

Introduction

A randomized clinical trial (HiFlo-Covid Trial) showed that among patients with severe COVID-19, treatment with high-flow oxygen therapy (HFOT) significantly reduced the need for invasive mechanical ventilation support and time to clinical recovery compared with conventional oxygen therapy (COT). However, the cost of this strategy is unknown.

Materials and methods

A post-trial-based cost analysis from the perspective of a managed competition healthcare system, using actual records of billed costs. From August 2020 to January 2021, a randomized open-label clinical trial was conducted in the general wards, emergency rooms and intensive care units (ICU) in three hospitals in Colombia. A total of 220 adults (18 years and older) with severe COVID-19 were randomized to HFOT through a nasal cannula vs. COT to assess hospital length of stay, need for intubation and mechanical ventilation, and time to clinical recovery, evaluated in a 28-day period (HiFlo-Covid Trial) . The objective of this analysis was to examine the total cost of HFOT treatment compared with COT in real-world setting. We calculate the mean unadjusted and adjusted total cost for the patient's entire stay. Cost models are adjusted for age (<60 and ≥60 years), ratio of partial pressure of arterial oxygen to fraction of inspired oxygen (PaO2/FIO2) at randomization, and comorbidities (arterial hypertension, diabetes, obesity [body mass index >30 kg/m2], chronic obstructive pulmonary disease, kidney failure, heart failure, and Child-Pugh class A-B liver cirrhosis). We used generalized linear models to compare total costs between groups, adjusting for baseline characteristics.

Results

The multicenter trial analyzed 199 patients, 99 patients were randomly assigned to receive high-flow oxygen through a nasal cannula and 100 to conventional oxygen therapy ¹⁷. Due to confidentiality restrictions, we were only allowed to access cost data in our hospital, which enrolled most patients in the trial. We included in this paper 94 (50%) participants from the COT group and 94 (50%) from the HFOT group (**Table 1**). Most patients were treated both in the general ward and the ICU, except for 9 patients (10%) in the HFOT group and 12 (13%) in the COT group that were hospitalized directly in the ICU; 5 patients (5%) in the HFOT group and 4 (4%) in the COT group did not require ICU. A total of 23 patients (5 females) died during the trial, 8 in the HFOT group and 15 in the COT group.

Total direct healthcare costs for the health system were 27% lower in the HFOT group versus the COT group, and the HFOT group was less costly in each cost category. Three categories make up 72% of all savings: Medications (41%) and ICU (31%). Notice the wide standard deviations in all cost categories, and that median costs are always well below the mean costs.

Table 1: Baseline participant characteristics

Variables	HFOT (n=94)	COT (n=94)
Age, years		
Mean (SD)	58.4 (13.6)	58.1 (13.8)
Median [IQR],	60.5 [50, 69]	58 [49, 67]
Range	27-88	26-86
Females (%)	27 (29%)	35 (37%)
BMI ([IQR]	28.8 [26.3, 32.1]	29.4 [26.1, 33.0]
APACHE II score, No. (%)	10 (8, 12)	10 (8, 12)
Comorbidities, No. (%)		
Hypertension	35 (37%)	42 (45%)
Diabetes	17 (18%)	19 (20%)
Liver cirrhosis	1 (1%)	0 (0%)
COPD	3 (3%)	1 (1%)
Hospitalized in ICU	89 (95%)	90 (96%)

HFOT: high-flow oxygen therapy; COT: Conventional oxygen therapy
COPD: Chronic Obstructive Pulmonary Disease; BMI: Body Mass Index

Adjusted mean differences are negative for all cost categories and for total cost per patient. Two categories achieve statistical significance in the cost difference at the conventional 5% threshold: imaging and clinical laboratories. Total cost was statistically significant at a 10% threshold, as well as the ICU category.

Discussion

This study is the first one to use real-world evidence in a COVID setting based on an RCT, finding a mean expenditure of a patient under COT to be USD 2,198 more than a HFOT patient, which would translate in 27% cost savings, comparatively higher than the figures reported in the literature. These findings suggest that HFOT in adult patients with severe COVID-19 infection as first-line oxygen management therapy does not result in higher hospitalization expenditure. In the HiFlo trial, the use of high-flow oxygen through a nasal cannula when compared to COT in patients with severe COVID-19 reported a significant decrease in need for mechanical ventilation support (66%) and time to clinical recovery within 28 days (11 days vs. 14 days), with no difference in hospital length of stay.

Table 2: Mean and median costs, by category, of patients in each group

Cost category	HFOT (n=94)		COT (n=94)	
	Mean (SD)	Median [IQR]	Mean (SD)	Median [IQR]
Medications	\$ 1,677 (3,124)	\$ 536 [289-2,147]	\$ 2,585 (3,658)	\$ 964 [355-3,100]
Intensive care unit	\$ 3,791 (3,001)	\$ 2,797 [1,998-5,005]	\$ 4,469 (3,330)	3,597 [1,998-6,374]
Procedures	\$ 487 (1,024)	\$ 196 [105-476]	\$ 674 (1,158)	\$ 238 [130-625]
Laboratory	\$ 682 (318)	\$ 593 [477-789]	\$ 835 (484)	\$674 [534-976]
Supplies	\$ 641 (993)	\$ 299 [243-771]	\$ 747 (919)	\$ 457 [107-948]
Images	\$ 194 (202)	\$ 82 [39-345]	\$ 261 (224)	\$ 180 [51-409]
General ward	\$ 401 (408)	\$ 274 [137-510]	\$ 438 (464)	\$ 314 [113-588]
Other	\$ 119 (207)	\$ 32 [3-131]	\$ 182 (351)	\$ 34 [12-154]
Total	\$7,992 (7,394)	\$4,979 [3,801-7,394]	\$10,190 (9,402)	\$ 6,641 [3,708-13,165]

HFOT: high-flow oxygen therapy; COT: Conventional oxygen therapy

Table 3. Adjusted comparison of costs in the Hi-Flo Trial

All patients until discharged (n=188)			
Cost category	Adjusted difference	p-value	95% CI
Medications	-691.5	0.183	(-1708.6 - 325.6)
Intensive care unit	-836.2	0.087	(-1794.7 - 122.4)
Procedures	-210.2	0.141	(-490.4 - 70.0)
Clinical laboratories	-150.5	0.013	(-269.7 - (-31.4))
Supplies	-82.0	0.566	(-362.0 - 198.0)
Imaging	-102.5	0.002	(-166.6 - (-38.4))
General ward	-70.7	0.272	(-197.0 - 55.6)
Total	-2192.3	0.093	(-4753.0 - 368.4)

HFOT: high-flow oxygen therapy; COT: Conventional oxygen therapy

Reduced costs may also be explained by clinically improving patients' respiratory condition, potentially reducing associated complications, diminishing the need of additional interventions, in addition to decreasing days required in the ICU, thereby reducing costs of procedures, medication, physicians' fees, and ultimately overall total hospital stay costs, while possibly favoring bed turnover providing healthcare for all in a pandemic. Despite the apparent difference in overall costs, and in each one of the categories analyzed, the overall result did not reach statistical significance at the conventional p = 0.05 level. Sample size, which was estimated for the clinical outcomes, may be part of the explanation. Additionally, healthcare costs in complex situations tend to have a peculiar distribution, with a long tail at the high end (22).

Conclusion

This economic analysis could not prove that among patients with severe COVID-19, cost of treatment with high-flow oxygen therapy (HFOT) is significantly different when compared with conventional oxygen therapy (COT).

More information:


@darosselli


drosselli@javeriana.edu.co
sergio.prada@fvl.org.co