

Dräger Review^{96.1}

The Magazine for Technology in Medicine **November 2008**

Air Rescue

Maximum performance in
minimum space

IT in the OR

Seamless support with
bits and bytes

TestCenter

Standards for tomorrow

Breathe Easy

New masks create
breathing space



A place to thrive.

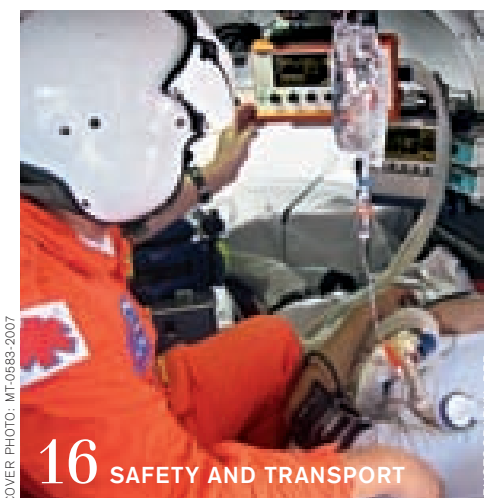


Dräger neonatal competence.

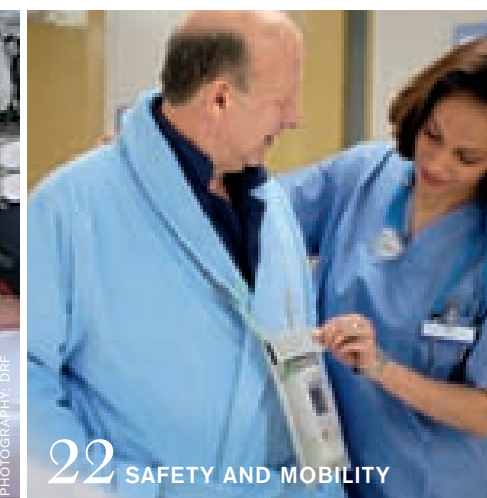
There is a perfect place in the world of perinatal care where everyone thrives. Where the vulnerable neonate can devote all its precious energy to growth. Where caregivers can anticipate and stay ahead of the changing needs of their delicate patients. Where the entire NICU works as one, for a new level of simplicity, connectivity, efficiency, and synergy. We call this place the Zone of Care. www.draeger.com

Dräger. Technology for Life®

Over **888 kilometers**, a Porsche Cayenne Turbo emits exactly as much CO₂ as one person in one year. Read more on page 12.



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What Moves Us—Dräger Worldwide

Dr. Božetěch Jurenka, Chief Physician, Anesthesiology & Intensive Care, Prague Military Hospital

"Afghanistan is a land of extremes. During the four months I worked there as an anesthesiologist in the Czech field hospital at Kabul Airport, the temperature fluctuated between -25 and +35 degrees Celsius. We also had to cope with lots of sand and dust. Those were tough challenges for the staff and for our equipment. In addition, the base was bombarded with rockets and subjected to a terrorist attack that our combat troops had to repel.

What astonished me most about this country, besides its very different culture, was the excellent equipment in our field hospital. It was comparable to the technology here in the Prague Military Hospital. We had medical gas equipment, modern medical technology that measured up to European

standards, and familiar devices such as the Oxylog 2000 emergency and transport ventilator, the patient monitors Delta and Gamma, and the Fabius anesthesia workstation. Everything worked reliably, even under difficult conditions. Our medical technicians and service specialists were flown in regularly. They performed maintenance procedures while the hospital's regular operations continued without interruption and all beds were occupied. Now I'm back in Prague, where there's plenty to do in our hospital. In our country, anesthesiology has a proud tradition, which we are continuing today at a high technical level. But I'll certainly be traveling again to deal with tanks, pipes, and valves—on my next vacation: I'm going diving."



PHOTOGRAPHY: PRIVATE. © TERRICAVOLI.COM 2008; TEXT: SILKE UMBACH



Captain Rick Rochford, City of Jacksonville Fire and Rescue Department, Florida, USA

"I was hired by the City of Jacksonville, Florida, in 1988. I had always dreamed of becoming a professional firefighter. I've got relatives who are firefighters in New York City, and I worked for years as a volunteer fireman. My practical background was the key reason why I joined the 'hazmat' team. That's the unit that deals with hazardous materials and the products generated by their combustion: toxic chemicals and fumes. Jacksonville had the first team of this kind in the United States, and we're proud of that! Our work has become increasingly important over the years. In the past, wooden houses would simply burn down, but today all kinds of synthetic materials are burning and releasing treacherous substances such as prussic acid (HCN). One firefighter collapsed with a cardiac

arrest while he was connecting fire hoses to a hydrant in front of a house. He wasn't even anywhere near the source of the fire, where his colleagues were wearing gas masks. But the fumes crept out of the fire and poisoned him. That's why it's very important for me to be able to measure volatile substances and give firefighters information about them. What I tell my men is: 'Do your best, but remember that your family is waiting for you at home. I want you to do a good job and grow old doing it.' My wife—a person I can talk to about everything, even on difficult days—also expects that from me. I've always got my HCN detector with me. And I'm grateful for the support I'm getting as I do my teaching and research about the risks involved in our profession. Great teamwork!"

Duncan Cumming and Neil Halewood, divers at Bibby Offshore Ltd., Aberdeen, UK

"We are aquanauts. We work on the sea floor, for example at the base of oil drilling platforms or in rescue operations. Just as though we were in a space station, our lives are completely dependent on technology—smoothly functioning technology that's reliable at all times. That's why we divers are 100-percenters. For us, innovation means 'trial without error.' Obviously, someone whose diving helmet develops a leak many fathoms below the surface won't have a chance to report the fault. On our ship, we live for one month at a time in the pressure chamber at five to 20 bar—exactly the pressure that our bodies are under at our working depth. Typical working depths for the North Sea are between 50 and over 200 meters—but with our equipment it would also be possible to work at 300 meters. In addition to deep-sea diving suits we also use diving bells, in which we ride from the ship to the sea floor. All of

this depends on the pressure chamber technology that Dräger has installed in the hold of the ship: it's got 20 million liters of compressed air on board. There's also a special rescue boat for the divers, which is also kept under deep-sea pressure. That's because a safe return from the pressure at 200 meters below the surface would last a week—that's how long the tissues of a human body would take to release the accumulated gases. We've worked for as long as three weeks in the depths of the sea. Afterwards, when we're aboard ship but not actually working, we have to stay cool, relax, read books, and literally breathe easy. When we're at home—for seven months of the year—we have to stay fit. That means working out five days a week at the gym, climbing, and skiing. Just like technical equipment, the human body also requires ideal maintenance in order to meet the challenges of the depths."



PHOTOGRAPHY: ST-15087-2008; THORSTEN JANSEN; TEXT: SILKE UMBACH



Olaf Barski, award-winning designer from Frankfurt am Main, Germany

"Hospital equipment was new to me. I had designed telephones and electric shavers, things that we use every day. But how do you illuminate a wound so that a doctor can make a clear diagnosis? I have to understand all aspects of the problems involved. What happens to an operating theater light when it's switched off or being cleaned? And will people use the equipment improperly when they're under stress.

To prevent misuse, I rely on design—and communication. That's why I listen to the people whose tools I'm designing. And some of the things I've learned amaze me. For example, many highly technical devices that are moved around every day don't have automatic cable rewind mechanisms—something you'll find on every kitchen appliance! Of course my first Dräger light had an automatic cable rewind. I want the things I create to perfectly match their function. So I have to do tough and meticulous devel-

opment work on every detail until I find the highest level of functionality. A key factor here is inspiration. When I was working on Stella, the first surgical light I made for Dräger, I visited the development center, which at that time was still located in Travemünde. Looking at the Baltic Sea I began to think about lighthouses and realized I wanted the light to float. Today we can design the most important thing—the light itself—even more perfectly. In the new light, 54 pairs of special LEDs located in 54 specially developed reflectors will generate light that permits an even better diagnostic view. In the future I'd like to design a complete operating theater, where all of the systems are seamlessly integrated so that people can do their very best work."

The new Dräger LED surgical light received the red dot design award in 2008 and has been nominated for the 2009 Design Award of the Federal Republic of Germany. Market launch is scheduled for March 2009.



PHOTOGRAPHY: JIONGKAI ZHANG/PHOTOGRAPHYLA.COM

Business is growing on the banks of the Pearl River

New Building at the Shanghai Facility

In keeping with a Chinese proverb that states “the louder the music, the greater the prosperity”, Dräger inaugurated its new production building in Shanghai’s Nan Hui district on September 26, 2008—complete with a dragon dance and thundering drum rolls. Stefan Dräger, Chairman of the Executive Board of Drägerwerk Verwaltungs AG, symbolically cut the red ribbon together with customers and representatives of the city government.

From now on, the 11,000 m² building will house a facility for manufacturing sub-assemblies for anesthesia devices and respirators, including the trolley for the “Fabius plus” anesthesia workstation. The new production hall will replace leased premises and provide space for the approximately 320 employees of the company’s Medical division.

The move into the new building will enable Dräger to expand its production operations in China and will also create room for larger projects. Dräger plans to create new jobs at its Shanghai facility in the mid-term future. Both divisions of Dräger have been represented in China since the mid-1990s.



Dräger—providing its customers with objective information since July 1912

Dräger Review: Starting Its 97th Year of News

The first Dräger customer magazine “Aus dem Draegerwerk Lübeck” (News from the Draegerwerk in Lübeck) appeared in the summer of 1912. Edited by Heinrich and Bernhard Dräger, it was one of the first industrial company magazines. Since then, it has published 96 English issues, each one of which aims to provide customers with information on Dräger’s technical developments and their applications. The publication quickly gained an excellent reputation as a company-published trade magazine. It has remained that way for all of the past 96 years, and the Dräger Review will continue to stay the course in the second century of its existence. From the very start, the magazine’s concept has been advanced, because Dräger has always considered its customers to be partners with whom it has a mutual understanding and is committed to a common cause. The magazine focuses solely on technology and its direct benefits for humanity, as the company and its customers share the conviction that—as Goethe put it—only the work proves the craftsman.

“The stories we tell are just as exciting as those our customers experience. The Dräger Review serves as a platform for these stories, which primarily recount experiences and impart knowledge,” says Burkard Dillig, who was responsible for the Dräger Review for more than 20 years and now works as Dräger’s Corporate Spokesman. The magazine will continue to perform this role in the future, thanks in part to a new design that meets the needs of today’s readers. The articles in the Dräger Review have always been written by people at the company. However, beginning with this issue, the editorial staff headed by Björn Wölke will also work together with a pool of experienced journalists. This change will ensure that the Dräger Review will not only remain a publication of experts at its core, but will also offer even greater benefits to its readers.



PHOTOGRAPHY: MESSE DÜSSELDORF

The sector will meet in Düsseldorf

MEDICA—World Forum for Medicine

The 40th World Forum for Medicine will be held in Düsseldorf from November 19 to 22. Over 4,200 exhibitors from 65 countries will display their products and services at MEDICA, the world’s largest trade show for medical systems. The presentations on some 120,000 m² of exhibition space will focus on electromedical equipment, medical technology, lab equipment, diagnostics, physiotherapy, orthopedic technology, medical commodities and supplies, information and communication technology, fabrics, facility furnishings, and building technology. In a booth of about 700 m² (Hall 11/J 39), Dräger will once again offer visitors an exciting program. It will display two patient paths (one for adults, the other for neonates) that show how hospital equipment can be used to save lives while minimizing patient stress. It will also focus on non-invasive applications, safe patient transport, and the fast exchange of patient data.



MT: 1348-2007

Individualized intelligence from the plant

Pre-configured Monitors

By the end of next year, the company will pre-install all software and IT configurations worldwide in Lübeck instead of at the customer site, as is currently the case. This will apply not only to Dräger’s Infinity® Delta, Gamma, and Kappa monitors, but also to future models. The changeover began with a pilot project in France and Spain and will gradually be expanded to other countries.

In the future, Dräger will request all of the relevant IT data from the customer so that the IT experts in Lübeck can make the corresponding network settings. Another new feature is the packaging, for which less material is now needed. Not only is this more environmentally friendly, but it is also expected to significantly reduce installation times.

Research Prize for Ventilation Therapy

The European Society for Intensive Care Medicine (ESICM) recently presented the first Bernhard Dräger Award for Advanced Treatment of Acute Respiratory Failure, with which Dräger is supporting a research project for improving ventilation therapy using non-invasive monitoring. The recipient of the award and its 15,000 euros in prize money was Dr. Hermann Heinze, 36, from the Clinic for Anesthesiology and Intensive Care Medicine at the Schleswig-Holstein University Hospital. The award was presented at the Society’s annual conference by Prof. V. Marco Ranieri, President of ESICM, and Dr. Daniel de Backer, Chairman of the ESICM research committee.

In his award-winning research project, Heinze will in 2009 investigate the extent to which the measurement of lung volumes can help manage recruitment maneuvers to re-expand collapsed lung tissue in patients suffering from respiratory failure. In doing so, he will also use new methods, such as the bedside measurement of functional residual capacity (FRC) and electric impedance tomography (EIT). The analysis of inflammation mediators in blood will be among the factors that Heinze will use to prove that applied respiratory maneuvers provide a less harmful therapy.

One-Brand Strategy for New Website

With a redesigned website, Dräger also aims to combine its divisions under one roof on the Internet. In addition to sporting a new look, the relaunched website will have completely reworked content and more multimedia features. The focus will particularly be on directly addressing Dräger’s various customer groups and their different needs. The new website is scheduled to go online in January 2009.

New Breathing Masks Help Everyone Breathe Easier

To date, **NON-INVASIVE VENTILATION (NIV)** has not yet received the recognition that studies unanimously agree is its due. New critical care ventilators and more comfortable masks are contributing to its increased acceptance

IT'S A HORRIFYING prognosis: chronic obstructive pulmonary disease (COPD) will be the third most frequent cause of death worldwide by the year 2030. The World Health Organization (WHO) is forecasting the extraordinary increase in occurrences of this complex syndrome. This development makes it necessary to reassess the ventilation therapies used to date, as was recently done in Germany in the clinical practice guideline “Non-Invasive Mechanical Ventilation as Treatment of Acute Respiratory Failure” (edited by: Dt. Gesellschaft für Pneumologie und Beatmungsmedizin e.V.). The objective of the guide-

line is to extend and establish the use of NIV in cases where acute medical indications are present. This will be to the benefit of a large number of patients, as Prof. Ralf Kuhlen, Chief Physician at the Clinic for Intensive Medicine at the Helios Klinikum in the Buch district of Berlin, explains. Kuhlen was substantially responsible for the formulation of the clinical practice guideline on non-invasive ventilation (see interview, p. 15).

Support and replace

According to the guideline, in many cases invasive ventilation is still unavoidably necessary as a life-saving measure. It is, however, associated with the risk of nosocomial infections, in particular the risk of ventilator-associated pneumonia and the consequent higher mortality and increased costs. It entails the risk of infection, since the trachea functions like an “expressway for germs.” It also requires measures to provide sedation and eliminate pain, and its long-term application leads to atrophy of the musculature and the need for slow weaning off the ventilator.

If a patient’s breathing has been adversely affected by pathophysiological changes, it may have to be artificially maintained. This requires the mechanical supply of oxygen and air and the removal of CO₂. In many cases sedation is also required. Equipment that can mechanically take over the function of the inspiratory muscles has therefore been developed. Modern ventilators such as the Evita XL offer a wide range of ventilation modes for optimal adjustment to the specific clinical situation—whether the ventilation is invasive or non-invasive.

A respirator for non-invasive ventilation was available for use in hospitals as early as 1928 in the form of the “iron lung,” which reproduced the breathing process by means of a cyclic sequence of underpressure (inhalation) and overpressure (exhalation) on the thorax. Ventilation by means of a mask is a new technology which has developed since the 1980s.

Such techniques were initially utilized for chronic illnesses, but are increasingly being applied in acute cases as well. They were, however, initially unable to gain >

ABSTRACT Evidence-based non-invasive ventilation avoids the risks of nosocomial infections with the consequent increased mortality and substantially higher costs. The German Clinical Practice Guideline will increase the acceptance of NIV. Newly developed breathing masks are an important “accessory” for NIV, whose use is desirable for both medical and economic reasons.

ClassicStar®

- ▶ Disposable non-invasive ventilation mask with adjustable cushion for premium comfort with anatomical fit and optimal leakage control
- ▶ Adjustable forehead support for improved distribution of contact pressure on forehead and bridge of nose
- ▶ Improved stability and fixing due to six-point headgear
- ▶ Compatible with Dräger ventilators incorporating an NIV option: Evita series, Savina, and Carina

Movable forehead support and pad for greater stability

The air-filled mask cushion can be adjusted to the patient's facial contours for more comfort and a more effective seal

Optional fixation points on the mask frame enable the headgear to be fastened in the individually most comfortable and stable way possible

O₂ connection for oxygen bleed-in or pressure measurement

Access for nasogastric tube

The standard elbow can be rotated in 360° and adjusted vertically in order to provide increased flexibility

Mask ventilation complies with the most rigorous criteria for evidence-based medicine

> widespread acceptance due to technical reasons, including inadequate synchronization between the ventilator and the patient, which led to complications in this form of artificial ventilation.

Since then, the combination of improved masks and refined mechanical ventilation modes has continually expanded the area of application for mask ventilation, so that it is nowadays even being used in emergency care and neonatal intensive care units. Non-invasive ventilation (NIV) causes much less serious complications than invasive ventilation. This result was obtained in a number of studies with clear statistical significance in the area of intensive care, which showed a significantly lower mortality rate for ventilation using masks as compared to the figure for intubation (e.g. Brochard, Mancebo, and Wysocki et al.; 1995). Nonetheless, adds Kuhlen, the use of NIV in acute medicine “remains inadequate” despite a body of favorable evidence-based data.

Costs halved

Purposefully and correctly applied, NIV can “significantly” shorten the time taken to wean patients off a ventilator. In 2003, Ferrer et al. confirmed the generally shorter average duration of stays both in intensive care units and at hospitals in their randomized study “Non-invasive Ventilation during Persistent Weaning Failure” (Am. J. Respir. Crit. Care Med., Vol. 168, No. 1, July 2003, 70-76).

According to a 2006 study by Schönhofer et al., an intubated ventilated pneumonia patient in Europe results in costs >

Breathe in and out, please



PHOTOGRAPHY: AP PHOTO

The lungs supply the body with oxygen and energy. A newborn baby inhales and exhales about 50 times per minute. Adults, on the other hand, fill and empty their lungs with approximately 0.5 liters of air only 12 to 16 times a minute. The inspiratory muscles have thus

exhaled more than a quarter of a million cubic meters of air by age 69—almost enough to inflate 23 of the first type of Zeppelin airship, the LZ-1, which was 128 meters in length.

The lung is a kind of fine-pored sponge with 30 million tiny sacs known as alveoli. In order to inhale (inspiration), the diaphragm contracts, creating a vacuum that sucks fresh air through the trachea and bronchi into the consecutive clusters of alveoli. From there, the air is transported into the arteries, which supply oxygen to the mitochondria (the so-called ATP factories), where it helps convert glucose into carbon dioxide (CO₂), water, and energy.

Annual CO₂ emissions equal to driving 888 km in a Porsche Cayenne

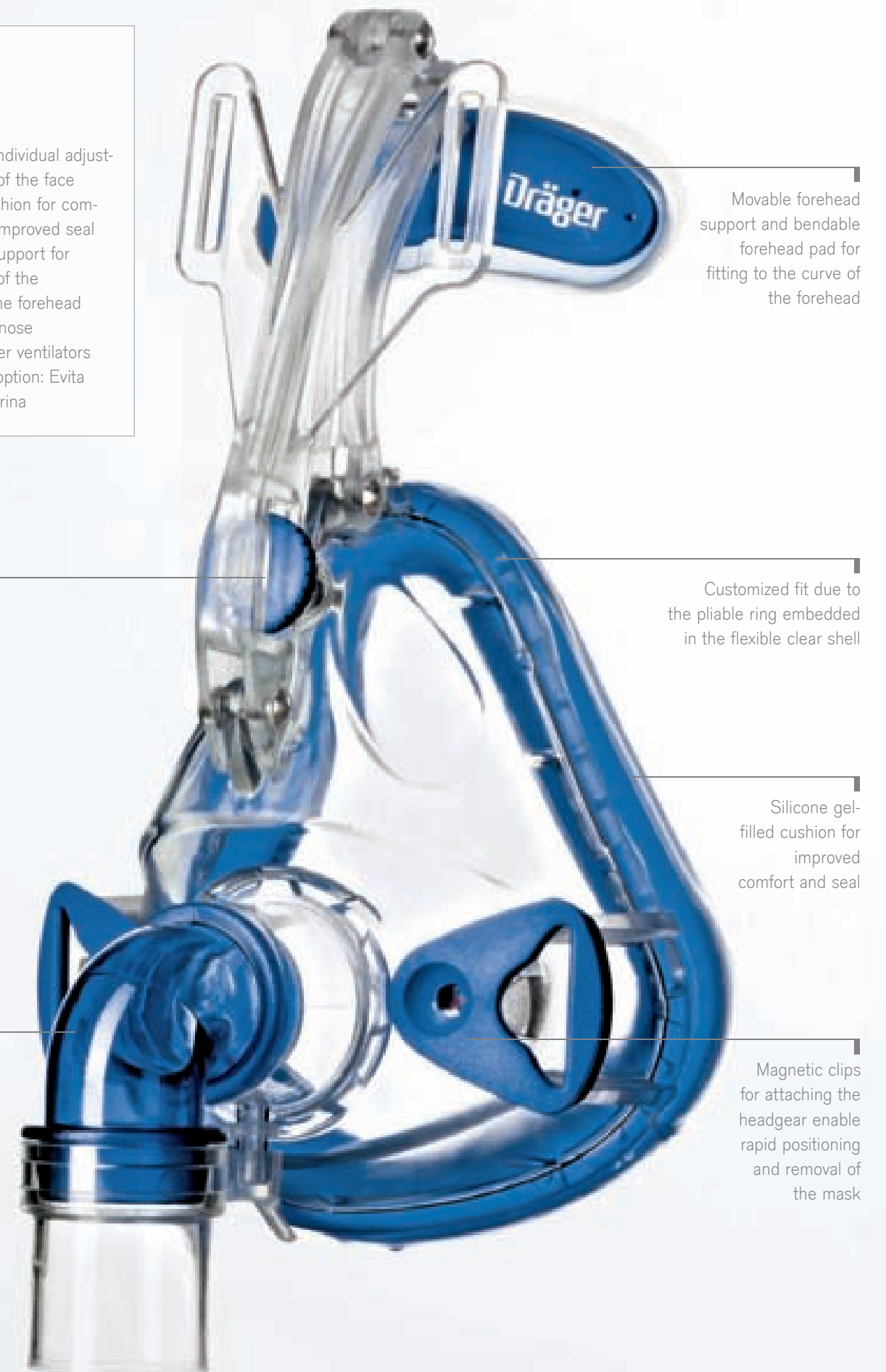
The CO₂ is then removed in reverse order, whereby veins carry the gas to the alveoli. When the lungs are passively exhaling (expiration), CO₂ and water are transported via the bronchia into the surrounding atmosphere. When a person is at rest, his or her “CO₂ footprint” is about 315 kilograms of CO₂ per year, which is equivalent to the amount produced by driving a Porsche Cayenne Turbo 888 kilometers.

The body makes use of various mechanisms to simplify respiration. What immediately comes to mind is the analogy of a lung with a spring. Primarily as a result of the diaphragm’s muscular force, the lung is expanded during inhalation and automatically deflates again during exhalation.

Another facilitator that is just as efficient but less noticeable is the substance that coats the alveoli and lowers the surface tension of water. Known as a surfactant, this substance stabilizes the differently sized alveoli and thus increases the expandability of the lung (compliance). The pressure difference during inhalation is reduced as a result, making the breathing process easier. A person whose respiratory system is obstructed will suffer either from oxygen deficiency (hypoxia) as the chief symptom, or else from increased CO₂ in the blood in the arteries (hypercarbia).

NovaStar®

- ▶ Reusable non-invasive ventilation mask
- ▶ Optimal fit thanks to individual adjustment to the contours of the face
- ▶ Extremely soft gel cushion for comfortable wear and an improved seal
- ▶ Adjustable forehead support for improved distribution of the contact pressure on the forehead and the bridge of the nose
- ▶ Compatible with Dräger ventilators incorporating an NIV option: Evita series, Savina, and Carina



Movable forehead support and bendable forehead pad for fitting to the curve of the forehead

Thumb wheel for adjusting the forehead support gradually

Customized fit due to the pliable ring embedded in the flexible clear shell

Silicone gel-filled cushion for improved comfort and seal

Standard elbow can be moved in 360° for increased flexibility

Magnetic clips for attaching the headgear enable rapid positioning and removal of the mask

NIV shortens the average length of stays and thus cuts case costs significantly

> of 25,000 euros, whereas non-invasive ventilation more than halves such costs to 10,300 euros. Further studies have revealed that, to date, the masks used have often been considered a limiting factor for NIV.

On the one hand, masks must be comfortable to wear and may not cause lesions—i.e. skin irritations; on the other, they must not permit anything more than

minor leakage that can then be fully compensated for by the respirator. The new NIV ClassicStar and NovaStar full-face masks provide substantial improvements in these areas. Another focus is on mini-

mizing the dead space of the mask. The NovaStar is the first full-face mask in hospital and institutional use to utilize an extremely soft gel-filled cushion, which provides an extremely good anatomical fit and combines a high level of both comfort and functionality. “We really like the gel cushion and the flexibility of the mask,” commented two physiotherapists after an exhaustive application test in a department of the Karolinska University Hospital in Solna, Sweden at the beginning of 2008. What’s more, the masks are “very easy” to use. In cases where artificial feeding is used, the nasogastric tube is covered by the gel cushion (NovaStar), or led to the patient via an opening (ClassicStar). Unlike conventional solutions, significant leakage and skin irritations can be avoided. Both masks cover the mouth and nose.

Accessories extend the range

A wide range of easy-to-fit accessories extends the range of applications. Components include both humidification filters and Barr-vent filters to protect against viral and bacterial infection. The masks with their respective filters and breathing circuits have, of course, been validated as complete systems. In total, the properties of current developments in mask technology contribute fundamentally to increasing the acceptance of NIV among both patients and care personal—and so promote the increased application of mask ventilation. **Imme Ubben**

Further information online:
[Product information](#)
[100 Years of Artificial Ventilation](#)
www.draeger.com/96/NIV

Heike Petermann

Milestones: the road to patient-oriented ventilation

1771 Discovery of oxygen as a component of air: *Carl Wilhelm Scheele and later Joseph Priestley (1775)*
1775 Respiration serves to provide oxygen: *Antoine Lavoisier*
1858 Manual ventilation method: *Henry R. Silvester*
1876 Negative pressure ventilation—the Spirophore at the Paris World’s Fair of 1878: *Eugène Woillez*
1882 Inspiration is triggered by O₂ shortage, expiration by an excess of CO₂: *Julius Bernstein*

1895 “Linde process”—filling bottles with gases such as oxygen: *Carl von Linde*
1903 “Biomotor”—portable devices for artificial respiration in a foot-driven cuirass: *Rudolf Eisenmenger*
1904 Pressure difference method using a negative pressure chamber: *Ferdinand Sauerbruch*
1906 Positive pressure machine (Brauer-Dräger®): *Ludolph Brauer*
1907 Time-controlled alternating-pressure ventilation (Dräger Pulmotor®; prototype): *Heinrich Dräger*
1908/09 Pressure-controlled alternating-pressure ventilation (dual-tube system) (Dräger Pulmotor®; series production): *Bernhard Dräger and Hans Schröder*
1928 Tank respirator, so-called “iron lung”—intermittent negative-pressure ventilation for the treatment of gas poisoning: *Philip Drinker and Louis Agassiz Shaw*

1937 Wooden Both respirator (Australia); produced by Morris Motors Ltd., UK (1938): *Edward Both*
1940 Worldwide polio epidemics until the 1960s
1947 Production of the “iron lung” by the Deutsche Werft, Hamburg—the torpedo tube from a destroyer (pressure chamber), bellows from a field smithy (drive), part of a fishing cutter (gearbox): *Axel Dönhardt and Reinhard Aschenbrenner*
1947/49 Parallel development of the iron lung at Dräger (prototype)/Model E 52—series production (1952)
1952 “Bag ventilation”: manual ventilation by means of a to-and-fro system; 200 patients ventilated by 1,500 students in Copenhagen
1952 Control of the tidal volume and the respiratory rate (positive-pressure ventilation): *Engström Respirator®*
1953 Ventilation via tracheotomy cannula or tube (Dräger Pulmotor principle): *Dräger Poliomat®*

1955 Controlled and assisted ventilation: time-controlled, constant volume—with humidification and warming of the breathing gas: *Dräger Spiromat®*
1965 Assisted ventilation: pressure-controlled, patient-triggered: *Dräger Assistor®*
1971 Volume-controlled ventilation with a feedback system: *SERVO® 900*
1982 Microprocessor-controlled ventilation and integrated ventilation monitoring: *Dräger EV-A*
1988 Introduction of patient-adapted ventilation: optimization of the spontaneous breathing support with BIPAP: *Dräger Evita® series*
1995 Further development of patient-adapted ventilation—introduction of AutoFlow and then of PPS (1997) and NIV (2000): *Dräger Evita 4*
2005 Reduction of ventilation time by automated weaning off the respirator using the knowledge-based SmartCare system *Dräger Evita XL*



ILLUSTRATION: FROM PATENT SPECIFICATION

1883 First patent for a respirator apparatus (see illustration): *John Ketchum*
1889 Lubeca® pressure regulator—supply of gases from bottles: *Heinrich Dräger*



Prof. Ralf Kuhlen was substantially responsible for the formulation of the Clinical Practice Guideline on non-invasive ventilation.

“NIV requires a different kind of patient management”

PROF. RALF KUHLLEN (43) is Chief Physician at the Clinic for Intensive Medicine at the Helios Klinikum in the Buch district of Berlin.

Why was the Clinical Practice Guideline on non-invasive ventilation (NIV) developed?

Kuhlen: For some indications, especially in the area of hypercarbic forms of respiratory failure, NIV offers clear advantages in comparison with invasive ventilation. These advantages include fewer germs entering the respiratory system and consequently a lower incidence of nosocomial infections due to the non-use of a tube, and no need to sedate the patient. These advantages have not, however, been fully utilized in critical care medicine to date, so that one of the guideline’s objectives was to establish the recognition due to NIV for the area of acute medical care and to extend its application. But the guideline also warns against too great an extension of NIV in cases with unclear indications, such as severe forms of hypoxaemic gas exchange abnormalities.

What was previously the limiting factor preventing greater use of NIV?

Kuhlen: Many studies have shown the advantage of NIV, but this knowledge has not yet taken hold in day-to-day hospital practice. NIV also requires a different kind of patient management. Patients who are awake require more attention from medical and care personnel in the initial phase—that of adaptation of the NIV. However, this increased effort at the beginning is compensated for by the corresponding reduction in the care needed as treatment progresses. The total effort required by the two methods of treatment—invasive and non-invasive ventilation—is about equal. However, all studies of NIV in cases of hypercarbic respiratory insufficiency indicate that fewer patients require intubation and that the survival rate connected with the ventilation episode is better.

How do you see applications of NIV developing in the future?

Kuhlen: The demographic development in many industrialized countries will mean that we have to face an increase in the number of patients with advanced stages of chronic obstructive pulmonary diseases (COPD). Good data supports the observation that many patients in this group profit from NIV and also experience an improved quality of life when the process is used outside the hospital environment.

Where do you see a remaining need for improvement in mask ventilation?

Kuhlen: A couple of points occur to me as a specialist in this area. But the most important improvement as far as the patients are concerned will be the significantly increased consideration of NIV when adequate indications are present in the everyday hospital environment. The primary objectives of the Clinical Practice Guideline are to spread knowledge of the value of the procedure for these indications.

Rescue from the Air

Air rescue operation profiles in Europe and the U.S. increasingly require the use of a compact ventilator with clinical capabilities. Air Evac, an air medical service company based in Missouri, will also soon be utilizing the Dräger Oxylog 3000 for **EMERGENCY TRANSPORT VENTILATION**

ALTHOUGH THE QUICK FLIGHT

to the scene of an accident is still an important element of an air medical rescue operator's repertoire, changes in the hospital landscape have led to a shift of emphasis. Helicopters are increasingly being used to transfer patients from one clinic to another. Prior to these changes, simple ventilators were sufficient to ensure controlled breathing during transport. Now, however, the increasing demands are requiring the use of ventilators that meet critical-care performance criteria.

The general technical demands of the task haven't changed, however—small

installation spaces, strict adherence to the tight restrictions on helicopter payloads, and resistance to vibrations are still essentials.

Helicopters save lives

Air rescue has a long tradition. Back in 1966, the U.S. National Academy of Sciences published a White Book on Death and Invalidity that criticized the lack of coordinated action with regard to the rescue of injured individuals, thereby laying the foundation for the creation of an organized civil rescue service in the U.S. Then, in 1972, the first civil rescue med- >

ABSTRACT Structural changes in healthcare systems are creating new challenges for air rescue services in Europe and the U.S. Cutbacks in treatment capacity in rural areas are leading to an increased need for patient transfer services, and the strategy for providing air rescue coverage has been adapted to meet the new demands. Rescue helicopters are no longer utilized solely for primary-care operations but are also increasingly being used for the provision of inter-hospital transfers.

This Air Evac Lifeteam helicopter has landed safely; the patient can now be transferred to an ambulance

PHOTOGRAPHY: AIR EVAC LIFETEAM

Ventilation is the key to air rescue operations

> ical helicopter began operating out of St. Anthony's Hospital in Denver, Colorado. Germany was actually ahead of the rest of the world in the civilian use of helicopters for air rescue operations at this time, as its first rescue helicopter—Christoph 1—had gone into operation at Munich-Harlaching Hospital on November 1, 1970. Germany had become a mass-motorized society by the end of the 1960s. As a result, the number of traffic fatalities rose to nearly 20,000 per year—but ground rescue services were not available throughout the country, nor were they equipped to provide qualified onsite medical care.

In 1972, the German federal government therefore procured several helicopters which were made available to the German states for medical rescue purposes. As a result, Germany was able to establish 22 air rescue locations, providing nearly nationwide coverage for helicopter rescue services. Today, Germany has more than 75 such helicopter bases. In 1974, the U.S. decided to introduce a nationwide air rescue system, which today encompasses an impressive fleet of more than 800 helicopters and 150 ambulance aircraft.

Ventilation on demand

A compact, high-performance ventilator is a must for both the emergency rescue and inter-hospital transfer systems today. This is especially true when critical-care ventilation quality is required in small spaces. In fact, ventilation is a crucial aspect of air rescue operations, because trauma patients flown by helicopter are ventilated much more frequently than patients transported in ambulances. What's

more, an ambulance can pull over to intubate a patient whose condition has deteriorated—but this is not an option in a helicopter.

Germany's ADAC Air Rescue division has therefore chosen to utilize the Dräger Oxylog 3000—with good reason. For example, the share of critical-care transports between clinical centers has increased significantly. At some medical helicopter rescue bases, these transfers now account for more than 30 percent of all flights. In such a situation, it's extremely helpful for therapeutic continuity if the different ventilation modes used by the clinics can be provided as needed in transit.

This is in fact the greatest strength of the Oxylog 3000—one which has ensured it a high market share in the air rescue sector in Germany. The compact unit utilizes the most common emergency ventilation modes, IPPV and SIMV. It also offers assisted ventilation and can measure the patient's spontaneous breathing, providing ventilation support only as it is needed (CPAP, ASB). Its performance also extends to the pressure-controlled BIPAP ventilation mode. Non-invasive ventilation (NIV; see also p. 10) can be activated as a supplementary function in the pressure-controlled ventilation modes BIPAP and CPAP.

“Because German medical helicopter rescue missions fly almost exclusively with anesthetists, there is a tendency to sedate the patient only as much as is necessary during the intubation in order to maintain their spontaneous breathing,” says Peter Dietl, who is responsible for air rescue applications at Dräger.



Perfect preparation ensures that



things get off to a fast start—when transferring patients and certainly in an emergency

PHOTOGRAPHY: PICTURE-ALLIANCE, ADAC

The German Air Rescue Service (DRF) also ventilates its patients in helicopters with the Dräger Oxylog 3000. “There were two important reasons for us to switch over to this unit,” says DRF medical director Dr. Jörg Braun. “Firstly, the previous distinction between primary-care and clinic-transfer helicopters is no longer present. Nearly all of our helicopters are now in dual use: they are employed for both acute emergency rescues and inter-hospital transfers. The Oxylog 3000 is a compact emergency ventilator that is equally suitable for both applications, and it can be used to ventilate 99 percent of all patients.” The device thus offers advantages in direct rescue situations just as it does in critical-care transfer operations.

Rescue helicopters generally first serve to transport emergency physicians onsite. The patients receive medical treatment there, and, if necessary, the helicopter subsequently acts as an ambulance aircraft, moving patients to the hospital most

suited to their needs. “Non-invasive mask ventilation is an interesting option,” says Braun. “Whether the situation involves COPD or asthma, skilled personnel can often use it to avoid intubation.”

Air Evac rescues in rural areas

The development of Germany's hospital landscape is similar to what has happened in the U.S., where, according to a 2006 study conducted by the Foundation for Air-Medical Research and Education (FARE), “...the closure of rural hospitals because of reimbursement and other financial pressures, or their conversion to Critical Access Hospitals (CAHs) with reduced services and fewer specialist physicians, has created large geographical gaps in the availability of specialized surgical resources.

Unfortunately, these rural areas are also the location of the most serious car crashes and are where 60% of fatal crashes in the U.S. occur, a rate nearly >

Air rescue with the Oxylog 3000

Along with traditional volume-controlled ventilation modes such as IPPV (purely volume-controlled) and SIMV (synchronized ventilation), the Oxylog 3000 also offers the BIPAP (ASB) and CPAP/ASB ventilation modes, which are used in state-of-the-art critical-care applications. CPAP/ASB supports spontaneous breathing, which eliminates the need to sedate the patient. BIPAP/ASB offers an additional pressure-controlled ventilation mode with simultaneous pressurized support of the patient's spontaneous breathing. These advanced ventilation modes fully support the continual ventilation of patients in critical condition who are being transferred from one hospital to another. The Oxylog 3000 can even be used to continue a ventilation separation procedure that has already been started.

The unit also offers the option of non-invasive mask ventilation (NIV) with automatic leakage compensation, thereby making it possible to avoid the intubation of critical-care patients in the pre-hospitalization phase.

Regular civil air rescue operations began in the 1970s

> double that of similar accidents in suburban or urban areas.” Medical rescue helicopters can help here by filling these gaps in coverage and improving access to special clinics.

Air Evac Lifeteam specializes in helping to close such rural bottlenecks—and with 78 air rescue bases, it’s the number two air rescue service in the U.S. The company operates in 12 U.S. states and is the market leader in nine.

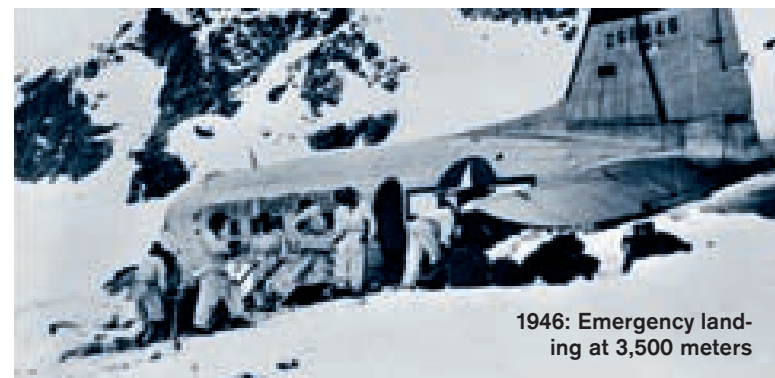
Air Evac Lifeteam’s commitment to rural America has generated a lot of public support for the organization, which now has more than 600,000 paying members. It operates 100 Bell 206 Long Ranger helicopters and has selected the Dräger Oxylog 3000 as its future ventilator. Air Evac Lifeteam’s entire active helicopter fleet will soon be outfitted with the Dräger Oxylog 3000.

“We’re the largest independent air rescue service in the United States,” says Julie Heavrin, director of Public Relations at Air Evac Lifeteam in West Plains, Missouri.

“Independent” in this case means that Air Evac is solely responsible for the helicopters themselves, as well as for their equipment, the pilots who fly them, and the paramedics who man them. Unlike their German counterparts, U.S. air medical rescue helicopters generally fly with specially trained paramedics rather than physicians.

Advanced treatment methods

“A total of 70 percent of our trips are between hospitals,” says Air Evac’s safety expert, Tom Baldwin. “It’s exactly in such



1946: Emergency landing at 3,500 meters

Swiss pioneers

In November 1946, a Douglas C-53 Dakota U.S. Air Force plane crashed into a glacier above the town of Meiringen in Switzerland. The plane, which was flying from Munich to Pisa, Italy, carried a four-man crew and eight passengers, among them high-ranking military officers and family members. After changing course twice and encountering poor visibility, the plane descended to 3,350 meters, which was 300 meters below the top of the glacier. All of the passengers survived the crash, but with severe injuries. Because the U.S. military was unfamiliar with the region, the Swiss Army had to carry out the rescue operation. After climbing for 13 hours, the first rescue team finally reached the crash site.

The team knew they didn’t have enough time to bring the injured people safely down to the valley. The Swiss did have experienced pilots, however, who were well trained in making landings on snow in mountainous regions. Two pilots, Pista Hitz and Victor Hug, each flew out in a Fieseler Storch, a plane that can remain in the air even when cruising at only 50 km/h, and which, with a little bit of headwind only requires a runway of about 50 meters. It took eight flights back and forth, but in the end the two brave pilots succeeded in rescuing all the injured people.

During the Korean War (1950–1953), the U.S. recognized the importance of being able to rapidly transport wounded soldiers out of the field and into military hospitals. By the time the war had ended, more than 20,000 wounded soldiers had been transferred to such clinics via helicopter. Specially designed rescue helicopters were then used in the Vietnam War to transport 800,000 soldiers. Regular civil air rescue operations began in Germany in 1970 out of Munich-Harlaching Hospital; they started in the U.S. in 1972 with a helicopter based in Denver, Colorado.

situations that the Oxylog 3000 offers us options that our current units can’t provide.” Even intubation can be carried out by extremely well-trained personnel, even if they’re not doctors.

“Intubation is actually very common in both ground medical rescue operations and in the air,” Baldwin reports, correcting an erroneous European preconception regarding the standard of care in this area in the U.S. “Air rescue services typically employ advanced treatment strategies such as the fast-acting short anesthesia Rapid Sequence Induction.”

One strategy doesn’t automatically exclude the other, however. After all, short anesthesia and intubation harbor risks that can be avoided through non-invasive mask ventilation in certain cases.

“The medical aspect of air rescue missions focuses strongly on airway management—in other words, strategies for ensuring that air passages remain open,” says Baldwin. “The fact that our crews will now have a non-invasive option for keeping patients breathing without having to resort to intubation will provide our patients with a big safety benefit.”

Baldwin’s conclusion is that Dräger was ultimately selected to provide the required ventilation unit because of the “combination of differentiated ventilation options, robustness, and the positive customer feedback we’ve heard regarding the Oxylog 3000.” **Mario Gongolsky**

Further information online, including:

- Product information
- Trainer software

www.draeger.com/96/Emergency



Air rescue requires teamwork. Professionalism in the cockpit...



LEFT PHOTOGRAPHY: ARCHIV FLIEGER KLUB MUSEUM DÜBENDORF PHOTOGRAPHY: DRF

...continues in the rear

Vital Signs through the Airwaves

The Infinity M300 patient-worn monitor securely and reliably transmits **VITAL PARAMETERS OF PATIENTS ON THE MOVE** via WLAN connections, giving them freedom of movement that can help accelerate recovery.

PARENTS take care of their children when they are young, and often children have to take care of parents once the latter reach old age. In between, doctors and other care givers help them both. Each of these life stages requires a balance between health monitoring and freedom of action. An imbalance here can be dangerous—even a matter of life and death. In such a situation, freedom of movement can work wonders—and a new small device is now doing just that by giving back some of the joy of living to patients with heart trouble, while at the same time monitoring their most vital parameters.

Isolde Schröder, a nurse at the Bad Wildungen Hospital in Germany, is one of the country's first healthcare professionals to have used the Infinity M300 mobile

patient monitor. "At first we were skeptical, as we usually are with new things," Schröder says. "We actually thought it was going to make life more difficult."

Vital parameters and positioning

However, it's the device's many positive features that have been attracting her attention since it went into service in June 2008. "It enables patients to be just as mobile as they were before—and sometimes even more so," she reports. As a result, patients can now leave their beds, unless otherwise instructed by their doctor. During the entire time, they are continuously monitored by the Infinity M300, which weighs only around 280 grams and is carried in a small case worn around the patient's neck. The device even comes with a special bag for use in the

shower. The Infinity M300 has a color display that shows real-time data on the patient's condition. It's also equipped with a wireless connection that continuously sends the information to the Infinity CentralStation at the nurses' monitoring station. Such supervised mobility boosts patients' self-confidence, which in turn can speed up the recovery process and potentially shorten their hospital stay.

The Infinity M300 stands apart from equipment produced by other medical device manufacturers. For one thing, the Infinity M300 has built into it the algorithms necessary for recognizing irregular heartbeats and values outside specific limits. That means the device functions even without the wireless connection to the Infinity CentralStation at the nurses' station. The color screen of the Infinity M300 displays patient data, which enables accurate identification of the wearer and helps ensure that he or she will be given the proper medication period.

But the real secret behind the Infinity M300 is invisible: the device connects on to the hospital's computer network via wireless, in the same way a laptop connects to a private network. This eliminates the need to install additional proprietary network components or antennas, which not only shortens installation time but also streamlines network management.

According to Detlev Froebel, a specialist for network solutions in Dräger's Marketing Department, the use of conventional WLAN data infrastructure can lead to substantial savings. Numerous successfully implemented Infinity OneNet projects (Dräger's name for the open, multi-

service data infrastructure also used for monitoring) have shown that along with the infrastructure cost savings achieved, this approach also results in much greater flexibility and a holistic approach to security. If hospital policies allow it, Infinity OneNet also enables patients to use the network infrastructure to surf the Web. Because of multilevel security, medical data is kept completely isolated from all other information flows, says Froebel. This network infrastructure can also accommodate other uses such as patient location.

WLAN technology is already well established and reasonably priced, so it's a relatively simple matter for hospitals to set up wireless networks that also function outdoors. Having done this, Bad Wildungen Hospital now has four patients who can move about freely within a predefined area. "It was unusual for us in the beginning," says Schröder, who had no prior experience with cardiac telemetry monitoring. There were several incidents in which patients accidentally left the wireless network's transmission area. Fortunately, the Infinity M300 sounds an alarm when that happens—and this alarm is triggered on both the device itself and at the central monitoring station. However, the Infinity M300 continues uninterrupted monitoring and analysis of vital parameters.

Continual monitoring advantages

Prior to going into the market in September 2008, the Infinity M300 also proved itself at the Avera Heart Hospital in Sioux Falls, South Dakota, USA. More than 60 devices have been transmitting patients' vital signs to a monitoring center at the

Dräger Infinity® M300 patient-worn monitor

The Infinity M300 provides the performance of a full-sized patient monitor in a compact patient-worn device. The mobile monitor, which is linked to the hospital computer network via standard WLAN (Wireless Local Area Network), displays ECG and SpO₂ data on its color screen. The device's software includes algorithms for detecting heart rate, heart rhythm, and oxygen saturation. In the event of an emergency, the Infinity M300 issues an alarm both through the device itself and at the Infinity CentralStation.

The Infinity M300 can be used with any standard WLAN (802.11 b/g) network, and data traffic is reliably secured with the help of a multilevel security concept. An ergonomic cable management concept reduces the amount of wiring needed for ECG and oxygen saturation sensors, thus ensuring patient comfort. The monitor has a built-in battery that can be easily recharged either at the bedside while the patient is wearing the device or at a central storage/charging station. This recharging feature eliminates the need to routinely discard batteries—saving time and money while helping the environment

hospital since June. The hospital's old telemetry system was shut down when the Infinity M300 was put into operation, says the hospital's biomedical technician, Jim Hitchcock, who is also happy about the color display of the new Dräger patient-worn monitors. "One of the first signs of a patient problem is often a declining SpO₂ value," says Hitchcock, "and if a clinician can see a patient's arterial oxygen saturation along with the ECG waveform, the clinician can save valuable time."

Hitchcock also appreciates the lithium-ion batteries that are recharged every night at a bedside charger next to the patient's bed. "You no longer have to change batteries like with the old devices," he says. This saves the staff a lot of time—and the

hospital a lot of money. Because the Infinity M300 can be installed relatively quickly, many non-cardiac departments are interested in the portable monitors as well. "The Infinity M300 is ideal for the intermediate level between intensive care and normal wards because it doesn't require monitors to be installed at beds in order to keep track of potentially unstable patients," Froebel explains. Thus it appears that many different kinds of patients will soon be benefiting from these new "little boxes of freedom."
Hanno Charisius

Further information online, including:

- Product brochure
- Data sheet

www.draeger.com/96/M300



Mobility to go: Just put on the Infinity M300 patient-worn monitor



New Networks for Anesthesia

In anesthesia, decisions have to be made quickly and efficiently. **MODERN MEDICAL TECHNOLOGY** can now bring together all the data that is generated before, during, and after surgery onto a single platform. This benefits both the patients and the doctors.

SEVERAL observations prompted Wim Amelinckx to tear down the informal fences in the A.Z. Nikolaas hospital back in 2005. At the time, he was working—just as he does today—as a head anesthesiologist in one of the largest hospitals in the Flanders region of Belgium, where he and 22 colleagues look after around 35,000 anesthesia patients a year. On this scale, anesthesia is usually performed according to a number of clearly defined routines. And yet, Amelinckx discovered, there were still many problems—too many, in fact—in his area of responsibility.

For example, the treating physicians spent a lot of time filling out the treatment protocols over and over again from scratch, and always on paper. Moreover, the handwritten instructions for the nursing staff had been known to cause misunderstandings during the patients' aftercare. Ultimately, the paper-based process regularly destroyed valuable information, because patients' folders would disappear into the archives and were difficult to find again. "We simply had to do something at the time," recalls Amelinckx. "That's why, with Dräger's help, we started integrating operating room technology into the world of information technology."

In the office domain, information technology (IT) has long proven its integrative strength. Whereas telephones, typewriters, and notebooks used to lead existences independent of one another, now one piece of hardware that is small enough to fit into a pants pocket is all that's needed to combine the digital tools required for everyday living and working. Software has also unshackled itself from inflexible ties to individual hard drives and instead migrated to the net- >

ABSTRACT Information technology is an important tool for integrating complex processes and at the same time enabling the seamless central storage of all data and documents. What is already standard in the office world is now making inroads into the operating room. Initial practical experience confirms the practicability, efficiency, and reliability of professionally implemented systems.



The Zeus anesthesia system combines technology for treating and monitoring patients in a single device that is linked to the hospital network via an Ethernet connection

The integration of IT in the OR frees up more time for patients



Information and its visualization support rapid and sound decision-making

> work. Texts, images, and corporate data are now downloaded from central servers, which are cheap to maintain and are available 24 hours a day. The hospital staff members' access to information is therefore boundless.

All on one screen

In the area of anesthesia, such scenarios remain a pipe dream. However, the

integration of information is progressing here too. The integration concept that Dräger is pursuing takes the form of a new system which comprises several modules that will improve the treatment of patients, increase efficiency within the hospital, and make the work of doctors and the nursing staff easier.

But freedom from time-consuming routine work is only the first milestone in

the process. "With Innovian, our clinical information system," says Georg Trott, Product Manager Information Technology at Dräger, "information is now presented in a way that enables doctors to make sound clinical decisions quickly."

To turn this vision into reality, the provider must offer its customers a complete and harmonized product portfolio

that is based on three pillars: a standardized product design, cross-departmental networking, and hospital-specific applications.

The biggest advances are currently visible in the design. The Zeus anesthesia system, for example, combines the technology for treating and monitoring patients in a single device and is also equipped with an Ethernet connection, which provides the link-up to the hospital network. The Medical Cockpit, which doctors can use to access patient data as well as monitor and alter treatment, is also markedly increasing the number of functions it encompasses. A 20-inch monitor, for example, now facilitates the clear display of the patient's vital signs and radiological images on a single screen, which can be operated with just a fingertip. The user guidance system is based on an intuitive concept, while the color layout of the interface and the visual and audible alarm signals are standardized across all of the new system's modules. "Complex technology is becoming simpler as a result," says Georg Trott. "The error rate is falling, while the amount of work required for training is significantly reduced."

Wireless data

However, the harmonization of inputs and outputs is only half the battle on the way to achieving the ultimate goal. This is because data changes into useful information primarily in situations where it can be called up at any site or location, processed automatically, and combined with other data to create practi-

Modular system

Dräger is taking a holistic approach to acute patient care, which ranges from emergency medicine and the OR to critical care medicine and neonatology. In close collaboration with experts from leading European, Asian, and American hospitals, the most important demands on the medical workstations of the future in a process-driven hospital environment were determined. The aim of this process was to shorten training times, avoid errors, and present all patient data so that the treating physicians can make even more effective clinical decisions. Implementing this vision requires the number of different user interfaces to be reduced and data to be more transparent, more consistent, and more closely integrated.

cal decision-making tools. Essential for these processes are software programs that harness the myriad possibilities of a modern hospital network and seamlessly map clinical processes.

Sometimes these processes can be fed directly into highly specialized hardware. One good example is the Dräger patient monitor with Pick and Go technology, which stays with the patient constantly and provides continuous monitoring of his or her progress, hospital admission to discharge. The documentation of data takes place automatically in the background, as does the switch from wired to wireless data transfer when the patient leaves his or her room. The monitor therefore remains constantly linked to the central server, which nurses, care assistants, and doctors at other points of the hospital can access as needed.

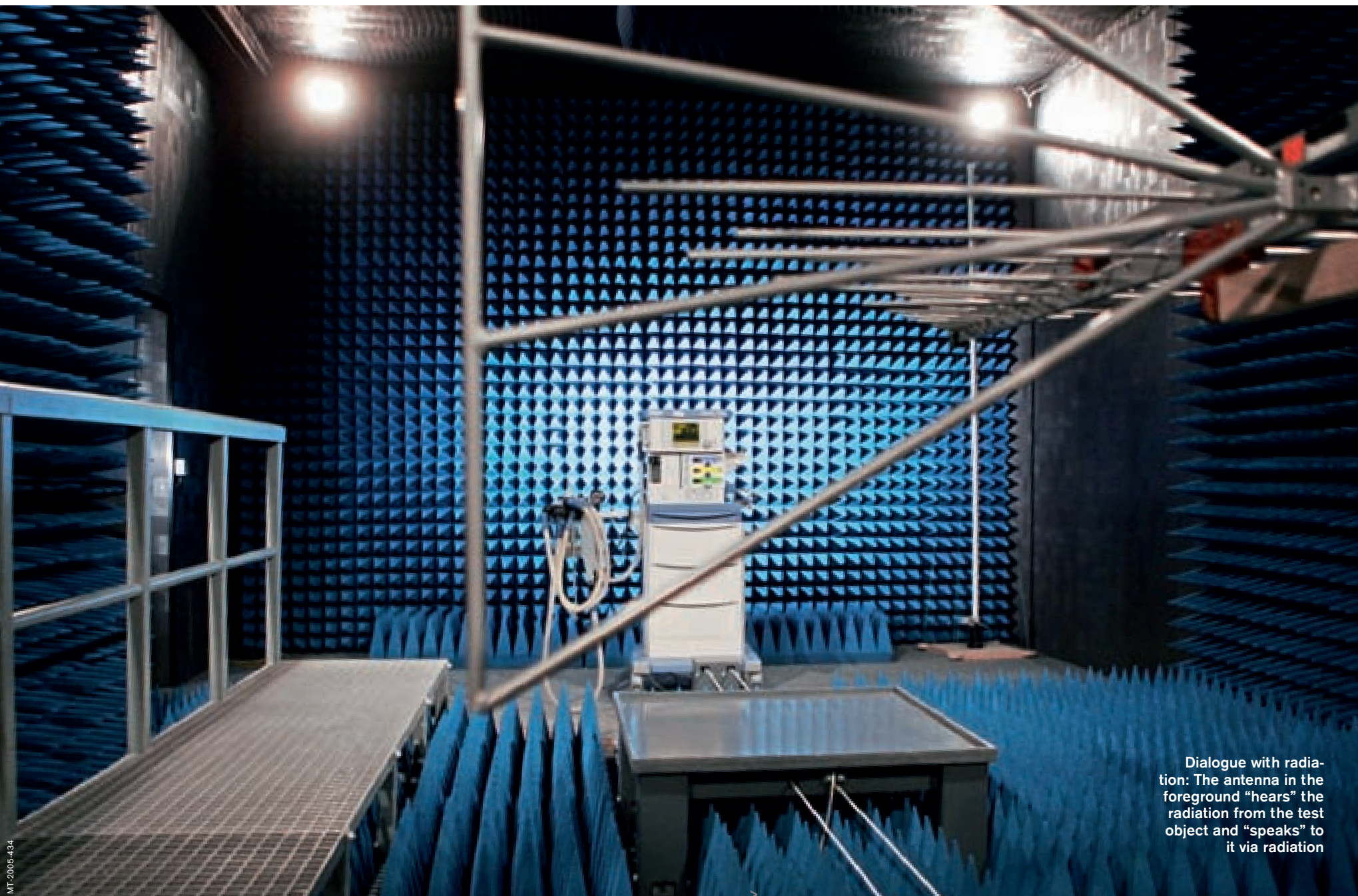
Amelinckx has also automated many processes with the help of IT. For exam-

ple, he has set up the network and applications so that an anesthesia patient's blood results and X-rays are immediately available on every PC in the hospital. He has also developed standardized forms into which important patient data flows automatically. This data can then be supplemented with new data directly and digitally on the monitor. It is also possible to insert recurring after-care treatments as a fixed text module. Amelinckx has also standardized the storage of data: it now moves together with the patient's electronic folder into the hospital archive.

Work in the operating room has also become much less stressful. "We now have more time for our patients," says Amelinckx with satisfaction. What about his colleagues' initial skepticism, Amelinckx is asked. "We won them over in just a few months," he recalls. "Now, IT in the operating room is accepted by them 100 percent." **Frank Grünberg**

Searching for the Standards of Tomorrow

Dräger's TestCenter in Lübeck is more than just the ultimate product reliability center. That's because it develops innovative, reliable, and efficient testing methods that also influence international standards. A tour with TestCenter manager **DR. UDO FELDHOFF**



Dialogue with radiation: The antenna in the foreground "hears" the radiation from the test object and "speaks" to it via radiation

IT'S THE LITTLE THINGS, TOO.

Dr. Udo Feldhoff unscrews a metal cylinder: "We test O-rings for anesthesia devices in here. We let them age artificially at temperatures of up to 70 degrees Celsius in a solution with conventional anesthetics." And this is just one of more than a dozen stations in the Dräger TestCenter, in which all of the company's products undergo thorough testing. The staff—half of them chemists, mostly female; the other half physicists, mostly male—works here as a team.

"We offer solutions," says Feldhoff, explaining the TestCenter's purpose. "If a product doesn't pass our tests successfully, we make appropriate suggestions for improvement."

In view of its rigorous approach, the TestCenter has gained recognition and even popularity, not just at the headquarters in Lübeck but also in the subsidiaries, where the team's concentrated expertise is also highly

The heart of the TestCenter is surrounded by offices, which are in turn enclosed by laboratories containing testing equipment. Only on a few of the testing rigs are the functions quite as visible as those that measure mechanical resistance through tensile force or shaking. "We have programmed the vibrating table, for example," says Feldhoff, "for road transport, so that we can use this 'shaker' to drive virtually over the roughest potholes in the roads between one end of Germany and the other."

Testing at Dräger means not just ensuring the obligatory adherence to international standards but also safeguarding

the product's suitability for use in day-to-day operation. This is one of the founding principles of product development at Dräger. The TestCenter supports this development at every stage of the process.

New area of biocompatibility

The TestCenter does more than just testing, however. It also carries out research—partly in collaboration with universities, hospitals, and other companies. Research is carried out, for example, on methods that allow the adherence to formulas for raw materials such as plastics to be checked inexpensively and reliably. There is also thermogravimetry—an analytical method in which a sample's changes in mass are logged and evaluated over a defined range of temperatures.

This testing expertise, which builds on newly developed processes and comprehensive databases as well as their mutual linking according to recognized methods, continues to surprise even the suppliers themselves. The TestCenter invests up to >

The TestCenter in figures

Office and laboratory space: around 2,400 m². Orders per year: around 8,000. The TestCenter, with its eight testing zones in 14 testing laboratories, is accredited according to ISO/IEC 17025 (certificate DPT-PL-3765.00). It also has two accredited calibration laboratories (DKD-K-04801) and holds accreditation according to ISO/IEC 17020 as an inspection center (DPT-IS-4056.00).

Extensive testing for maximum reliability and safety in everyday use



MT-2008-322

Porcelain crucibles are burned clean at around 850 °Celsius



MT-1824-2008

Plastic samples in small glass vials on their way to analysis



MT-2008-267

Sample prepared for thermogravimetry (see p. 29)



MT-2008-210

Testing pre-stressed plastic sample rods in cleaning fluid

> a fifth of its budget in research and innovation.

The TestCenter is also breaking new ground in terms of biocompatibility. “We’re developing methods that allow us to keep the impact of materials on the human body at a negligible level,” says Dr. Feldhoff, pointing to an incubator to illustrate how the researchers measure the outgassing of the plastics used in it. “Since there are currently few threshold values for babies in this regard, for example, we need to set our own values and have them verified and defined by international studies,” he explains. In this case, the testing revealed just 1.0 percent of the occupational exposure limit (OEL) for adults in the workplace.

These are findings that the TestCenter is also contributing to international standards committees. This is one of the roles, for example, held by Corinna Brieske, who was initially trained in the TestCenter as a laboratory assistant and continued there in a work-study program during her studies for her diploma in technical chemistry. “At the moment I’m working in international standards committees on methods to safeguard biocompatibility,” she reports.

For Brieske—whose mouse pad bears a picture of a horse—this is not just about replacing animal testing with suitable technical and statistical methods wherever possible. These methods must be at least as reliable as the previous methods used, but they must not be any more expensive.

Brieske is certain that the methods being developed in Lübeck will in the fu-

ture become the basis of future international standards—which will then also satisfy higher ethical standards.

A few glass doors further along, Gerd Matzke is also working on the standards of tomorrow: “In collaboration with one of the most renowned hospitals in Germany and other experts, we are currently working on a concept for networking hospitals by means of wireless communications that will not interfere with medical equipment.” Cell phones are still banned from a lot of hospitals, but the desire for radio-based networking is growing as its advantages become more apparent, the physicist points out, referring to innovative wireless patient monitoring systems.

Testing in the cathedral

For the required studies, the TestCenter can rely on climate-controlled and acoustic chambers and on what is probably the most impressive of the facility’s rooms, the completely shielded EMC chamber. Among other things, the electromagnetic compatibility of equipment is tested



MT-1823-2008

The TestCenter team led by Dr. Udo Feldhoff is more than just a group of inspectors. Rather, they see themselves as problem solvers providing a service

here. “With its impressive height of six meters, this chamber has already been christened the ‘cathedral,’” says Dr. Feldhoff, rounding off the tour through the laboratory stations, where there is still plenty more to see. The testing facilities range from anesthesia devices with an artificial lung which is used to develop soda lime that leaves no residues in respiratory air, to a battery of mass spectrometers for the automatic and precise determination of ingredients.

The benefits of the TestCenter can of course be documented in economic terms by taking into account factors such as the faster access to international markets that results from having the various certifications.

The TestCenter’s true value, however, lies in the employees’ expertise: in their training, their team skills, and the creativity with which they distill theory and practice into a constant supply of new solutions. All of the employees successfully face up to the hardest test every single day: ensuring the reliability and safety of all Dräger products. **Nils Schiffhauer**

The Hospital of the Future

The **MINDEN CLINIC** prepared itself for a new era in health care with a radical overhaul. Fundamental process changes and optimized architecture combine the efficient use of resources with a higher feel-good factor for patients.

IF YOU APPROACH Minden Clinic from the edge of town, skirting the fields, you'll be amazed by its size. The complex is 300 meters long and is built on a plot of land the size of three soccer fields. In other words, it's much bigger than a traditional hospital. However, the buildings are only three floors at most; clinics covering so much ground are seldom this low. But the novelty doesn't end there. Another unusual feature is the separate patient and visitor entrances, which help ensure the privacy of patients. The traditional patient admissions area in the foyer is also missing. Further exploration of the clinic reveals many things that are not known in other hospitals—at least not yet.

A clinic reconsidered

Minden dared to do something that most hospitals would never do—build an entire clinic on a greenfield site (quite literally) and combine it with a complete change of internal organization and processes.

The aim was to improve and speed up treatments and increase both cost efficiency and patient comfort. The building work cost 210 million euros and the clinic has been in operation since March 2008. Other companies are more likely to attach their new developments to old buildings and therefore miss possible opportunities to optimize processes.

With regard to this conservative behavior Peter Lohfert, the clinic adviser at Minden, says, "Clinic builders often engage an architect quickly without going to the trouble of restructuring the organization. This is because most clinical workers are afraid of new organizational



The future of the hospital is reflected in Minden

structures and the political co-financers want to see fast results." Basic reorganization requires time for a long planning phase and the time-consuming implementation of the new processes.

However, this is essentially what the future will look like. After all, without such changes many hospitals would have to close for financial reasons. "Without reform, 30 percent of clinics will not survive the structural changes currently taking place in the health care industry," says Lohfert.

Minden has taken this approach on-board, even though it is initially more difficult, and in doing so has awakened interest both in Germany and abroad. Hospital operators and investors who are also planning new developments and require information make regular pilgrimages to the clinic—there has even been a visit from as far away as Saudi Arabia. After all, only a few new hospitals actually provide full service health care.

As with many other institutions, planners were faced with the choice of modernizing their century-old building on two sites or daring to contemplate "something completely new." The introduction of flat-rate payments in the healthcare system clinched the decision for something new.

With the new scheme, patients no longer pay per night but rather a flat rate fee depending on their individual case. It would be expensive if patients were to stay longer in hospital and involve many departments, those responsible completely redesigned the hospital. In particular, they combined the construction >



PHOTOGRAPHY: HARALD WIESE

Building a new clinic also means rethinking processes and organization

of the new complex with a reorganization of the processes.

“A key element here was the centralization and grouping of tasks in order to avoid the repetition of work and so keep the costs as low as possible,” says PD Dr. Christian Schmidt, medical representative on the Board of Directors of the Mühlenkreiskliniken association, to which the Minden Clinic belongs. Architectural changes help speed up the work of the staff by making their paths around the building shorter. At the same time they increase the patients’ comfort. Finally, moving to electronic patient files, including x-ray images, helps to reduce paper usage. “Previously, four folders per patient were not unusual,” recalls Schmidt.

Centralization creates space

These guiding principles for new construction are being implemented in many places. What is most radical here is the interdisciplinary arrangement of the hospital. The individual departments no longer have their own operating rooms (ORs) and separate wards. Instead, 17 of the 18 ORs are located in a central part of the building and are used by multiple departments. This enables better utilization of these facilities, especially given that in the old clinic they were spread out over seven different parts of the building. Four ORs were eliminated through better organization—a feature that creates space for more modern equipment in the other ORs.

And that’s where Dräger came in. For example, the medical division supplied modern anesthetic equipment and

respirators as well as a patient monitoring system for the entire clinic. In order to cut costs further, the departments were merged into several medical centers, where a central coordinator controls the profitability and the optimal use of rooms, staff, and equipment. As a result, doctors of different disciplines work more closely together. This avoids repeated consultations and shortens the length of treatment.

Even the nursing section has undergone changes. It now combines several wards and is organized according to the individual length of care each patient requires—from intensive care through to general nursing for multi-night stays. In contrast to the previous situation, patients with different medical conditions now share the same room. For example, a rheumatism patient could be together with a heart patient. This leads to the better utilization of beds and, as hospital stays are shorter, only 864 beds are required instead of 1074.

Of course patient comfort has also been considered. The majority of patients have a double occupancy room with a bathroom and floor-to-ceiling windows overlooking the countryside. According to a British study, this aids their recovery. Fewer painkillers are required and hospital stays are shorter. These developments demonstrated that higher process efficiency can be combined with improving the recovery process.

The new operational structure is supported by the architectural design. Having fewer floors speeds up processes, as less time is wasted waiting for eleva-

tors. The number of elevators has been reduced to 21 (previously there were 36) and these are used much less than before, helping to reduce maintenance costs.

Additionally, staff members are relieved of time-consuming transportation duties—laboratory samples and medications are transported in pneumatic tubes while laundry, food and other heavy items are distributed in small containers by fully automatic, battery-powered transporters, mainly in the basement but also in the elevators. The separation of patients and visitors into two corridors avoids encounters between visitors and bed-ridden patients on their way to consultation, and also prevents emergency cases from crossing paths with outpatients or logistics traffic.

Architecture helps healing

The centralization was made even more attractive by the fact that, together with four other institutes, the Minden Clinic has been part of the Mühlenkreiskliniken association since 2006. For example, the central kitchen cooks for all five hospitals; meals are simply warmed up in the wards. The procurement of materials and medications was centralized—the laboratories in each clinic specialize in different areas, thus avoiding redundant structures. The administration department is also centralized.

All of this has one aim in mind: to ensure efficiency and optimal patient care—a concept that has a future not only in Germany but also elsewhere. **Dyrk Scherff**

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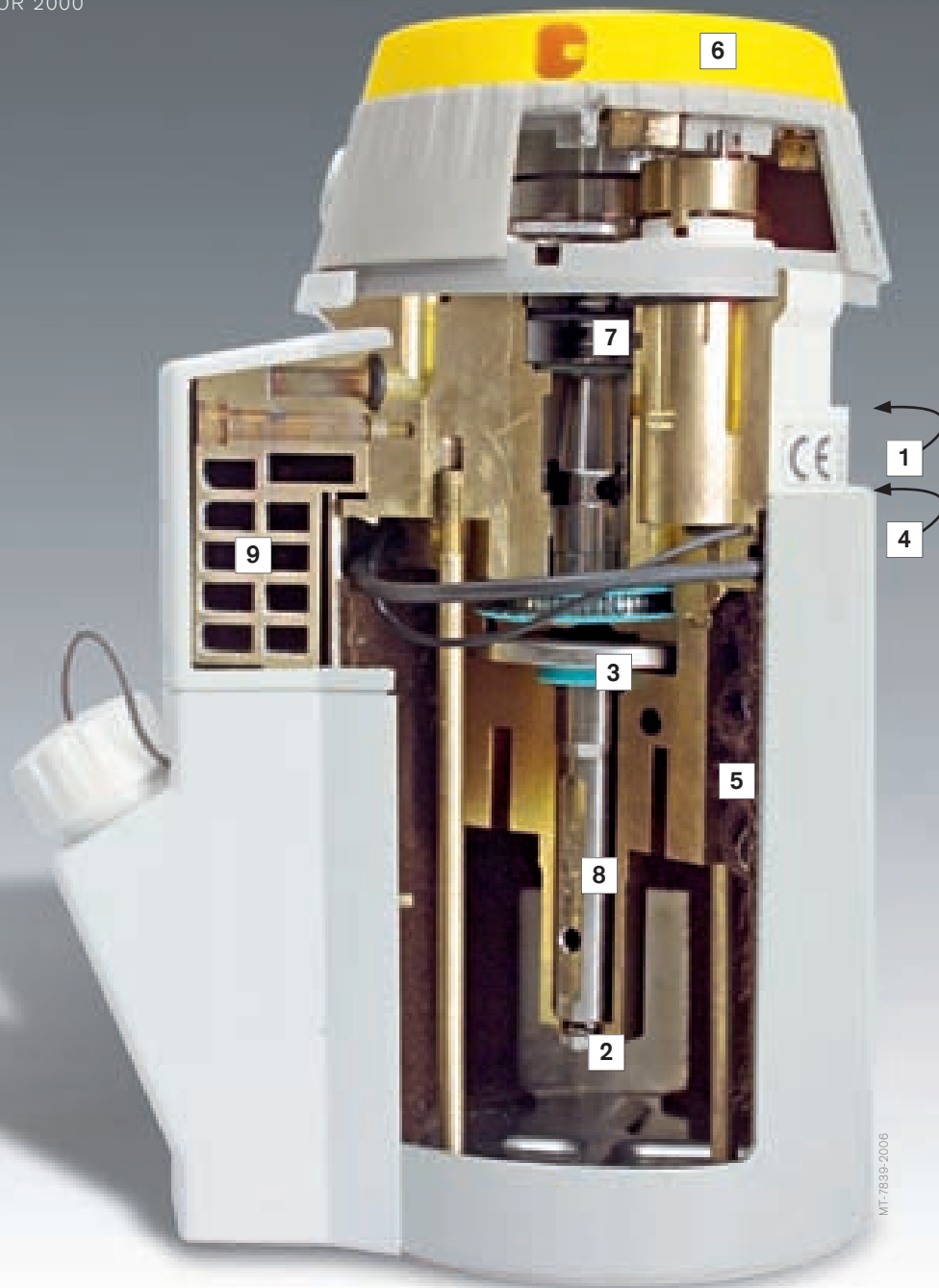
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Precise Anesthetic: Vapor 2000

The Vapor 2000 is used to introduce precise amounts of an anesthetic agent into the fresh gas for the purposes of anesthesia. The anesthesia device delivers air or a mixture of oxygen and nitrous oxide to the Vapor 2000 **1**, where it is separated into two different gas flows. One of these gas flows is saturated with the anesthetic agent in the vaporizing chamber **2**. The other flow is routed directly to the Vapor 2000's outlet **4** via a bypass **3**. The final concentration of the anesthetic gas results from the mixing ratio of the two gas flows. The anesthetic agent enters the vaporizing chamber via a textile tube **5**, which functions like a candle wick. The anesthetist uses the control dial **6** to adjust the dosage cone **7** to supply the exact quantity of fresh gas saturated with anesthetic agent. The mixing ratio of the two gas flows produces the desired concentration of anesthetic agent at the outlet—e.g. two percent Sevo-

flurane by volume. The saturation of the fresh gas with the anesthetic agent is dependent on the vapor pressure of the anesthetic agent and thus depends on the temperature. The higher the temperature of the Vapor 2000, the more the anesthetic agent will be taken up by the fresh gas. Therefore, a mechanical controller **8** ensures a constant concentration of the anesthetic gas at an ambient temperature of 10 to 40 °Celsius. This controller is like a bimetallic thermometer and functions using the differing coefficients of expansion of different materials. The Vapor 2000's pressure compensator **9** eliminates pressure fluctuations during ventilation by the anesthesia device. If necessary the Vapor 2000 can be transported although it is filled with anesthetic agent. It has a capacity of 300 ml—50 ml greater than an anesthetic agent bottle. The first Dräger Vapor was developed in 1958.