ECRONICON OPEN ACCESS

EC PULMONOLOGY AND RESPIRATORY MEDICINE

Guest Editorial

Virtual Sleep Lab 3.0. Implementation of Telemedicine in the Diagnostic Process of Sleep Apnoea Syndrome

Azpiazu M, Navarro-Soriano N* and Egea-Santaolalla C

Functional Sleep Unit, OSI Araba University Hospital, Vitoria, Spain

***Corresponding Author**: Nieves Navarro-Soriano, Functional Sleep Unit, OSI Araba University Hospital, Vitoria, Spain.

Received: July 18, 2017; **Published:** July 25, 2017

Sleep apnoea syndrome (SAHS) is a very prevalent, albeit underdiagnosed, disorder which, in our community, is suffered by an estimated 14% of men and 7% of women [1]. Currently there is growing recognition of the impact that this disorder has on health, not only because of its increased prevalence [2], but also because of an increased understanding and its consequences at different levels [3]. This is leading to a higher demand for assessment requests which, given the current situation of limited health resources, is saturating sleep units and causes overly lengthy waiting times for diagnosis and treatment.

On the other hand, the concept of telemedicine, i.e. the use of telecommunication systems to remotely manage medical attention, has already been developed for some years now. This has the potential to improve health care access, monitoring and related costs. So why not take advantage of these advances in the medical field?

With regard to sleep medicine, the *American Academy of Sleep Medicine* (AASM) supports the use of telemedicine as a tool to improve patient health by improving access to sleep units. However, this improvement has to be linked to a quality assessment and care in diagnosis and treatment [4]. In addition, a recommendations guide to help plan and make decisions when implementing a telemedicine program [5] has already been published.

Telemedicine applications in sleep medicine include: telemonitoring of polysomnography, CPAP telematics, monitoring of symptoms and adverse effects, adherence to CPAP treatment including remote adjustment of CPAP settings, patient education and reinforcement interventions by means of video consultations and applications (app) [5-8]. Nonetheless, we continue to manage the problem inefficiently, with unacceptable times for processing diagnosis and treatment compared to what one would expect today.

In our case, taking the sleep unit's conventional route, process time to diagnosis stood at 80 weeks.

Needing to innovate sleep management, we sought to conduct a hybridization project with a company accustomed to order lists and immediacy response. This company was the automobile company Mercedes-Benz TM Spain which, through its continuous improvement division, introduced LEAN methodology (work technique to reduce waste that does not create value) to our processes: generating indicators, assessing our problems and managing solutions. This is how a new concept in the sleep unit came to be: The Virtual Sleep Laboratory (LVS).

We initiated this new organizational model in 2014, creating a protocol with Primary Care for the referral of patients with suspected SAHS based on an asynchronous electronic transfer of the request with standardized information. This transfer was made possible thanks to the implementation of a unique electronic medical history (out-patient and inpatient), constituting a health-care network. In addition, the data to be collected on the request are: the reason for referring the patient and the results obtained from two questionnaires, one for SAHS (BERLIN) [9] and one for sleepiness (EPWORTH) [10]. We initially employed the BERLIN questionnaire, however, after having analysed the data obtained from our community, we decided on the STOP-BANG [11] questionnaire, since these indicate a better screening value to discard a relevant SAHS (AHI ≥ 15) with a cut-off point of 2.

Once the virtual request is received, it is assessed using the data provided. If sufficient data are available, risk stratification is performed based on the patient's pre-test probability and comorbidity. This probability is calculated from the score obtained in the STOP-BANG, so that: if it is less than or equal to 2, probability is low; 3 - 4 is intermediate; and greater than or equal to 5, high. By doing this, the simplest diagnostic test (simplified polygraph) is assigned to the highest or lowest probability (high sensitivity), and a more complex one (multi-channel polygraph) for intermediate probability or should central or positional apnoea be suspected. On the other hand, priority is also assessed according to the patient's records (accident rate or profession) and comorbidities. In the event that the consultation received is insufficient, nursing contacts the patient to complete the data necessary for their assessment.

This change with respect to the conventional process allowed us to reduce the time from weeks to only a few days from Primary Care handling the request to consultation for assessment, and of the 1,193 requests received during the year, 79% were answered in less than 24 hours, with an average of 2.3 days. Meaning that during the first half of 2015 time to diagnosis had been reduced to 30 weeks.

Nonetheless, by applying Lean Thinking, we initiated the process of performing virtual test requests by transferring them electronically, eliminating the intermediate steps. In this manner, the process time to diagnosis of applications for the first half of 2016 was 20 weeks. This represents a 76% improvement in diagnostic process time since the LVS began (Figure 1).

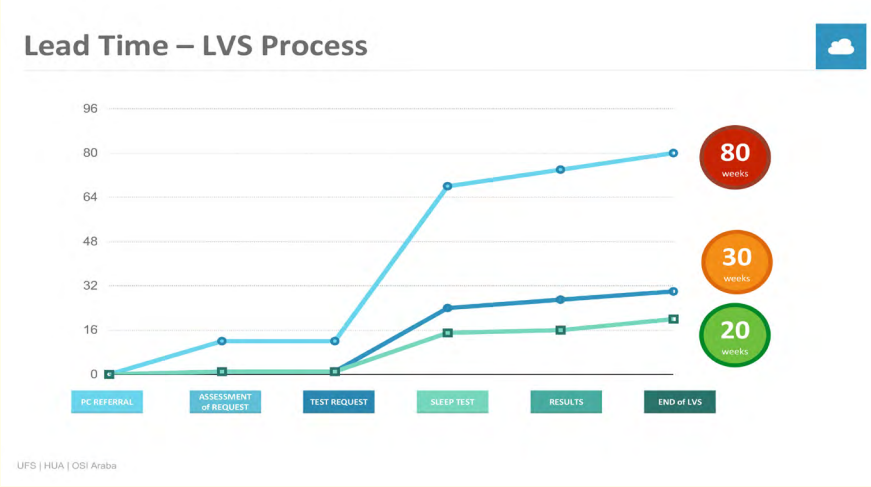
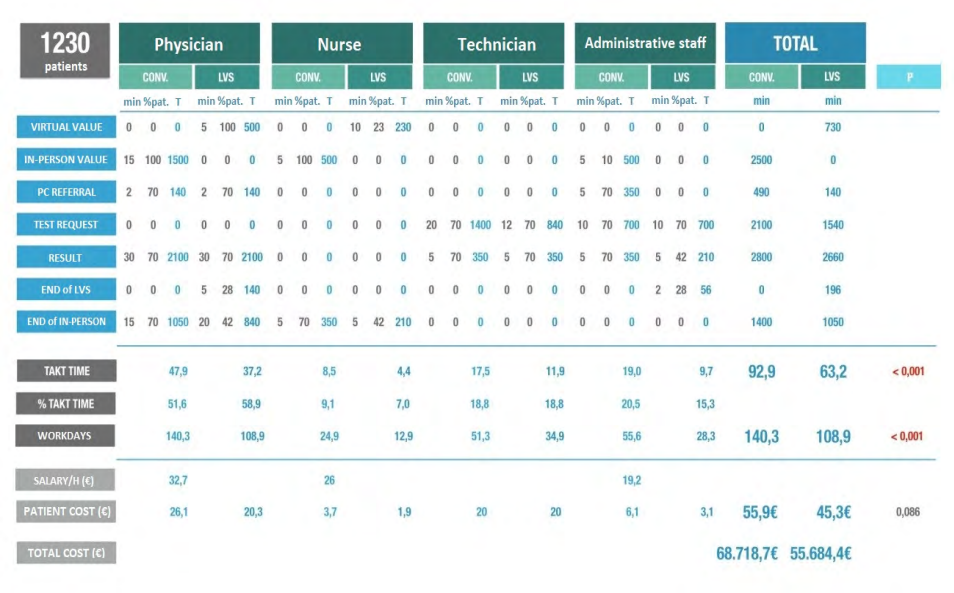


Figure 1: *Comparison of the process times at each phase.*

Once the results were obtained, records, a high percentage of which are read automatically (Manual review), by simplified polygraphs, based on work published by our group [12] (Spanish Sleep Network), only cites in-person consultations for those patients for whom SAHS is confirmed (apnoea-hypopnoea index (AHI) ≥ 5 with high-level polygraphs, and AHI ≥ 10 with simplified polygraph). With regard to patients with low clinical probability and negative results, these can be discharged from the LVS, the general practitioner is informed of the results and a report is sent to their home detailing the process performed, healthy sleep methods and alarm signs that might prompt a new consultation. In the sleep cohort for Vitoria, of the 1,193 patients assessed, we only suspected a false negative in 6.2%, of which 1.8% was confirmed. 63% of the patients were referred to consultation for therapeutic decision, and 37% were discharged from the LVS.

Moreover, in the management of this diagnostic process we have to establish the time that we dedicate to the patient in a sleep unit, referred to as Takt Time (contact time). To do this, we calculate the times and costs at each stage of the process, estimating average times for 100 patients according to the staff involved and the percentage of patients assessed, we then compare these with those of the conventional process (Figure 2).



1230 patients	Physician						Nurse						Technician						Administrative staff						TOTAL		
	CONV.			LVS			CONV.			LVS			CONV.			LVS			CONV.			LVS			CONV.	LVS	P
	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	%pat.	T	min	min	
VIRTUAL VALUE	0	0	0	5	100	500	0	0	0	10	23	230	0	0	0	0	0	0	0	0	0	0	0	0	0	730	
IN-PERSON VALUE	15	100	1500	0	0	0	5	100	500	0	0	0	0	0	0	0	0	0	5	10	500	0	0	0	2500	0	
PC REFERRAL	2	70	140	2	70	140	0	0	0	0	0	0	0	0	0	0	0	0	5	70	350	0	0	0	490	140	
TEST REQUEST	0	0	0	0	0	0	0	0	0	0	0	0	20	70	1400	12	70	840	10	70	700	10	70	700	2100	1540	
RESULT	30	70	2100	30	70	2100	0	0	0	0	0	0	5	70	350	5	70	350	5	70	350	5	42	210	2800	2660	
END of LVS	0	0	0	5	28	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	28	56	0	196	
END of IN-PERSON	15	70	1050	20	42	840	5	70	350	5	42	210	0	0	0	0	0	0	0	0	0	0	0	0	1400	1050	
TAKT TIME			47,9			37,2			8,5			4,4			17,5			11,9			19,0			9,7	92,9	63,2	< 0,001
% TAKT TIME			51,6			58,9			9,1			7,0			18,8			18,8			20,5			15,3			
WORKDAYS			140,3			108,9			24,9			12,9			51,3			34,9			55,6			28,3	140,3	108,9	< 0,001
SALARY/H (€)			32,7						26												19,2						
PATIENT COST (€)			26,1			20,3			3,7			1,9			20			20			6,1			3,1	55,9€	45,3€	0,086
TOTAL COST (€)																									68.718,7€	55.684,4€	

Figure 2: *Takt Time. Calculation of times and costs at each stage and for personnel involved. Conv.: Conventional process; %Pat.: % of patients.*

With the changes that we made in the SAHS diagnostic process, LVS contact time was significantly less than a conventional in-person process (63.2 minutes versus 92.9 minutes, $p < 0.001$), providing the doctor with reduced workdays. The overall cost per patient is also lower (€45.30 versus €55.90), although without statistical significance.

To sum up, using this strategy based on the concept of *Lean Thinking, work philosophy frequently used in the business world*, associating the use of new technologies, it is possible to achieve a change with respect to conventional management of the diagnostic process by employing these new technologies, transforming the diagnostic process into a more efficient out-patient and virtual continuous process to help us manage the growing demand for assessing requests without reducing the quality of care, reducing costs and waiting lists, and without the need to increase sleep unit human resources.

Bibliography

1. Durán J., *et al*. "Obstructive sleep apnoea-hypopnoea and related clinical features in population-based sample of subjects aged 30 to 70 yr". *American Journal of Respiratory and Critical Care Medicine* 163 (2001): 6685-6689.

2. Peppard PE., *et al*. "Increased prevalence of sleep-disordered breathing in adults". *American Journal of Epidemiology* 177.9 (2013): 1006-1014.

3. Javaheri S., *et al*. "Sleep Apnea: Types, Mechanisms and Clinical Cardiovascular Consequences". *Journal of the American College of Cardiology* 69.7 (2017): 841-858.

4. Singh J., *et al*. "American Academy of Sleep Medicine (AASM) position paper for the use of telemedicine for the diagnosis and treatment of sleep disorders". Journal of Clinical Sleep Medicine 11.10 (2015): 1187-1198.

5. Singh J., *et al*. "Sleep Telemedicine Implementation Guide". American Academy of Sleep Medicine (2016).

6. Verbraecken J. "Telemedicine Applications in Sleep Disordered Breathing". *Sleep Medicine Clinics* 11.4 (2016) 445-459.

7. Sparrow D., *et al*. "A telemedicine intervention to improve adherence to continuous positive airway pressure: a randomised controlled trial". *Thorax* 65.12 (2010): 1061-1066.

8. Isetta V., *et al*. "Telemedicine-Based Approach for Obstructive Sleep Apnoea Management: Building Evidence". *Interactive Journal of Medical Research* 3.1 (2014): e6.

9. Netzer NC., *et al*. "Using the Berlin questionnaire to identify at risk for the sleep apnea syndrome". *Annals of Internal Medicine* 131.7 (1999): 485-491.

10. Chiner E., *et al*. "Validation of the Spanish version of the Epworth Sleepiness Scale in patients with a sleep apnoea syndrome". *Archivos de Bronconeumologia* 35.9 (1999): 422-427.

11. Chung F., *et al*. "STOP-Bang questionnaire: A Practical Approach to Screen Obstructive Sleep Apnoea". *Chest* 149.3 (2016): 631-638.

12. Juan F Masa., *et al*. "Effectiveness of Home Single-Channel Nasal Pressure for Sleep Apnoea Diagnosis". *Sleep* 37.12 (2014): 1953-1961.

Volume 4 Issue 3 July 2017