D-18800-2020

Gas Consumption Analytics – Data Analytics in the OR

Green Anaesthesia at the Florence Nightingale Hospital

Efficiency improvements and environmental friendliness in anaesthesia

Sustainability is a much-discussed topic nowadays and is receiving more and more attention in all manner of areas. The term "Green Hospital" describes this trend in the healthcare system. The focus is on reducing the carbon footprint, which is also an important issue in anaesthesia. Our new data-based solution for anaesthesia has been designed to collect and automatically analyse the enormous flow of data from the modern, networked anaesthesia workstations used during an OR procedure. The data collected enables clinical users to gain a transparent insight into rates of gases consumption and the associated costs. Gas Consumption Analytics assists with the consistent implementation of low-flow anaesthesia by clearly presenting the relevant data, enabling anaesthesia to be performed in a more efficient and ecologically sound way.

A RETHINK IN ANAESTHESIA

Do you have an overview of how many volatile anaesthetics you use, or have you ever considered how much greenhouse gas is emitted daily using inhaled anaesthetics in your OR? The inefficient use of narcotic gases leads to higher costs and makes a significant contribution to your CO_2 footprint. It has been estimated that worldwide each year the harmful effects to the climate from narcotic gases are equivalent to the CO_2 emissions from 1,000,000 cars.[1]

Consequently, it is becoming increasingly important for anaesthesia to also act in a more environmentally friendly and cost-efficient way. To this end, in their position paper for the "Sustainability in Anaesthesiology and Intensive Care Medicine" commission, the German Society of Anaesthesiology and Intensive Care Medicine (DGAI) and the Professional Association of German Anaesthesiologists (BDA) have already recommended reducing emissions through the consistent use of low-flow and minimal-flow narcoses with volatile anaesthetics.[2]

In the field of anaesthesia, Gas Consumption Analytics enables the reduction of volatile anaesthetics by providing an overview of the consumption of narcotic gases and gives information about the associated fresh-gas flow. Data analytics assist you with the consistent use of low-flow and minimal-flow anaesthesia. In this way you contribute to environmental protection and at the same time cut your costs.

FLORENCE NIGHTINGALE HOSPITAL – ANAESTHESIA

The Florence Nightingale Hospital has more than 600 beds and twelve specialist departments, including a clinic for anaesthesiology and intensive care medicine. Each year, around 10,000 patients receive anaesthetic care there in ten state of the art operating rooms.

Maximum patient safety together with effective and efficient care, under the principle of "continuous improvement and development", are among the aims of the anaesthesiology and intensive care clinic at the Florence Nightingale Hospital.

D-2503-2021

Gas Consumption Analytics dashboard

Under the motto "Flow as low as you can go!" Prof. Dr. Manuel Wenk, head of anaesthesiology and intensive care at the Kaiserswerther Diakonie company's Florence Nightingale Hospital in Düsseldorf has taken on the challenge of designing anaesthesia to be cost-efficient and environmentally friendly. To do so, he is counting on a reduction in gas flows to low- and minimal-flow anaesthesia. In order to create transparency and to encourage a rethink among colleagues, the Dräger Connect data analytics platform with gas consumption analytics was integrated into the current anaesthesia processes. In this way, the results can for the first time be presented quantitatively, which means progress and opportunities for improvement can be discussed among the anaesthesia team.

> "The detailed and beautifully prepared analysis of gas consumption provided by Dräger Connect motivates my colleagues every day to ensure their actions keep the environmental footprint of the anaesthesia as low as possible through the consistent application of "Flow as low as you can go!""

Prof. Dr. med. Manuel Wenk,
Head of anaesthesiology,
intensive care and pain management
Florence Nightingale Hospital
Düsseldorf, Germany

LOW-FLOW ANAESTHESIA FOR THE BENEFIT OF THE PATIENT, THE ENVIRONMENT AND THE BUDGET

Low-flow and minimal-flow anaesthesia are defined by the level of the fresh-gas flow (l/min). They involve a significantly lower fresh-gas flow than the patient's respiratory minute volume (low-flow: 1.0 l/min; minimal-flow: 0.5 l/min; Metabolic flow: 0.35 l/min)[3]

Consistent implementation of low-flow anaesthesia is beneficial for patients, the environment and the hospital's budget.

Patient

Incidences of postoperative pulmonary complications (PPC) account for approx. 5% of common complications arising from machine ventilation.[4] They are often costly and increase mortality.[5] One in five patients with a PPC die within 30 days postoperative.[6] The clinical routine often involves working with high fresh-gas flows. A consequence of high fresh-gas flows is cold, dry respiratory gas that leads to a cooling and dehydration of the respiratory system.[7]

Insufficient breathing gas humidification can consequently result in a structurally and functionally compromised respiratory system. Even if the ventilation with cold and dry gas is for a relatively short time, this can still result in damage to the patient's lung function.[8] The ideal would be absolute humidity of 17 to 30 mg H_2O/l and an anaesthetic gas temperature of 28 °C. Low-flow anaesthesia contributes to breathing gas humidity and meets these requirements.[9]

Environment

Approx. 50% of total greenhouse gas emissions from an OR come from volatile anaesthetics.[10] Based on an average use of hypnotic gases and 10,000 anaesthesia procedures per year, the resulting annual CO_2 footprint is equivalent to that of 200 average German citizens.[11] In this way, volatile anaesthetics harm the environment and contribute towards climate change.

Compared to low-flow and minimal-flow anaesthesia, high flow anaesthesia emits a large amount of narcotic gases. Comparing the greenhouse gas emissions from an anaesthetic with a fresh-gas flow of 0.5 l/min versus one with a flow of 5 l/min during a six-hour operation with 1 MAC and sevoflurane as the volatile anaesthetic, the low-flow anaesthesia can reduce emissions by 89.5%.[12]

Budget

Approx. 5% of the total budget of an anaesthesia department can be attributed to inhalation anaesthetics, which could make up 20% of the total medical costs in an anaesthesia department.[13] Consistent implementation of low-flow anaesthesia significantly reduces the consumption of greenhouse-gas emitting volatile anaesthetics. Therefore, the environmental benefits go hand in hand with significant cost savings. This means that with a reduction in the fresh-gas flow from 4 l/min to 1 l/min, costs are cut by between 55% to 75%.[14]

In short, the efficiency of the anaesthetic gases used increases with the reduction in the fresh-gas flow. Low-flow anaesthesia benefits patient outcomes and brings ecological and economic benefits at the same time. To achieve this requires a transparent presentation of the consumption data and costs, as well as of the fresh-gas flow settings. The gas consumption analytics in Dräger Connect enable a clinic-wide and efficient reduction in the use of anaesthesia gases through networked medical equipment and intelligently prepared data.

The monetary benefits of low-flow anaesthesia

Assumptions:

120-min. surgery

Sevoflurane price
EUR 81 per 250 ml

10 OR theatres
250 OR days
with 3 cases per day

10-year use

Scenario:

Fresh-gas flow 0.5 instead of
2 l/min in steady state

Saving:

approx. EUR 7.31 per cases*

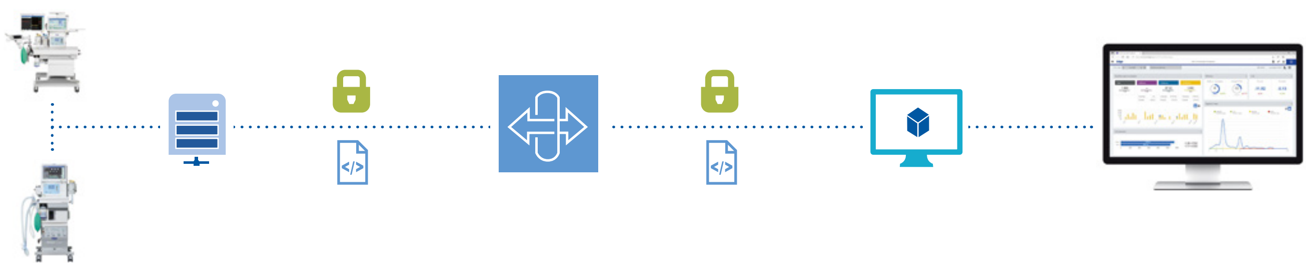
over 10 years approx.
EUR 528.525

DRÄGER CONNECT FUNCTION – GAS CONSUMPTION ANALYTICS

The collection of data and generation of meaningful insights from them can be extremely difficult if the resources to set up the dataflows and data analytics are lacking. Dräger Connect automatically evaluates the logbooks of the networked devices and presents the results on individually configurable dashboards. In this way the user can obtain a detailed overview of the gas consumption of individual anaesthesia devices and of the entire fleet, at any time and anywhere. The data are sent encrypted to a cloud, where they are intelligently evaluated and analysed. The analysis can be accessed via a secure browser connection by any internet-enabled end-user device. The simple connection of existing anaesthesia devices to Dräger Connect enables fast and custom scaling of the digitalisation of your OR. Gas Consumption Analytics provides you with an overview of the following information:

- Fresh-gas flow
- CO_2 equivalent of the anaesthetics consumed
- Consumption of volatile anaesthetics / O_2 / N_2O / AIR
- Patient uptake versus consumption
- Costs per case
- Costs per minute

The parameters for fresh-gas flow limits and the purchase price of the volatile anaesthetics can be individually adjusted.



Medical devices network with Service Connect® Gateway**

Secure transfer of technical device data (RDC) no patient ID

Backend data-processing

Visualisation via web browser in the hospital

*The calculations were made using Gas Man® simulation software.[15]

**Not all products, features or services are available in all countries. Mentioned trademarks are only registered in certain countries and not necessarily in the country in which this material is released. Current registrations can be found at www.draeger.com/trademarks

ANAESTHESIA ANALYTICS – FLORENCE NIGHTINGALE HOSPITAL

In 2019 the Florence Nightingale Hospital implemented Gas Consumption Analytics in order to uncover the potential for reducing consumption of volatile anaesthetics. Before the introduction of Drager connect the Florence Nightingale Hospital were already advocates of low flow anaesthesia, however the gas consumption analytics for the period between December 2019 and May 2021 showed a reduction in average fresh-gas flow of a further 20.19%. This led to a reduction of greenhouse gas emissions and of the costs of anaesthetic gases per minute of 14.29%. In total, the efficiency of the anaesthesia per case rose by more than 8.36% as a result.

The Florence Nightingale Hospital example shows how if used when low-flow anaesthesia is consistently implemented, Gas Consumption Analytics provides the necessary data to obtain an overview of the gas consumption of all of the anaesthesia devices. Dräger Connect visualises your results and in addition shows you the CO_2 equivalent savings. This encourages a rethink in terms of the role of low-flow anaesthesia and hence contributes to environmental protection.

See for yourself the possibilities data analytics offers for cutting emissions and costs in your OR.

	Comparative data from the gas consumption analytics		Difference
	Dec. 2019	May 2021	
Cases	395	449	
Avg. case duration (minutes)	74	93	
Avg. consumption per case (ml) Sevofluran	17.52	19.5	
Avg. costs per case (EUR)	10.36	11.16	
Avg. costs per minute (EUR)	0.14	0.12	-14.29%
Avg. FG-flow per case (l/min)	3.17	2.53	-20.19%
Avg. efficiency per case Sevofluran (%)	49.76	53.92	+8.36%

Further analysis revealed that by reducing the average consumption of sevoflurane by 0.0207 ml/min in May 2021, savings in emissions equivalent to 0.225 t CO_2 were made.

This equates to 1,759 driven car kilometres.[16]

By reducing the fresh-gas flow, the average costs of an anaesthetic can be cut by

14.29%

per minute.

Reducing the fresh-gas flow contributes considerably to a reduction of greenhouse gas emissions. In May 2021, this alone was enough to save

0.225 t CO_2

emissions, which is equivalent to driving

1,759 km

in a car.

Want to find out more? We would be happy to discuss our offerings and arrange a specific appointment with you.
Call us on +49 (0)800 882 882 0 or use the contact form at: www.draeger.com/contact.
We look forward to hearing from you!

PDF-11550

SOURCES

1. M. P. Sulbaek Andersen, S. P. Sander, O. J. Nielsen, D. S. Wagner, T. J. Sanford, Jr, T. J. Wallington, Inhalation anaesthetics and climate change, BJA: British Journal of Anaesthesia. 2010 Dec; 105(6):760–766. doi: 10.1093/bja/aeq259

2. Schuster M., Richter H., Pecher S., Koch S., Coburn M.: Position Paper with Specific Recommendations*: Ecological Sustainability in Anaesthesiology and Intensive Care Medicine. Anästh Intensivmed 2020; 61:329–339. doi: 10.19224/ai2020.329

3. Hönemann C., Mierke B.: Low-Flow, Minimal-Flow und Metabolic-Flow Anaesthesia, Published by Drägerwerk AG & Co. KGaA

4. Canet et al.: Prediction of postoperative pulmonary complications in a population-based surgical cohort, Anesthesiology. 2010 Dec;113(6):1338-50. doi: 10.1097/ ALN.0b013e3181fc6e0a

   Güldner et al.: Intraoperative protective mechanical ventilation for prevention of postoperative pulmonary complications: a comprehensive review of the role of tidal volume, positive end-expiratory pressure, and lung recruitment maneuvers, Anesthesiology. 2015 Sep;123(3):692-713. doi: 10.1097/ ALN.0000000000000754

5. Miskovic A., Lumb A.B.: British Journal of Anaesthesia. Postoperative pulmonary complications. 2012;118 (3): 317–34

6. Canet et al.: Prediction of postoperative pulmonary complications in a population-based surgical cohort, Anesthesiology. 2010 Dec;113(6):1338-50. doi: 10.1097/ ALN.0b013e3181fc6e0a

   Güldner et al.: Intraoperative protective mechanical ventilation for prevention of postoperative pulmonary complications: a comprehensive review of the role of tidal volume, positive end-expiratory pressure, and lung recruitment maneuvers, Anesthesiology. 2015 Sep;123(3):692-713. doi: 10.1097/ ALN.0000000000000754

7. Canet J., Gallart L., Gomar C, Paluzie G., Vallès J., Castillo J., Sabaté S., Mazo V., Briones Z., Sanchis J.; ARISCAT Group. Prediction of postoperative pulmonary complications in a population-based surgical cohort. Anesthesiology. 2010 Dec;113(6):1338-50. doi: 10.1097/ALN.0b013e3181fc6e0a. PMID: 21045639

8. Bilgi et al., Comparison of the effects of low-flow and high-flow inhalational anaesthesia with nitrous oxide and desflurane on mucociliary activity and pulmonary function tests., Eur J Anaesthesiol. 2011 Apr;28(4):279-83. doi: 10.1097/EJA.0b013e3283414cb7
   Kilgour et al.: Mucociliary function deteriorates in the clinical range of inspired air temperature and humidity, Intensive Care Med. 2004 Jul;30(7):1491-4

9. Kleemann PP.: Humidity of anaesthetic gases with respect to low flow anaesthesia. Anaesth Intensive Care. 1994 Aug;22(4):396-408. doi: 10.1177/0310057X9402200414. PMID: 7978204

   Aldrete J. A., Cubillos P., & Sherrill D.: Humidity and Temperature Changes during Low Flow and Closed System Anaesthesia. Acta Anaesthesiologica Scandinavica. 1981; 25(4): 312-314. https://doi.org/10.1111/j.1399-6576.1981.tb01657.x

10. Sherman, Jodi D. MD*; Berkow, Lauren MD, FASA† Scaling Up Inhaled Anesthetic Practice Improvement: The Role of Environmental Sustainability Metrics, Anesthesia & Analgesia: 2019 Jun; 128 (6):1060-1062. doi: 10.1213/ANE.0000000000004095

11. Schuster M., Richter H., Pecher S., Koch S., Coburn M.: Position Paper with Specific Recommendations*: Ecological Sustainability in Anaesthesiology and Intensive Care Medicine. Anästh Intensivmed 2020; 61:329–339. doi: 10.19224/ai2020.329

12. Sherman J., Feldman J., Berry J.M.: Reducing Inhaled Anesthetic Waste and Pollution Anesthesiology News. Anesthesiology News 2017;12–14

13. Bach A.: Kosten von Sevofluran im gesamten perioperativen Umfeld [Costs of sevoflurane in the perioperative setting]. Anaesthesist. 1998 Nov;47 Suppl 1:S87-96. German. doi: 10.1007/pl00002505. PMID: 9893887

14. Suttner S., Boldt J.: Low-flow anaesthesia. Does it have potential pharmacoeconomic consequences? Pharmacoeconomics. 2000 Jun;17(6):585-90. doi: 10.2165/00019053-200017060-00004. PMID: 10977395

    Baum J.A.: Low Flow Anaesthesia with Dräger Machines. 2004

    Lortat-Jacob B., Billard V., Buschke W., Servin F.: Assessing the clinical or pharmaco-economical benefit of target controlled desflurane delivery in surgical patients using the Zeus anaesthesia machine. Anaesthesia. 2009 Nov;64(11):1229-35. doi: 10.1111/j.1365-2044.2009.06081.x. PMID: 19825059

15. Med Man Simulations, Inc. (2021). Gas Man® (4.3) [Software]. https://www.gasmanweb.com/software/

16. “CO_2 development in Germany”, German Association of the Automotive Industry (VDA). (2021) CO_2 development in Germany – VDA