

## The Clinical Utilization of Inhaled Pulmonary Vasodilators

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# The Clinical Utilization of Inhaled Pulmonary Vasodilators

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## Introduction

Inhaled Nitric Oxide (INO) and other pulmonary vasodilators, like Flolan, have demonstrated positive physiological responses in select patient populations; however, no clinical studies have proven any long term outcome benefits in mortality and morbidity<sup>1</sup>. However, INO and Flolan are commonly used as rescue therapy in order to stabilize critically ill patients until a more definitive treatment can be implemented and future direction of care can be discussed with the family. Currently, Lehigh Valley Health Network utilizes both drugs and has a titration protocol for Flolan (fig 1) but not for INO (fig 2).

### OBJECTIVES OF STUDY:

- Better assess the clinical outcomes of inhaled pulmonary vasodilators.
- Determine if INO and Flolan are being administered correctly and for the appropriate clinical indications.
- Streamline administration for their future utilization.

## Methods

- A retrospective chart analysis of 158 patients (124 treated with Flolan and 34 patients treated with INO) was performed.
- The clinical indication, clinical response, and total drug administration time was recorded.
- For the patients treated with Flolan it was noted if the prescribed titration protocol was adhered to.
- A positive response was recorded if one or more of the following were observed during treatment: an overall increase of 2% in SpO<sub>2</sub>, a 20% increase in P/F ratio, an overall reduction of 10% in FiO<sub>2</sub>, a sustained 15% reduction in Mean Pulmonary Artery Pressure (MPAP), or if hemodynamic support was reduced.
- A neutral response was recorded if none of the above changes were observed.
- An unknown response was recorded if the changes could not be determined secondary to treatment with either Flolan or INO.

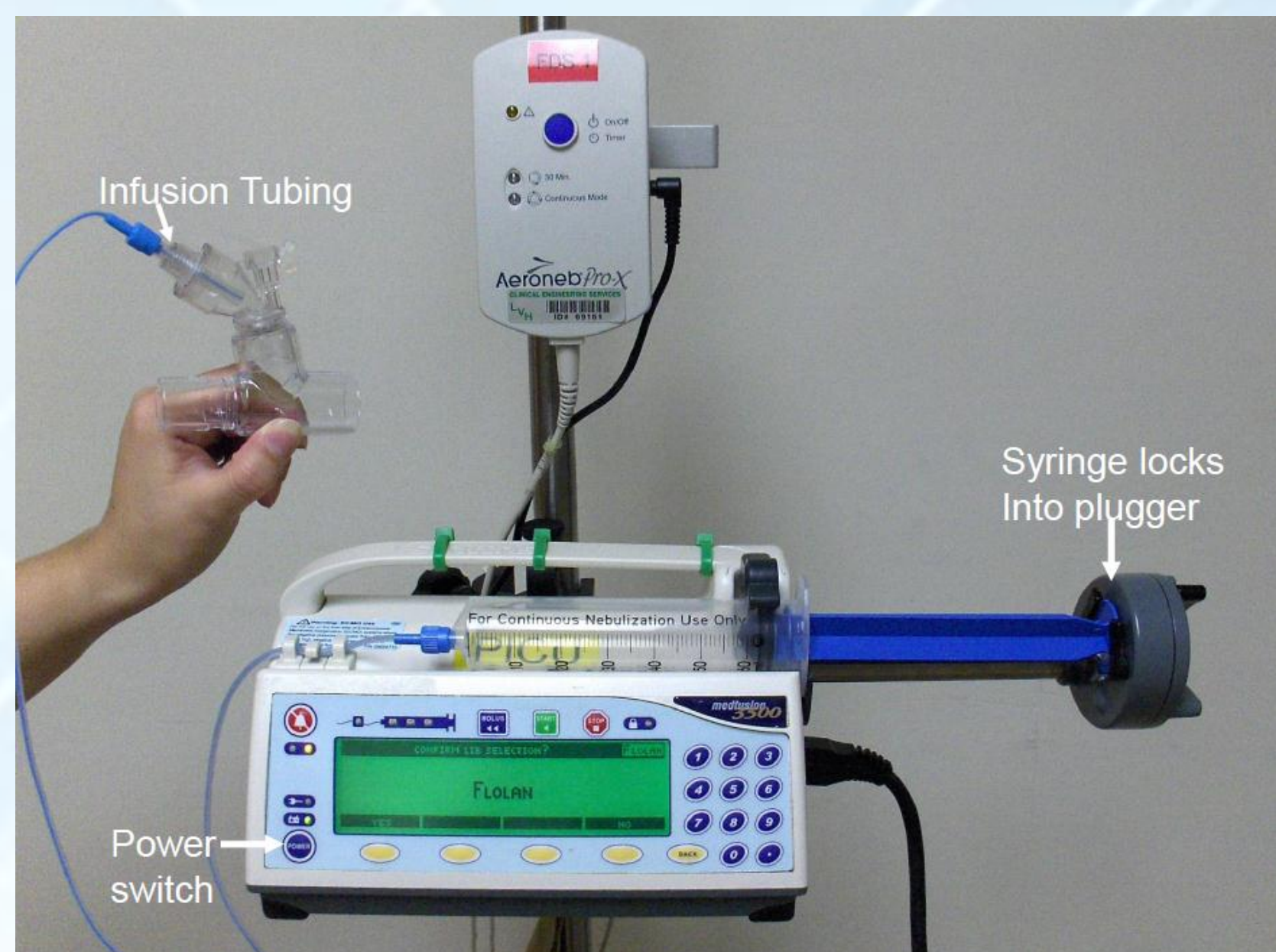


Fig. 1: Flolan Ventilator Set-Up



Fig. 2: INO Ventilator Set-Up

## Results

	Flolan	INO
Mean time on drug	82.5 hours Adjusted: 61.9 hours	37.5 hours
Median time on drug	41.5 hours Adjusted: 39.6 hours	25.8 hours
Range of hours	0.75 – 663.2 hours	2.3 – 162.9 hours

**Table 1: Time summaries for INO and Flolan.** The “adjusted” times for Flolan are the mean and median times calculated absent of data that was recorded two standard deviations above or below the mean. 95% of data fell within +/- 2 standard deviations.

### Clinical Indications For INO

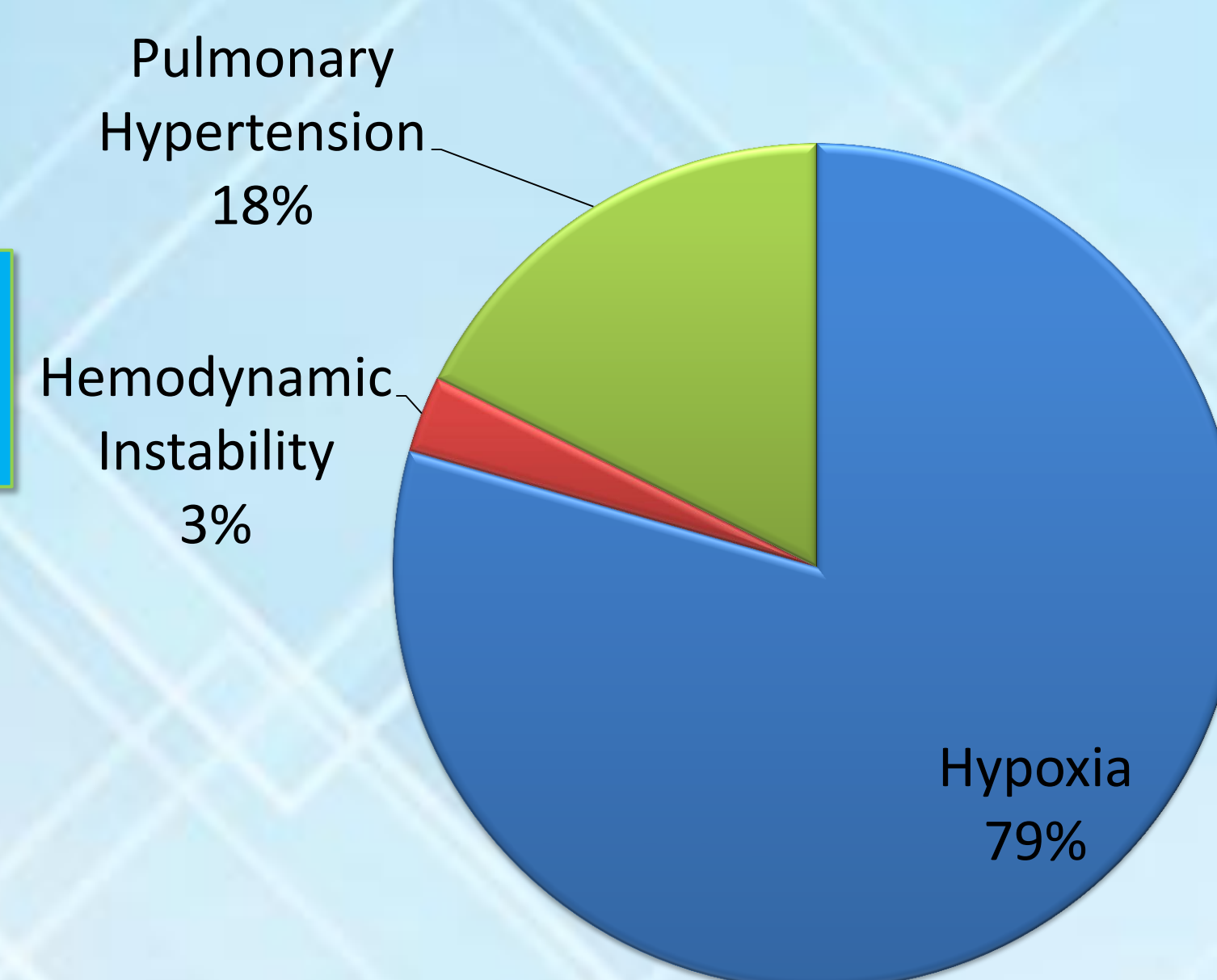


Figure 1: Clinical indication for INO administration

### Clinical Indications for Flolan

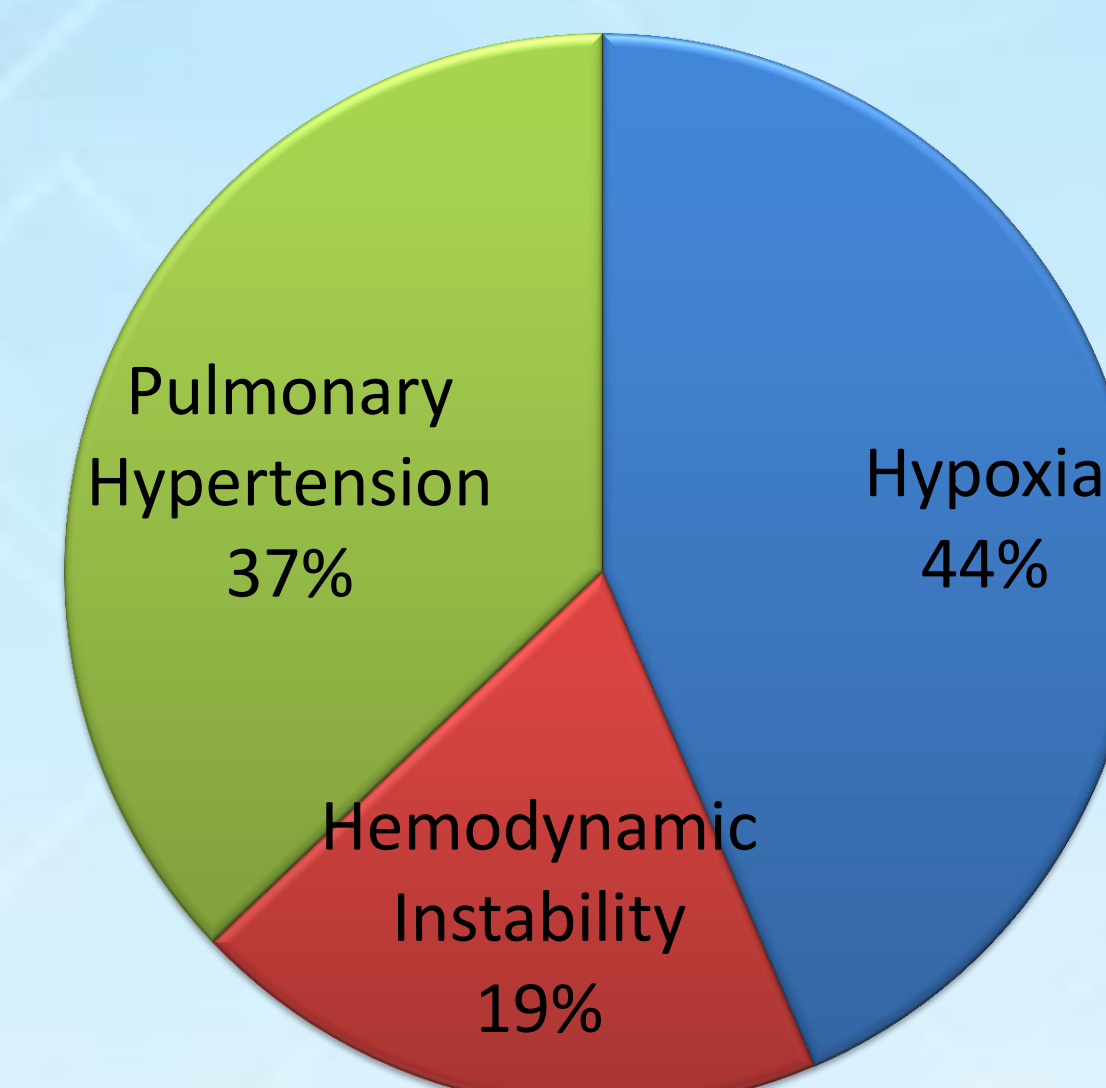


Figure 2: Clinical indication for Flolan administration

### Clinical Responses for INO

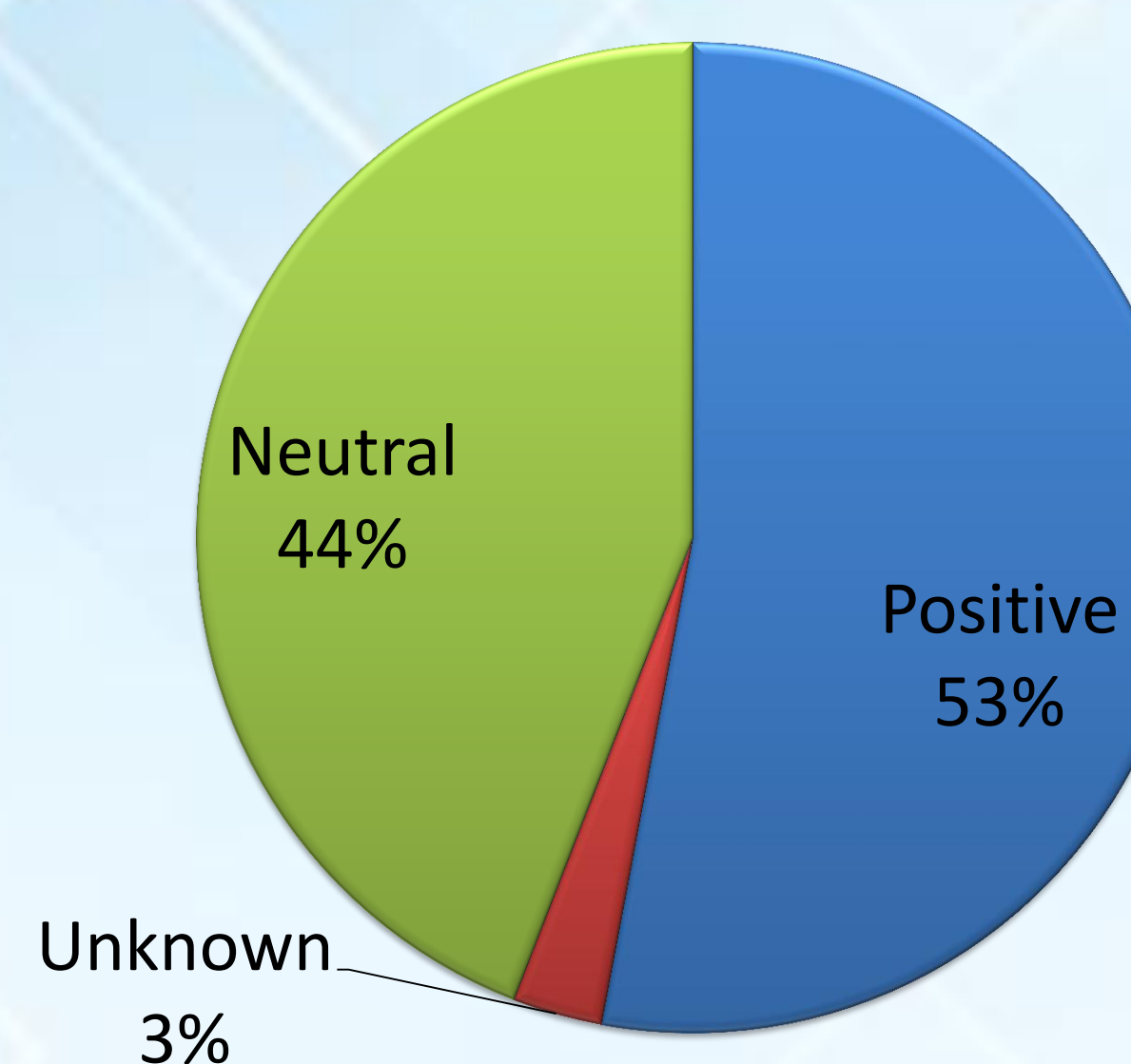


Figure 3: Clinical responses for INO administration

### Clinical Responses for Flolan

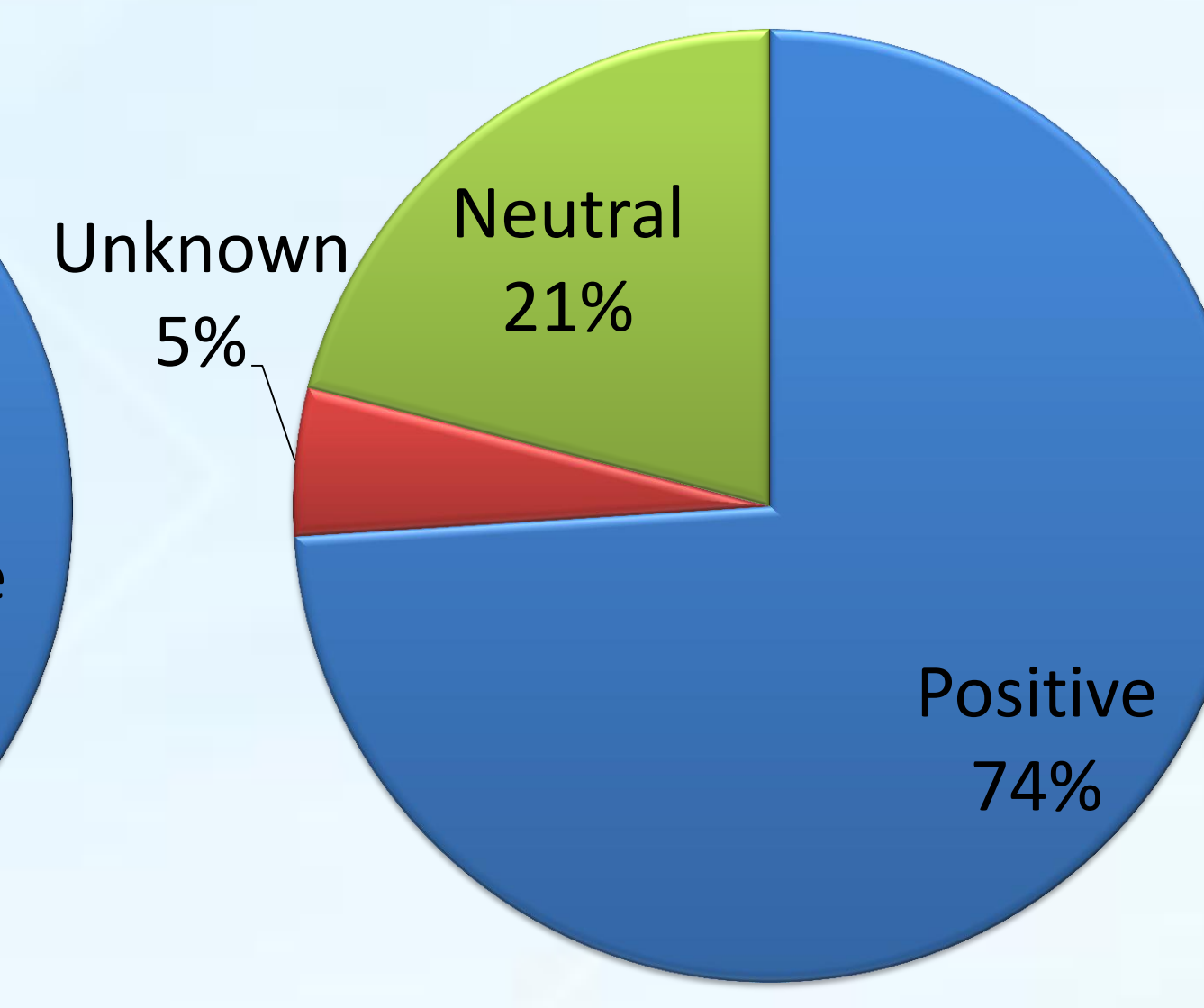


Figure 4: Clinical responses for Flolan administration.

\*Flolan protocol followed in 58% of cases

## Discussion

These results provide insight into how inhaled pulmonary vasodilators are being administered at LVHN. According to the data Flolan and INO are being used correctly and effectively at LVHN, although there is opportunity for improvement.

- Of the 158 patients observed, all were treated for one of the three clinical indications.
- The majority of patients had a positive clinical response to the intervention.
- While the positive response rate recorded warrants the use of these therapies, the titration protocol for Flolan was only followed about half of the time it was used (58%). It is important that the protocol be followed because it is in place to ensure that patients do not react adversely to a sudden discontinuation of the drug and to ensure that the lowest effective dose is administered (which minimizes costs and potential side effects).
- Flolan had a positive response rate about 20% higher than INO; although, it is possible that the small sample size for INO may have contributed to this observation.
- Flolan is more affordable than INO and has fewer potential side effects.
- Long term use of INO has been associated with methemoglobinemia and increased bleeding risk<sup>2</sup>.

## Conclusions about Future Care

1. Due to the lower cost of Flolan administration and the risks associated with INO, Flolan should be used preferentially over INO when possible.
2. Steps should be taken to ensure that the Flolan protocol is followed more closely to optimize clinical outcomes and cost.
3. A titration protocol for INO should be implemented to optimize clinical outcomes and cost.

**By implementing these recommendations, the institution may reduce costs, improve clinical outcomes, and increase the effectiveness of inhaled pulmonary vasodilators.**

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