Monitoring every breath

Monitoring the way patients breathe can tell doctors a lot more about your health than you might imagine, Kate Bell **finds.**

"Our device keeps track continuously and actually monitors the breathing rather than the chest movements nurses have to rely on, improving patient safety."
Barbara Lead

We're all used to the idea that doctors can diagnose medical problems through monitoring blood pressure, taking blood tests or urine samples. What may seem less obvious is the fact that the very way you breathe can provide information on everything from whether you're likely to have a heart attack in the next 45 minutes, whether you're about to have an asthma attack, if you have lung cancer or even if you're actually still breathing within your oxygen mask.

These tests and more can be carried out by checking not only the rate at which a patient is breathing, but the moisture profile of their breath, a team of scientists at Surrey based medical device research and development company Anaxsys Technology has found.

"Two thousand people a year die in the UK from asthma attacks. We're working on a device that will alert sufferers in time to get treatment"
Dr Deryk Williams

The team has developed a monitor that is now being marketed to hospitals in the UK, Switzerland, Holland, Germany and Spain. The device, respiR8, was developed with help from a grant from the Government backed Technology Strategy Board. It monitors patients on oxygen and alerts nursing staff to two potential problems - respiratory depression where the patient isn't breathing enough, and rapid breathing above 27 breaths per minute which can be a sign of an imminent heart attack. A patented moisture sensor is fitted inside the oxygen mask, and the moisture level of the patient's breath is used to work out the current respiratory rate.

Dr Deryk Williams, Managing Director of Anaxsys Technology, said "Patients in casualty or post operative recovery can experience low breathing rates for many reasons, but if they're not breathing properly it's an obvious problem. Nurses monitor the breathing rates at regular intervals of maybe every 10 to 15 minutes, but problems may occur in between checks".

"One problem of visual observations is that chest wall movements are not totally reliable; patients can have breathing difficulties and their chest still moves."
Zia Mursaleen

Barbara Lead, Commercial and Development Director, Anaxsys, continued, "Our device keeps track continuously and actually monitors the breathing rather than the chest movements which nurses currently have to rely on. Because of this, it can identify problems such as obstructed breathing that may not be obvious to someone looking at chest movement and therefore improves patient safety."

Zia Mursaleen, Finance Director, Anaxsys, points out "One problem of visual observations is that chest wall movements are not totally reliable; patients can have breathing difficulties and their chest still moves. Our device overcomes that problem 100% because we measure directly from the patient's breath".

The respiR8 device has completed 37 trials in UK hospitals and is in use at seven hospitals in the UK already – with a further 34 trials planned across the country this year. A recent report issued by the Royal College of Anaesthetists and the Difficult Airway Society showed that routine monitoring of breathing could reduce deaths in intensive

care, and that the absence of a breathing monitor contributed to 74% of airway related deaths.

Professor Ravi Mahajan, Professor of Anaesthesia and Intensive Care in Nottingham University and Chairman of the Royal College of Anaesthetists' Safe Anaesthesia Liaison Group observes that "Respiratory rate monitoring is one of the most essential requirements to assess patients. In the same way we monitor pulse rate and blood pressure, we have to monitor respiratory rates. Until now, we've had to rely on personal observations by medical staff because there's been no objective way of doing it. This automatic monitoring is the future because it will allow respiratory rate monitoring at the bedside in the most accurate manner."

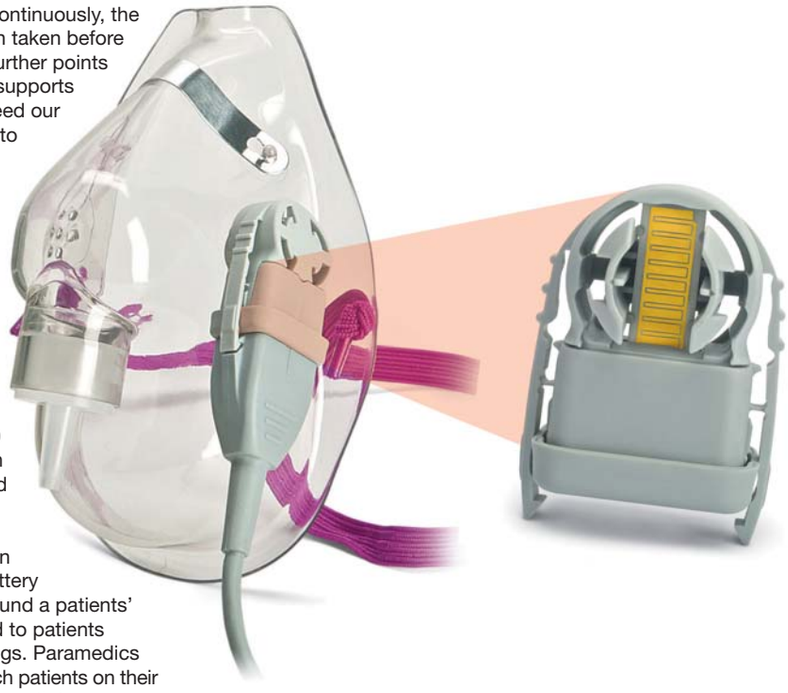
Professor Albert Dahan, Professor of Anaesthesiology, Leiden University Medical Centre, added that "The respiR8 device is an important tool in measuring breathing in a variety of circumstances, such as the postoperative setting, in patients with sleep apnoea but most importantly as a device during diagnostic procedures.

This in fact may save lives! I am currently using the device in a research setting in volunteers that receive potent experimental pain killers that may cause respiratory arrest. Being able to precisely monitor breathing rate is a valuable addition to the research."

Increased breathing rates are equally worth checking on, the Anaxsys team points out. Williams: "There's good evidence in the literature that an increase in a patient's respiration rate could give as much as half an hour's warning of a heart attack, so the respiR8 device can give the medical team time to intervene before the full problem occurs.

Dr Deryk Williams: “Our device will help patients manage their asthma so that they have fewer attacks. ”

Because respiR8 monitors the breathing continuously, the increasing trend can be spotted and action taken before the full heart attack occurs." As Williams further points out "respiR8 does not replace nurses but supports them in keeping their patients' safe. We need our experienced and skilled nurses to be able to respond appropriately to the information provided by respiR8 "



Mobile checks

A fully transportable device is also in development for use in ambulances. Once the hospital version of the monitor is providing sufficient returns, Anaxsys plans to reinvest the profits in producing an ambulance friendly version. The company has already started work on a prototype after it was awarded a £100,000 grant from the Strategic Health Authority in the East of England and the East of England RDA.

Williams says the team has started work on developing a more robust and portable battery operated version that can be strapped around a patients’ wrist or ankle. “It could also be easily fixed to patients trapped at road accidents or within buildings. Paramedics base the strategy they use to evacuate such patients on their overall ‘fitness’, and respiratory rates can give vital information when time is of the essence”. Measuring breathing rates and the water profile in the breath may seem simple, but it offers a lot of possibilities.

Asthma, sleep apnoea and cancer - it’s all in the breath

The way a patient breathes out can indicate more than just the rate at which they’re breathing. By analysing the changing concentration of the water vapour per breath, it’s possible to identify underlying problems such as asthma, bronchitis or pneumonia or even lung cancer, and the team at Anaxsys is working on future devices using their patented sensor technology that will meet the needs to identifying these and other conditions.

Williams: “Two thousand people a year die in the UK from asthma attacks. Children are a particular problem because the only currently available monitoring systems include a device called a peak flow meter and a device called a spirometer. These devices require forced expiration and are hard to use for many patients and are not suitable for most children under eight . We’re working on a device that will need only normal breathing to show whether someone’s asthma is getting worse, so alerting them in time to get treatment. By using our device, patients will be able to manage their asthma so that they have fewer attacks.”

Lead: “There’s no need for anyone to die from asthma, it’s unnecessary and unacceptable. We have very good drugs to treat asthma, but it’s difficult for patients to accurately assess their condition. They accommodate their problems, walk up stairs more slowly, don’t carry heavy shopping. We need a reliable simple test and there’s nothing there at moment. Our research is showing that we can produce a reliable monitor that’s small enough to carry around and easy enough for even a child to use”.

The team at Anaxsys is also working on a straightforward adaptation of respiR8 that will result in a device for the diagnosis of sleep apnoea. Williams says, “Untreated, sleep apnoea can cause high blood pressure and other cardiovascular disease, memory problems, weight gain and is associated with increased mortality. Moreover, untreated sleep apnoea may be responsible for job impairment and car crashes. It is estimated by NICE that more than 12 million adult Americans suffer from this problem and around 2 million in the UK. What’s more, it is estimated that up to 90% of sufferers are not diagnosed even though a very effective treatment is available.

The opportunity is to adapt the respiratory rate counter to an overnight monitor that will demonstrate the patient’s breathing pattern. This will support the diagnosis of sleep apnoea so doctors can begin treatment and potentially transform the sufferer’s quality of life.

Among even more future possibilities offered by the Anaxsys research, is a simple test for screening for lung cancer. A discovery was made in October 2008 during a clinical trial at a clinic in Bangladesh with a prototype device from Anaxsys for checking for COPD. The investigator noted something unusual in the shape of the graph produced by the device and went on to note that the subject had been diagnosed with lung cancer. Further subjects were also identified with the same graph shape associated with lung cancer, and subsequent studies have given a good indication that it is possible to screen for lung cancer. Lead says; “Our device has the potential to provide a low cost, safe point of care screening tool for lung cancer at a primary care level potentially enabling earlier intervention and improving survivability . It is still early stage research but there is the possibility of developing a low cost, safe screening tool for lung cancer”.

Mursaleen adds; “we’re a small company with limited resources, so we’re looking for partners for developing this and other potential products that are in the pipeline that have got fantastic potential.”

Anaxsys is also looking to co-develop and license its technology for asthma and COPD diagnosis and management.