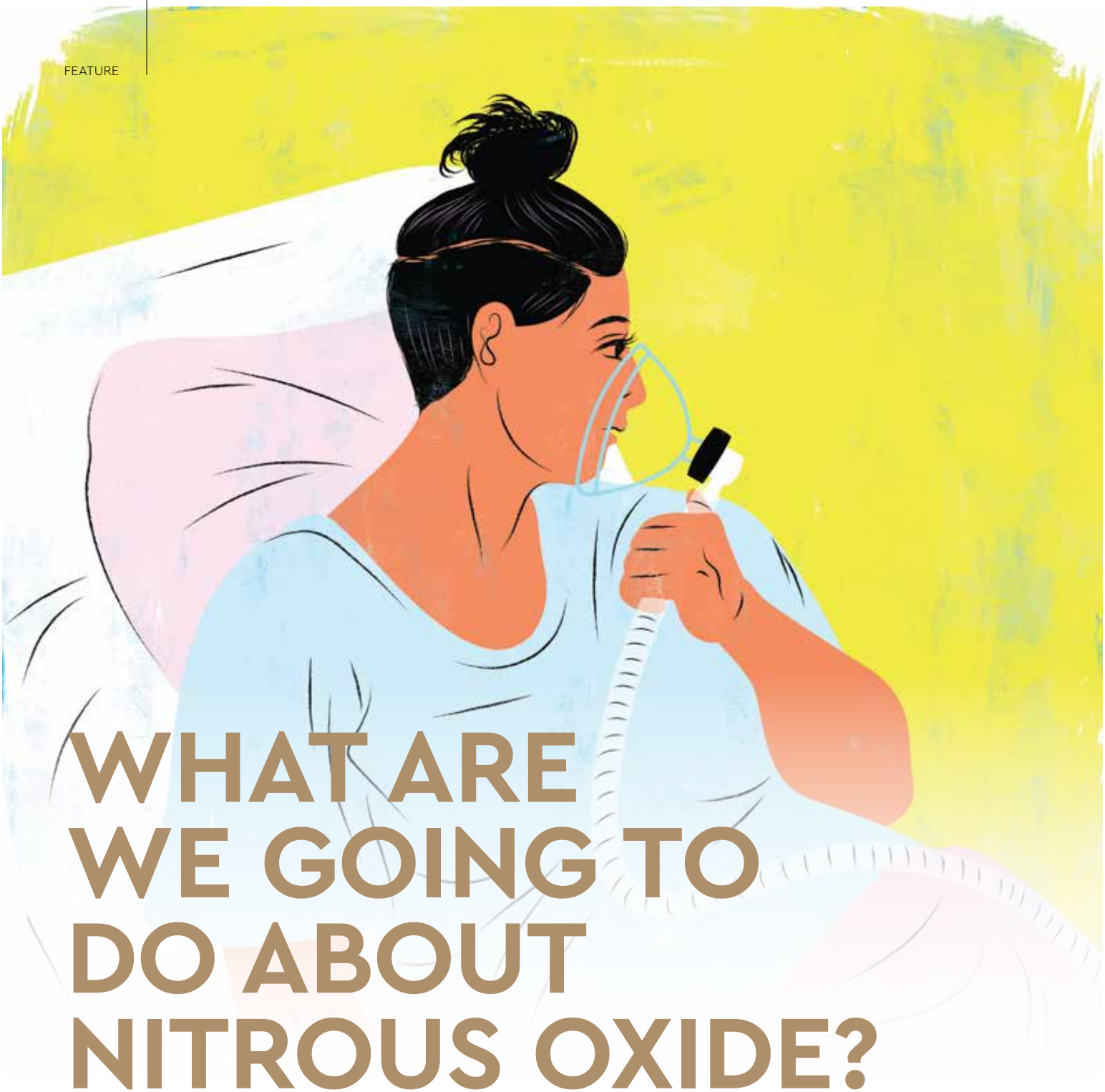

WHAT ARE WE GOING TO DO ABOUT NITROUS OXIDE?

Nitrous oxide, commonly used by labouring wāhine across all maternity facilities in Aotearoa, provides a safe pain-relief solution for women wanting something to take the edge off labour pain, whilst remaining mobile and in control. Dr Rob Burrell, anaesthetist at Middlemore Hospital and Chair of the Australian and New Zealand College of Anaesthetists Sustainability Group discusses the utility of Entonox, its environmental impacts, and suggests solutions midwives can advocate for in their respective work settings.

DR ROB BURRELL ANAESTHETIST MIDDLEMORE HOSPITAL

Nitrous oxide is a great drug, and combined with 50% oxygen as Entonox, it is a very useful pain-reliever in maternity care. Midwives have access to a safe, predictable, at least moderately effective agent, under the control of the labouring woman. With its quick onset and offset, it is almost ideal for childbirth. Nitrous oxide is a valuable asset; we need to ensure we continue to have it available.

The pharmacological effects - euphoria, analgesia, and anxiolysis - fit well with the need for economical and immediately available pain relief in childbirth, and maternal safety is ensured because the user must be conscious. Giving a woman control of her own pain relief is safe, consumer-centric, and frees the hands of health providers to manage other aspects of care.

Once a mainstay of anaesthesia, nitrous oxide has been used since 1844. Hospitals pipe nitrous oxide, and all anaesthetic machines to this day are fitted with the ability to administer precise concentrations of the drug, but times have now changed. Anaesthetists hardly use nitrous oxide anymore, and it is no longer carried on ambulances for painful emergencies. Dentists (especially paediatric dentists) use nitrous oxide, but it should be noted in lower concentrations than obstetrics; 20-30%, rather than 50%. Whilst this fabulous agent meets the needs of New Zealand parturients, its place amongst the rest of healthcare is fading. In fact, the birthing units in our hospitals and communities are now the biggest users. Midwives are the professional group with the most recent experience, and the greatest exposure. There are two problems with nitrous oxide: industrial exposure, and its contribution to climate change.

Industrial exposure is insidious. With almost no metabolism by the patient (anaesthesia) or the mother (childbirth), exhaled nitrous oxide mixes into the room air, breathed by the nearby healthcare staff. Operating rooms have sophisticated systems for scavenging gases away from staff, and the standards for theatre air-conditioning are extremely high, with a complete air change every three minutes. Birthing suites are not required to meet the same levels; as a result staff will be breathing at least some nitrous oxide, when Entonox is in use. The chronic effects of nitrous oxide include DNA alteration, disrupted vitamin B12 metabolism with subsequent neuropathy, and adverse effects on a developing fetus. In my own hospital, Middlemore, the birthing unit is a converted ward, with air changes half that of the New Zealand standard for a labour ward. The only time we attempted to measure midwife exposure, the levels were considered to be safe, but there is certain exposure for those caring for labouring women using Entonox analgesia.

Nitrous oxide is measurable in the atmosphere, rising inexorably over the past 200 years, just like CO_2. About 60% is from natural sources, the remaining 40% from human activity. Most of that 40% is from agriculture; nitrogen fertilisers and animal urine get broken down by soil bacteria releasing nitrous oxide. Nitrous oxide is a potent greenhouse gas, with heat-trapping ability 265 times greater than carbon dioxide. Nitrous oxide is also an ozone-depleting substance. Consequently, tackling climate change, particularly in New Zealand, will mean reducing nitrous oxide emissions from all sources, not just farming. While not (yet) in our emissions trading scheme, its footprint will require offsetting from healthcare under the Carbon Neutral Government Program.

Nitrous oxide as Entonox is a valuable choice for New Zealand's labouring women. For mothers, it is safe, effective, and meets their needs. It is critical that we continue to keep nitrous oxide available, but there are concerns for those healthcare professionals with prolonged exposure, and there are environmental implications we will be forced to consider.

Using the global warming potential of CO_2 as a unit, the warming impacts of greenhouse gases are measured in $kgCO_2$ equivalents. The carbon footprint of Entonox analgesia for childbirth in my hospital is $287kgCO_2eq$ per birth. Waitākere DHB numbers are possibly twice that, while CDHB is possibly lower (other sites are currently doing their own calculations). For perspective, $287kgCO_2$ is the equivalent of driving a small car over 2,000km, or burning 125 litres of petrol, for every baby born. The carbon footprint of nitrous oxide from childbirth is very significant. If my hospital is about average, with 60,000 births per annum in Aotearoa, the carbon footprint of Entonox across maternity facilities is 18,000 tonnes (the estimated carbon footprint of a labour epidural is a couple of kg, and of a caesarean section probably some tens of kg). Perhaps counter-intuitively, hospital-based vaginal births may not be as high carbon, on average, as those in community facilities, where fewer analgesic options are available.

The great news is that technology may come to our rescue, to reduce occupational exposure and climate change. Technical solutions akin to centralised vacuum cleaning systems are now available to scavenge and destroy exhaled nitrous oxide either as portable units, at the bedside, or amenable to reticulated systems as part of new facility builds. There are at least two companies in Sweden which make this type of equipment, and we can expect to take a look at the technology sometime this year.

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As usual, there are some questions for which we will have to find answers:

- What does it cost and who will pay?
- How portable is portable?
- What fraction of nitrous oxide is captured?
- How would we manage the more complicated mouthpiece and tubing?
- Do we need training, and how do we ensure we are maximising effectiveness?
- Will the extra costs involved be less than the anticipated carbon offsetting fees required by 2025?

The view of the Sustainability Network of the New Zealand Society of Anaesthetists, is that there is potential to protect our people, and our environment, while maintaining access to effective, safe analgesia under maternal control. We believe that where safe technical solutions exist to such problems, we should adopt them. Any new birth facility builds should incorporate a reticulated nitrous oxide destruction system, and portable units need to become available in existing units. We also believe that none of this will happen unless healthcare professionals demand it, and we ask for your support as individuals, and collectively as members of your professional organisations.

The next step is to assess the technology, in our local settings. If it is what we need, we will all have to speak up, and advocate for healthcare institutions to provide it. We must keep ourselves safe, protect our environment, and let our mothers do what they need to do: give birth safely, and make their own choices, with help from high quality maternal care. ■