

# Should Nitrous Oxide Be Used for Laboring Patients?



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## KEYWORDS

- Nitrous oxide • Labor analgesia • Maternal satisfaction • Analgesic effectiveness
- Drug safety

## KEY POINTS

- Unlike neuraxial labor analgesia, N<sub>2</sub>O provides highly variable labor analgesia, ranging from very poor to very good.
- Despite this variability, parturients who choose to use N<sub>2</sub>O where neuraxial analgesia is an option (including after trying N<sub>2</sub>O) report satisfaction similar to that reported by women who use neuraxial analgesia. Parturients using N<sub>2</sub>O report higher satisfaction than subsets of parturients who experience inadequate neuraxial labor analgesia.
- Regarding safety, parturient and neonatal adverse effects occur at rates similar to other techniques and may be no more frequent than in patients who undergo labor and delivery without analgesia. Environmental exposure and health risk to health care providers are minimal when proper scavenging of exhaled gas and adequate ventilation are used.
- Costs of administering N<sub>2</sub>O appear similar to other alternatives for labor pain relief. Costs may be lower than for neuraxial techniques because non-anesthesia trained nursing staff can monitor nitrous oxide analgesia safely.
- N<sub>2</sub>O analgesia provides a useful alternative for pain relief in parturients who decline neuraxial labor analgesia or who have contraindications to neuraxial blocks, and may offer advantages over patient-controlled systemic opioid administration and non-pharmacological techniques.

## INTRODUCTION

Despite decades of widespread acceptance as a labor analgesic modality in numerous European countries, self-administered nitrous oxide (N<sub>2</sub>O) has only

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recently captured great interest in the United States. The rare US medical center offering N<sub>2</sub>O for labor in 2007<sup>1</sup> grew to an estimated 150 hospital labor and delivery units and 50 birthing centers in just a few years.<sup>2</sup> In contrast, roughly half of parturients in Finland, Norway, New South Wales Australia, Canada, and New Zealand and two-thirds of parturients in the United Kingdom and Sweden were estimated to have used N<sub>2</sub>O when birthing centers were surveyed 10 years ago.<sup>1</sup> The availability of N<sub>2</sub>O in institutions where neuraxial block is routine has been debated.<sup>3,4</sup> Despite a surprising paucity of evidence regarding its analgesic effectiveness, the long history and popularity of its use is compelling; the beneficial attributes of this modality are many, and the drawbacks are few (**Box 1**). The evidence as well as adverse effects, environmental exposure risks, and barriers and costs are reviewed, concluding that N<sub>2</sub>O should be added to the modalities available to laboring parturients.

## HISTORICAL CONSIDERATIONS

Several excellent reviews of the early history of N<sub>2</sub>O use for anesthesia during surgery have been published,<sup>5,6</sup> and **Table 1** depicts a brief historical chronology. The discovery of N<sub>2</sub>O is attributed to Joseph Priestly, who demonstrated its use in 1772.<sup>5</sup> In 1800, Humphry Davy reported that N<sub>2</sub>O was useful at relieving toothache and associated it with pleasurable sensations during self-administration.<sup>5</sup> Dentist Horace Wells first suggested the use of N<sub>2</sub>O as an anesthetic and self-administered it for a tooth removal; however, his public demonstration in Boston for surgery in 1845 was a failure.<sup>5</sup> William Morton, a year later in 1846, demonstrated the successful use of ether as an anesthetic at Massachusetts General Hospital, considered by some as the beginning of anesthesia as a medical practice.<sup>7</sup>

Other inhalational anesthetics preceded N<sub>2</sub>O use in obstetrics. The year after ether for surgical anesthesia was successfully demonstrated in Boston, James Simpson successfully used it for a vaginal delivery in 1847<sup>6</sup>; however, wider acceptance of inhaled anesthesia for labor did not occur until John Snow administered chloroform to Queen Victoria during the birth of 2 children in 1853 and 1857.<sup>6</sup> The first use of N<sub>2</sub>O in obstetrics is credited to Stanislav Kličovich, who developed a machine to deliver an 80/20 mixture of N<sub>2</sub>O and oxygen.<sup>8</sup> Although he wrote of its safety and efficacy during labor in 1881, barriers, including cost, unfamiliarity of equipment, and access to equipment, prevented its widespread acceptance in laboring women.

During the early twentieth century, other devices for N<sub>2</sub>O administration were developed. The Minnitt apparatus (A. Charles King, Ltd, London, England), introduced in 1933, delivered 50% N<sub>2</sub>O in air. In 1936, the Royal College of Obstetricians and Gynecologists certified it as safe for use in obstetric patients attended by nurse midwives.<sup>9</sup> In 1961, Tunstall<sup>10</sup> described Entonox (BOC Healthcare, Manchester, England), a 50%/50% mix of N<sub>2</sub>O and oxygen in a single cylinder, which was introduced into practice in the United Kingdom in 1965.<sup>10</sup> This combination was thought to be safer than mixing N<sub>2</sub>O with air, and the device is currently in widespread use. Although N<sub>2</sub>O was used in the United States during the 1970s, its use declined the following decade,<sup>11</sup> likely eclipsed by the growing popularity of neuraxial analgesia for labor during that time.

Although use of N<sub>2</sub>O for surgical anesthesia has declined in the United States in the twenty-first century, the past 5 years have seen renewed interest in N<sub>2</sub>O for labor.<sup>12</sup> In 2013, a barrier to N<sub>2</sub>O use for labor in the United States was overcome with the

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