



Demand for Affordable “Sleep Study”

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Published online: 19 December 2018
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Disastrous consequences resulting from sleep deprivation or its repeated interruptions are highlighted, not only by health professionals, but also by the media. Usually, patients are referred to a sleep specialist by the primary health providers after the initial history taking and assessment of sleep hygiene. In rare instances, primary health care providers do the screening with an Epworth Sleepiness Scale (ESS) before referring them to a “sleep study” centre or to a sleep specialist. The ESS provides a validated measure of the patient’s general level of daytime sleepiness and presents the physician with an initial screening tool to help assess the sleep debt. By the term “sleep study” one is usually referring to polysomnography (PSG), which is the gold standard for diagnosis and evaluation of the severity of various sleep disorders. Heightened public awareness of sleep disorders had caused a significant increase in the demand for sleep-related evaluations and sleep studies.

PSG is considered as an expensive test even in the developed countries. In many of these countries, this test is not supported by insurance companies. Even in those situations where there is a provision for insurance support, companies insist on unattended home sleep study, which is relatively less expensive than in-lab PSG. In the developing world, health insurance is a recent phenomenon and it can be availed of only by the privileged few, but it is a distant dream for the large number of “have-nots”.

The computer is an important component of sleep analysis equipment that can not only bring down the cost of the study, but also improve the quality of the analysis. It can make a hypnogram on the basis of several parameters, like EEG, eye movements, EMG and several other parameters. We cannot forget the days when sleep professionals used

to spend hours scoring hundreds of pages of EEG signals and other parameters recorded on moving papers. Today, computers can analyse and produce a hypnogram in seconds. Computers can do effective filtering to quantify different EEG waves. It can do power spectral analysis of EEG and provide information about delta power, which is almost impossible without the help of the computer. Analysis of the principal component in EEG and comparison of the power of different EEG frequencies can help in classification and quantification of sleep. The computer can do inter-hemispheric EEG coherence analysis, which can also aid in sleep analysis. Analysis of gamma oscillations and mu rhythms can support not only sleep classification, but also the ‘awake’ state. Medicine had benefitted enormously from the advances in technology. In fact, modern PSG itself is a standing example where sleep science had benefitted from basic scientific discoveries. But, have we come to a stage where we can blindly depend on the computer-made hypnogram to diagnose and treat patients? The answer is a big “NO”. We have to move forward a lot before we can come anywhere near that stage.

The need for a healthy relationship between technology and medicine is paramount in health care. Those who argue in favour of depending on the computer based analysis point out that ‘humans’ are basically flawed, and there are several instances of anecdotal errors of medical judgement. Attempts to play up human error are unfair. But this need not be used as a justification for introducing devices using machine learning, artificial intelligence and other awe-inspiring advances for improving the quality of medical equipment. It is an accepted fact that health science has certainly benefitted from these technologies. At the same time, we cannot ignore the humongous costs involved in research leading to the introduction of these new technologies in sleep analysis. Government-sponsored research for the advancement in medical science, especially sleep medicine, is shrinking all over the world. It is thus left to the tech companies to undertake research in this field. As tech companies are profit-seeking corporate bodies, they are driven to focus on higher profits that these new devices

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would bring to the company. With the result, advanced technologies are made available for the able-to-pay population, and the majority, who cannot pay, are unable to access the level of medical care available only to the favoured few. The media, Internet and company advertisements always make the people aware of the availability of better options that are beyond the reach of the poor. This only helps to increase the dissatisfaction level of millions of ordinary people.

Coming back to the question of bringing down the cost of sleep study equipment, there are several ways to approach it from the production side. The equipment will be cheap if they are manufactured in those countries where the cost of production is low. Though the proposition sounds simple, there are several practical difficulties. It is often difficult to have a good competitive product, if one starts the development of the equipment right from scratch. Failures of initial products will be enough to get a bad name for the company and kill the enterprise. On the other hand, established companies can shift the production base to those countries where the cost of production is low. This is happening in many industries. This can happen only when there is political backing.

One of the major components responsible for making in-lab PSG more expensive is the cost of the manpower, namely sleep physician and technologist. As the devices required for picking up the signals from the body for sleep analysis are improving, the day is not far off when anyone could apply these sensors on himself or herself without external assistance. Miniaturisations of amplifying and analysis systems have already reached a high level of perfection. Cost reduction should also go hand in hand with these changes, but the commercial interest of the companies is standing in the way of price reduction. If the companies are investing huge amounts in research and advancement, they should be able to get back what they have invested. If they are assured of increase in the number of devices that they would be able to sell, the cost will go down.

Manufacturers can take it for granted that there will be massive increase in sale when good quality, less costly sleep recording and analysis systems are available, which can be used for unattended home sleep studies. Even now, the increasing popularity of home studies is not entirely due to the insistence of insurance companies, but it is also due to

the fact that a relatively reliable inference could be arrived at from the present day home sleep study equipment. PSG is a non-invasive diagnostic tool, just like the heart rate or blood pressure monitors. A simple sleep study need not have a professional person in attendance, unlike a CPAP titration which should only be done under the watchful eyes of a sleep specialist. (Unfortunately, many salesmen in some developing countries are selling CPAP equipment and doing CPAP titration, without the knowledge or recommendation from any doctor.) There should be strict control over the sale and use of pressure breathing equipment; however, there need not be any control over the sale of sleep study equipment. Use of sleep laboratories will shift from its present day emphasis on laboratory-based PSG to titration and sleep-related tests.

There are certain things that the professional bodies involved in sleep medicine can do at their end. They can form expert groups to monitor the quality of sleep study machines so that the public is made aware of the plus points and minus points of each of the company's products. Companies should not be riding on their reputation in the field to sell the products. As a first step, professional bodies should encourage the companies to publish the algorithms used by them for sleep stage analysis. Those who come out voluntarily to announce the algorithms should be given incentives to display their equipment during conferences. At the same time, it is the responsibility of the expert groups of professional bodies to devise ways and means to test the claims made by the volunteering companies.

We can conclude by stating that the public awareness of sleep disorders had caused a significant increase in the demand for sleep studies. Unfortunately, laboratory-based PSG is an expensive test. There should be governmental support for research in machine learning, artificial intelligence and other advances to make effective and good home testing sleep study equipment. Advance in technology should project PSG as a diagnostic tool, just like the heart rate or blood pressure monitors. Professional bodies should play a more active role in monitoring sleep study equipment and should also ensure that good quality products are made available to the public at an affordable cost.