte intrahospitalario de pacientes, además de reducir el desperdicio de insumos, disminuir los costos de atención médica y mejorar la seguridad del paciente.

**DESCRIPTORIOS:** Enfermería; Gestión de riesgos; Terapia por inhalación de oxígeno; Seguridad del paciente; Transporte de pacientes.

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## INTRODUCTION

Patient safety consists of a framework of organized activities that creates cultures, processes, procedures, behaviors, technologies, and environments in healthcare that consistently and sustainably reduce risk, decrease the occurrence of preventable harm, make errors less likely, and reduce the impact of harm when it does occur. <sup>(1)</sup> Understanding the frequency, causes, and nature of incidents and adverse events (AEs) enables the development of strategies that minimize harm resulting from care provided and unnecessary suffering for patients and healthcare teams.

The hospital environment is full of technological resources that assist in the care provided with the aim of restoring health and preserving the life of patients. Among these technologies is oxygen, which is on the World Health Organization (WHO) list of essential medicines and is used in patient care at all levels of integrated health service networks. <sup>(1)</sup>

The flow of patients in a hospital environment is an uninterrupted activity with a potential risk of incidents and AEs. In this sense, planning for its execution and an operational routine to carry it out are of utmost importance, minimizing the possibility of these oc-

currences related to equipment and patient care, protecting the patient from harm. Therefore, the risks and benefits of transporting a patient must be considered, including an assessment of the patient's clinical condition before transport, the benefits that this transport can generate for the patient, the team that will accompany the patient and the equipment available. <sup>(2)</sup> In this sense, intra-hospital transport becomes indispensable and necessary, regardless of its criticality. <sup>(3)</sup> In this context, the inability to maintain adequate ventilation and oxygenation during transport or while in the destination sector must be taken into account.

In view of the need to transport patients, oxygen therapy cannot be overlooked as an essential resource. This therapy consists of administering oxygen (medical gas) in a concentration higher than that found in the atmosphere in room air, with the aim of correcting and attenuating oxygen deficiencies (hypoxia), and is applied in the treatment of clinical problems in patients, including in situations of intra- or extra-hospital transfer of patients. <sup>(2,4-6)</sup>

Medical oxygen is a non-flammable, non-toxic, non-corrosive, tasteless, odorless gas, however, it is a powerful oxidant that causes vigorous burning in combustible materials and is a com-

burent (it does not burn, but feeds and intensifies combustion), it is highly refrigerated in the liquid phase. <sup>(7)</sup> It has several applications such as use in anesthesia, in cases of pneumonia, treatment of respiratory problems, administration of medication through inhalation or nebulization, among others. <sup>(6)</sup>

It is extremely important to follow the prescription of supplemental oxygen according to well-defined indications and its dosage. Its use requires the multidisciplinary team to be familiar with the method of oxygen administration, duration of therapy and monitoring, especially when transporting the patient. It is known that oxygen is similar to any other drug, and when misused or lacking it, it can have harmful effects on the body if not properly controlled. <sup>(1)</sup>

During the coronavirus pandemic, healthcare institutions were on alert for the rational use of oxygen due to its shortage on the market, which implied the need to adopt measures such as controlling waste resulting from leaks in storage systems and distribution networks, the use of gas at incorrect pressures, the use of poorly adjusted flow meters, disconnections, among others. <sup>(1)</sup> Another aspect to be considered is the implementation of adequate technical support for all oxygen supply

# Experience Report

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and delivery systems within the hospital environment.

In this context, in early 2021, during the pandemic, we identified high oxygen consumption in a hospital group in southern Brazil, due to the significant increase in the number of refills of oxygen cylinders that were used to transport patients within the hospital, which, at times, led to shortages. During this period, positive cases of Covid-19 reached their peak, reaching 10,511 cases per day in Rio Grande do Sul, overcrowding Intensive Care Units (ICU) and Emergency Care Units (UPA), generating a shortage in the supply of oxygen in healthcare institutions. The main factors that contributed to the shortage were: inadequate use of cylinders by healthcare professionals and their lack of knowledge of how to calculate oxygen consumption based on the flow rate of the gas in the device that supplies it (catheters, masks, and invasive and non-invasive respirators) for transport; shortage of personnel for distributing cylinders in the institution; lack of informative material for professionals on how to safely transport patients; and the lack of training on the subject for hospital care teams.

In view of the above, the Risk Management department of the aforementioned hospital group identified several opportunities for improvement in the oxygen supply process and, together with professionals from the various areas involved in this process, outlined actions to reverse this scenario and mitigate possible adverse events for the institution's users. From this perspective, this experience report aims to describe the actions taken to promote safe intra-hospital transport of patients on oxygen therapy in a public hospital group in southern Brazil during the coronavirus pandemic.

## METHOD

Experience report from the Conceição Hospital Group (GHC), in

Porto Alegre, Rio Grande do Sul, Brazil, 100% linked to the Unified Health System (SUS). The GHC is one of the largest public health institutions in the southern region of Brazil and is composed of the Hospital Nossa Senhora da Conceição (HNSC), with 784 beds; Hospital da Criança Conceição (HCC), with 204 beds; Hospital Cristo Redentor (HCR), with 237 beds; Hospital Fêmina (HFE), with 163 beds; Moacyr Scliar Emergency Care Unit (UPA), with 19 beds; and 12 Primary Health Care Units (PHC). The HCR and HFE were not included in this study. Ethical aspects were respected and, since this research did not involve human beings, analysis by the Research Ethics Committee was waived.

## RESULTS

In healthcare institutions, oxygen is supplied in gaseous form via a gas network or via aluminum cylinders of various sizes (3, 5, 7, 10, 15, 20, 40, 50 liters). According to information from the warehouse, the high-pressure oxygen cylinders used for intra-hospital transport are 7 liters in size, with up to 150 kgf/cm<sup>2</sup> of pressurized oxygen, containing around 1050 liters. The calculation of the volume of oxygen in the cylinder for transport is as follows:

Tidal Volume O<sub>2</sub> (VCO<sub>2</sub>) = total volume of the empty cylinder (liters)

X cylinder pressure in  $\text{kgf/cm}^2$  or BAR  
 $\div 1000 = \text{volume in m}^3$ ;

Useful volume of a O<sub>2</sub> cylinder is around 90% of its capacity and 10% residual volume;

Oxygen cylinder autonomy in hours = volume of the full cylinder  $\div$  oxygen flow rate supplied to the patient.<sup>(8-9)</sup>

Example: 07 liters X 150 Kgf/cm<sup>2</sup> = 1050 liters of O<sub>2</sub> – 10% residual volume = 945 liters of O<sub>2</sub> or 0.945 m<sup>3</sup>.

Therefore, a patient receiving oxygen via nasal catheter at 5 liters/minute from an oxygen cylinder would have an autonomy of 189 minutes or 03 hours and 09 minutes.

However, this information was not explicit and available to the care teams and needed to be disseminated within the institution with the proper guidance of the professionals. Therefore, the method used to raise awareness among professionals about the conscious consumption of oxygen was ongoing education and the production of educational material for technical support to the care areas.

The context of the COVID-19 pandemic in Porto Alegre triggered high consumption of oxygen refills, which generated occasional shortages, also associated with waste in the use of oxygen cylinders, used in the transport of intra-hospital patients by GHC care teams, as shown in Table 1.

**Table 1 - Historical series with the number of oxygen cylinder refills at HNSC, HCC, UPA Moacyr Scliar and Primary Health Care Units of GHC. Porto Alegre, RS, Brazil, 2025.**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2022	231	197	229	343	244	298	362	318	89	295	125	140	2871
2021	538	452	1279	673	558	245	448	219	281	254	338	301	5586
2020	227	246	296	185	187	300	3	363	370	437	401	307	3322
2019	207	319	304	194	317	282	415	325	271	293	322	214	3463

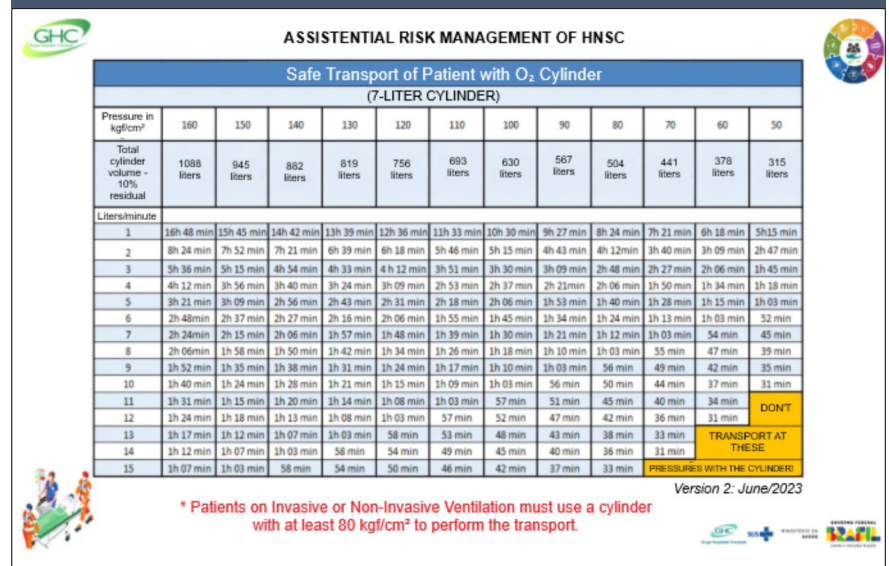
Based on this context, GHC Risk Management mapped the work process and sought a theoretical framework to support corrective actions to guide the safe transportation of patients with oxygen cylinders at HNSC. Thus, intervention actions were instituted with special precautions for transportation and for guidance of care teams during intra- and extra-hospital transport within the institution, such as: preparation of a guidance poster on “Safe Transport of Patients with Oxygen Torpedoes” for HNSC care teams; preparation of a video with guidelines for the appropriate use of oxygen cylinders in the intra-hospital transport of patients admitted to HNSC, which was shared on the hospital's social media; production of the safe transport chart, which was shared on GHC Risk Management's social media and in the institution's employee work groups; carrying out on-site training for employees in more than 25 HNSC inpatient units, five HCC units, UPA Moacyr Scliar and 12 APS Units at GHC; in addition to extending the hours of oxygen supply at the institution through the warehouse.

Continuing education in service was the main tool used as a strategy to improve processes, through video and in-person training, which addressed the following topics: storing the oxygen cylinder in a clean, ventilated place, away from heat sources; storing the cylinder in a safe, fixed place, to avoid falls and possible accidents with it; checking the volume of oxygen in liters or pressure, and the flow rate of the oxygen supply route to plan patient transport; ensuring adequate ventilation in the cargo compartment before transporting the containers; checking that the cylinders are secured; checking that the valve is closed and that there are no leaks; checking that the valve outlet cap (when present) is correctly positioned; not allowing the cylinder valve to come into contact with oil, grease or chemical agents, especial-

ly if the cylinder contains oxygen or other oxidizing gases; using handcarts with chains that allow the cylinders to be secured during transport to the care units.

Figure 1 shows the table distributed on the bulletin boards of the GHC care units to guide multidisciplinary teams.

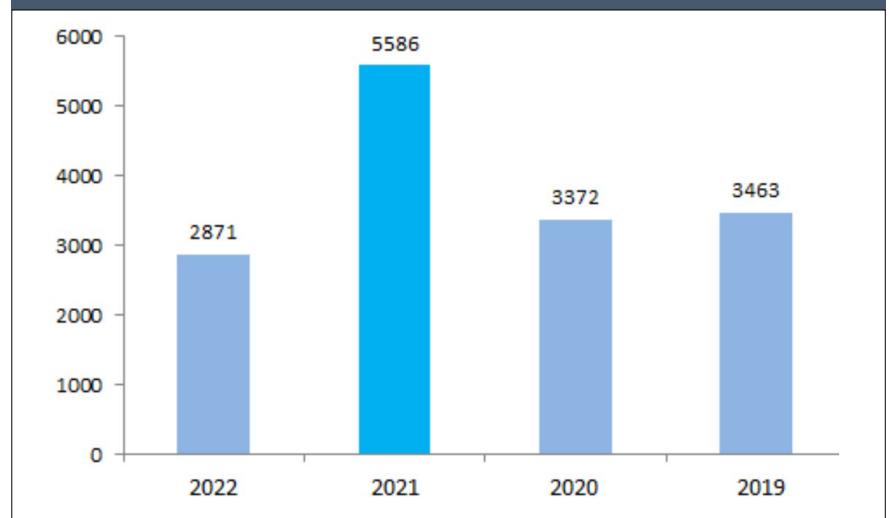
**Figure 1 - Poster distributed on the walls of the care units of HNSC, HCC, UPA Moacyr Scliar and Primary Health Care Units of GHC to guide the teams. Porto Alegre, RS, Brazil, 2025.<sup>(10)</sup>**



Based on the actions taken, as a result, there was a 34.95% reduction in the number of oxygen refills at the aforementioned institution from the

1st to the 2nd quarter of 2021 and 14.86% from 2019 to 2022, as shown in Figure 2.

**Figure 2 - Number of oxygen cylinder refills at HNSC, HCC, UPA Moacyr Scliar and Primary Health Care Units of GHC. Porto Alegre, RS, Brazil, 2025.<sup>(11)</sup>**



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## DISCUSSION

Given the context of the coronavirus pandemic and the shortage of oxygen supply, it can be inferred that in order to achieve coherent results in relation to the health needs of patients and the optimization of available resources, it is necessary to have efficient rationalization in the allocation of resources, which in the vast majority of cases are limited.<sup>(12)</sup>

The healthcare team (nurses, nursing technicians, physiotherapists and doctors) must be familiar with the operation of oxygen cylinders to carry out transport safely.

“ Therefore, determining the oxygen supply autonomy required for transport is essential to ensure adequate supply, which depends on the oxygen flow rate per minute, as well as the amount of oxygen contained in the cylinder prior to transport.<sup>(13)</sup>

”

The oxygen level must be determined with appropriate support according to the patient's condition prior to transport. Oxygen is administered through a nasal cannula, face mask, non-rebreathing mask or oro-tracheal tube, considering its flow according to the ventilatory device used. Another point to be considered is that for the transport of critically ill patients, on mechanical ventilation, where it is necessary for the oxygen cylinder to have a minimum volume, greater than in other types of ventilatory support, for the mechanical ventilator to be able to cycle and provide the established amount to the patient.<sup>(14)</sup>

One study found that intra-hospital transport with oxygen cylinders was associated with a longer ICU stay, but had no significant impact on mortality.<sup>(14)</sup> Incidents and/or adverse events related to intra-hospital transport may occur during its execution, and can be mitigated by checking equipment prior to transport, preparing the patient, providing appropriate sedation and having a trained transport team.<sup>(4)</sup>

In another non-randomized prospective observational study conducted in two tertiary hospitals, 48 patients were included and 58 transports were performed. Significant cardiorespiratory changes were observed in 39 patients, totaling 86 episodes, as well as 16 adverse events related to equipment failure (including oxygen depletion during transport) and team failure, including battery problems and communication failures. The average duration of transport was 52 minutes, and the average distance traveled was 325 meters. It was found that, during intrahospital transport of patients undergoing invasive ventilation, cardiorespiratory changes were frequent (67.2%) and adverse events occurred in 75.7% of the transports performed.<sup>(13)</sup>

A recently published integrative

review on safety in the transport of critically ill patients in an intra-hospital environment presented numerous cases of adverse events in critically ill patients during intra-hospital transport, making it imperative to create institutional protocols to assist and standardize transport, minimizing failures and favoring safe practice.<sup>(15)</sup>

The deficit in the supply of oxygen to the institution in question triggered actions to reorganize work processes. From there, there was a need to create strategies for oxygen management and guidelines for care teams on the handling of oxygen cylinders, as well as the need to plan the safe transportation of patients, avoiding waste of supplies and promoting patient safety, in accordance with the SUS principles of equity and comprehensiveness.

## CONCLUSION

Based on the findings of this study, it can be inferred that promoting safe intra-hospital transport of patients on oxygen therapy during the coronavirus pandemic was essential for reducing clinical complications and adverse events, in addition to reducing the waste of supplies such as oxygen, thereby reducing healthcare costs and improving patient safety.

The promotion of ongoing in-service education focused on improvement processes, restructuring the work process, training, and dissemination of technical information to healthcare teams were essential for achieving the results, optimizing the use of oxygen in response to the high demand generated by the coronavirus pandemic.

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