

## Spotlight on Sensors: Part 2

### Getting the Message

Braebon's Don C. Bradley has seen a lot in his years in the sleep industry, but a subtle shift at the 2010 APSS signaled a new awareness that surprised the 20-year sleep veteran.

Previously, inquiries at Braebon's APSS booth were noticeably more reserved in their enthusiasm about portable sleep monitoring. Don C. Bradley, the co-founder of Braebon Medical Corp, sensed the apprehension and compared it to dipping toes in the water. At the 24th annual APSS in San Antonio, attendees clearly knew the temperature of the water—and many decided to dive in.

The subtle shift in sophistication and acceptance mirrors the industry's continuing validation of ambulatory sleep monitoring. The shallow questions of the past have been replaced by serious inquiries. "The level of acceptance is noticeably greater than previous years," says Bradley. "People want to get accurate data and results. They want to know how the software works and what is actually happening within the algorithms—as well as how easy is the device to use for patient and clinicians."

Separate measuring of oral and nasal pressure was a hot topic, as was the possibility of expanding capabilities to monitor the performance of the CPAP while it is attached to the patient within the patient's own bedroom.

#### Better Sensors, Better Data

Braebon's titration sensor accomplishes a further expansion of a sleep lab's capabilities by allowing technicians to see flows, volumes, leaks, and actual pressures from any PAP device. Bradley educates attendees about this equipment, while also teaching technicians the finer points. "Knowing the tricks of using a sensor effectively is another important point," explains Bradley. "At a recent event, we had several groups of technicians who were using our cannulae. They were concerned about occlusions inside the nose. One tip is to ask patients to blow their noses and clean out nostrils before they come to the lab. Maybe have them trim nose hairs so you don't occlude. You can also trim the nasal prongs so they are actually perpendicular to the flow of air, and you get much more accurate signals."

#### Focus on Snoring

As portable monitoring becomes ever more refined, Bradley maintains that focusing on overlooked details such as snoring can make a difference. Merely paying attention to these differences is often a foreign concept, but determining snores per hour is a good start.

If you have the number of snores per hour, asks Bradley, then what about the effect in magnitude and volume/power? Knowing the actual change in volume when a patient undergoes therapy has merit, and it is one reason Braebon developed the Q-Snor, as well as placing this technology within the MediByte™ portable sleep screener (invented by Bradley and Richard A. Bonato, PhD, RPSGT, co-founder and CEO of Braebon Medical Corp, Ontario, Canada, to monitor the efficacy of oral appliance therapy).



"Q-Snor" by Braebon

Within the three main types of technologies used to determine snoring, technicians can access sensors that qualitatively measure vibrations on the neck—*qualitative* auditory signals or *quantitative* auditory signals. "The vibratory signal may contain artifacts such as cardiac pulses or head/body movements," explains Bradley. "The qualitative or quantitative audio sensor may contain external artifacts such as talking. It is the quantitative audio sensor that can give us the most valuable information related to snoring in the patient. The quantitative audio sensor (Braebon Q-Snor) allows you to do a proper pre- and post-comparison of *both* snoring indices and change in overall volume in patients. This is paramount if one is to assess the effectiveness of certain types of therapies."

#### Accurate Signals

Understanding sensor technology is paramount in ensuring the collection of accurate signals. As an example, piezo technology cannot measure events with low frequency content. At 10 HZ or higher, a piezo sensor responds acceptably well to what is going on. "If, however, you are looking to measure respiratory effort in patients with breathing rates of between 6 to 30 breaths per minute, and look for relative amplitude changes for each breath, a piezo sensor cannot give you what you need," explains Bradley. "An accurate signal refers to not only the sensor's ability to react quickly enough to the physiological event being measured, but to also output a signal that should be linearly proportional to the physiological event being measured.

"If I inhale and then exhale quickly, you won't see the proper signal with a piezo based pressure sensor," continues Bradley. "There will be a slow decay because of the filtering that has been added by the manufacturer to generate signals in the low frequency band that do not really exist. Properly developed sensors ensure that the sensor technology used generates an accurate signal. Some technologies are better than others. One must also consider the fact that just because a manufacturer states a type of technology is being used, it is not a guarantee that the sensor will accurately reproduce the physiological signal being measured. There are other factors that must be considered such as internal filtering of the raw signal before it even reaches the PSG amplifier system."

## Can You Trust Your Equipment?

Respected organizations such as the American Academy of Sleep Medicine (AASM) are always concerned with accuracy standards for things such as hypopneas. Bradley points out that the AASM did in fact come out with guidelines on nasal hypopneas. Calling them “a great first stab,” he laments that the guidelines could only go so far since there has not yet been enough research to substantiate measuring oral pressure for indications of oral only events.

At the base of all sleep units, the question is essentially the same: Is what you see on the screen an accurate reflection of what is physiologically going on with patient? The recorded and displayed signals have meaning to the trained eye, but are they reliable? If you can't trust your equipment, or know how to effectively use it, says Bradley, you have a fundamental problem. Sensors are the primary piece of equipment for obtaining signals and they must accurately reflect the physiological event being measured.

All sensors have limitations, and those limitations must be understood. Without proper understanding, you cannot expect to obtain accurate signals. The same type of sensor can use different technologies to give you a signal.

Accurately assessing the chest and abdominal effort of breathing is a basic function. When sensors are plugged into a PSG system, some technicians are simply *hoping* the filters and sampling rates are set right and that the sensor is working according to what they need. “The information comes up on the screen and you take that as gospel,” says Bradley, who in addition to his role as founder also serves as chief technology officer at Braebon. “But is that really what is happening? Is there effort happening on the chest and abdomen? One cannot answer that question without having a basic understanding of the technology involved.”

There are many technologies and methods for measuring airflow: pressure sensors; thermal sensors; and esophageal balloons to name three. Whatever method is used, Bradley contends that quality matters. “I could go out and buy the cheapest pressure sensor, and then I could buy a more expensive one,” says Bradley. “If you put a cannula on the patient and feed it simultaneously to both pressure sensors, you will see two totally different signals—yet people think if it is a pressure sensor, they are measuring accurately.”

## Problems with Pressure

There are several different types of cannulae used to measure airflow to gauge the nasal and/or oral breathing component. “You’ve got the thermal side, so you can measure nasal and oral apneas because you’ve got a thermal sensor,” says Bradley. “However, you don’t have the oral component on the cannula, and that is something Braebon looked at and worked out. We have the PureFlow and PureFlow Duo cannulae. These cannulae have a big scoop designed to give you an accurate, almost 1:1 relationship between the nasal breathing and the oral breathing—as well as give you a reliable signal.

The PureFlow combines both the nasal and oral component into one signal whereas the PureFlow Duo, when working with the Braebon PT2 Dual Pressure Transducer, gives separate oral and nasal signals. This family of cannula allows users to look into oral breathing and be able to determine oral hypopneas or other phenomena that may be present in the oral signal and not in the nasal signal.

There are a lot of technical issues in trying to grab oral pressure and accurately represent it, because engineers are not dealing with an enclosed system. “You’ve got leaks everywhere as well as the changing shape of the oral orifice,” laments Bradley. “The nasal one is a little easier because you design prongs that go in and they act like pitot tubes so you can measure the pressures and infer airflow fairly accurately. Even though people have different diameters on their nose, there is not that much of a change. But the mouth really changes shape throughout the night plus, it has been shown, people change their breathing patterns throughout the night between nasal and oral. They have even had studies showing that the person will actually change their breathing between left and right nostrils throughout the night. It is almost like we are just getting into the science of these types of things and it is all coming down to how can we easily and accurately measure the amount of air moving in and out of the patient.”



MediByte : Level 3 : 12 Channels

## The Future

If 2010 feels like a new awareness, what will the next decade bring? For Braebon, the long-term goals are part of a day-to-day strategy that builds on the fundamentals of meeting customers at trade shows and sleep laboratories. Spreading the message about MediByte and the MediByte Jr. is a top priority since the unit takes the company's best sensor technology and essentially puts it in a compact device to record and store data. Deemed too far ahead of the curve in 2003, the locking connectors, simple software, and explanatory videos are all poised to properly outline the product for patients and clinicians.

For Bradley, optimism is easy to come by thanks to growing recognition that sleep is nothing less than an enormous part of overall health. “We spend a third of our life sleeping, and you need to know what is going on while in this state of slumber. I enjoy helping people and improving their quality of life. The industry has really grown and the best companies are lean, mean, and responsive—and have attributes that I have boiled down to the four Fs— Focused, Flexible, Friendly, and Fast.”

Don Bradley is founder and chief technology officer for Braebon. He has worked in the sleep diagnostic industry for more than 19 years. He has designed and developed many medical devices including PSG systems and sleep sensors, authored several articles in technical and research publications, and given talks on technology in sleep.

For more information, visit [www.braebon.com](http://www.braebon.com)