

# Nocturnal perspiration as a parameter and predictor

## *Introducing the Q-strip to quantitatively measure nocturnal perspiration: a review of literature*

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### Abstract

One third of a person's life is spent on sleep, therefore the quality and habit of sleep affects health. A single case study indicated that perspiration could serve as a prognostic marker. Diagnosing nocturnal perspiration is common clinical practice, since this serves as a major symptom in many pathologies. Till this day no specific evidence-based approach for diagnosing nocturnal perspiration exists. By introducing the Q-strip, a device which quantitatively measures nocturnal perspiration, this could be acquired. The Q-strip could serve a purpose in diagnosing nocturnal perspiration more efficient without being intrusive. In addition to its health sensing potentials, the Q-strip makes it possible to visualise perspiration patterns. This introduces the possibility to examine the quality of sleep. Future research is recommended to investigate this.

Keywords: Diagnosis, Health sensing system, Nocturnal perspiration, Parameter, Pathology, Predictor, Q-strip, Subjective measurement, Sweat pattern, Symptoms

Perspiration is likely to be the result of autonomic overactivity caused by disease (A.J. Viera *et al.*, 2003). A single case study indicated that perspiration, quantified by its pattern during nights, could serve as a prognostic marker (D. van der Werf, 2017). It was observed that cystitis, common flu, and menstruation influenced this pattern, possibly due to

the fact that nocturnal perspiration was caused by these events. This was observed using the newfound Q-strip device that measures humidity and thus perspiration during sleep. It is expected that nocturnal perspiration patterns, measured using this Q-strip, could serve as a prognostic marker for different pathologies.

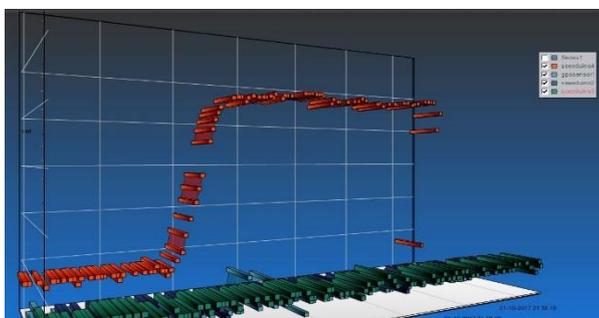


Figure 1: Example graph of Q-strip data  
The peak (red line) in the graph represents measured humidity (D. van der Werf, 2018)

In general, complaints of nocturnal perspiration are common in clinical practice (C.W. Su *et al.*, 2007). Various pathologies have nocturnal perspiration as a symptom. Since the Q-strip measures perspiration during sleep, it is expected that this device could be useful in identifying nocturnal perspiration and thus diagnosing pathologies.

### Nocturnal perspiration

Nocturnal perspiration can be defined as drenching sweats that require the patient to change bedclothes (A.J. Viera et al., 2003). Note that there is no strict definition for nocturnal perspiration. Some clinicians tend to classify nocturnal perspiration as mild, moderate and severe, shown in Table 1.

Table 1: Definitions of nocturnal perspiration  
Definitions given by different authors, divided in classes

Author	Classes	Definition
Lea and Aber, 1985	Mild	No bathing or change of clothing required
	Moderate	Sleep disturbed by need to arise and wash face or other affected body areas, but no clothing change
	Severe	Both or clothing change required
Quigley and Baines, 1997	Mild	No change in bedclothes necessary; sweating only reported after specific questioning
	Moderate	No change of clothing necessary; washing of affected areas required; sweating volunteered by patients as a specific problem
	Severe	Volunteered by patients as drenching sweats requiring a change of clothing or bed linen or both

Perspiration helps to reduce core body temperature when it rises above certain limits or thresholds, called the thermoneutral zone (TNZ) (J.W. Mold et al., 2012). Rise above the TNZ triggers a hypothalamic response resulting in dilation of sweat glands. The exact height of this threshold differs throughout the day, being at its lowest point in the morning. The body temperature then tends to fall slightly in the evening whereas lower core temperature facilitates sleep.

### Nocturnal perspiration as a symptom

Diagnosing nocturnal perspiration is common clinical practice, since this serves as a major symptom in many pathologies, shown in Table 2. It is known that the release of inflammatory mediators during infections, autoimmune diseases, and malignancies temporarily alter the TNZ (B.J. Holtzclaw et al., 2001). Patterns of nocturnal perspiration have been explained by rise and fall of viral loads, bacteria, interleukins, and tumour necrosis factors. Acquired Immunodeficiency Syndrome (AIDS)-related lymphoma as an example, since patients with this disease have a history of fever, weight loss, and nocturnal perspiration (D.M. Aboulafia et al., 1997). Next to this it is found that depressed patients sweat more at night than control subjects (D.H. Avery et al., 1999). Recently M. Tufail (2019) described a 26-year-old male in a case report about Tuberculous Empyema. He suffered from dry coughs, nocturnal perspiration and fever for over three weeks. This is a classic case of Tuberculous Empyema,

in which nocturnal perspiration plays a major role. Since this patient suffered for more than three weeks an X-ray was performed which concluded the diagnosis Tuberculosis Empyema. The current method of diagnosing nocturnal perspiration is subjective, no specific quantitative measurement is available to conduct nocturnal perspiration. Various pathologies such as Tuberculosis Empyema, AIDS-related lymphoma, and psychological disorders rely on nocturnal perspiration as a symptom for diagnosis.

Table 2: Pathologies with nocturnal perspiration as a major symptom. (A.J. Viera et al., 2003)

Pathologies with nocturnal perspiration as a symptom	
<b>Malignancy</b> Lymphoma Leukaemia Other neoplasm	<b>Rheumatologic</b> Takayasu's arteritis Temporal arteritis
<b>Infections</b> Human immunodeficiency virus Tuberculosis Mycobacterium avium complex Infectious mononucleosis Fungal infections (histoplasmosis, coccidioidomycosis) Lung abscess Endocarditis Other infection	<b>Endocrine</b> Ovarian failure Hyperthyroidism Diabetes mellitus (nocturnal hypoglycaemia) Endocrine tumours (pheochromocytoma, carcinoid tumour) Orchiectomy
<b>Other</b> Obstructive sleep apnea Gastroesophageal reflux disease Chronic fatigue syndrome Granulomatous disease Chronic eosinophilic pneumonia Lymph node hyperplasia Diabetes insipidus Prinz metal's angina Anxiety Pregnancy	<b>Psychiatric disorders</b> Depression Anxiety

### Other causes

Next to the various pathologies, medication and alcohol may contribute to nocturnal perspiration. Antipyretics such as acetaminophen and aspirin are the most common contributor-drugs (Physicians' desk reference, 1999). This is most likely a rebound effect as the antipyretic effects subside. Use of some antihypertensives, antidepressants, tamoxifen, leuprolide, and niacin are possibly causal as well. Table 3 states pharmaceutical agents that were labeled as having nocturnal perspiration as a side effect. Alcohol use, particularly alcohol dependence, also may cause nocturnal perspiration.

Table 3: Drugs causing nocturnal perspiration (H.L. Fred, 1993)

Drug	
Donepezil Indinavir Saquinavir Zalcitabine Cyclosporine	Pegaspargase Rituximab Interferon alfa-2a Daclizumab

### Current diagnosing method

As earlier mentioned, identification of nocturnal perspiration is highly dependent on subjective measurements (*J.W. Mold et al., 2012*). Self-reported sweating may be due to other factors waking the patient at night compared to self-reported non-sweaters. Diagnosis is determined as follows: examination of patients history is the first step in this process. Next to this, physical examination takes place where the patients vital signs (temperature and blood pressure) are being measured. If no abnormalities are found, nocturnal perspiration is evaluated using different laboratory tests. If the patient continues to complain of nocturnal perspiration, a diary of the patients temperature during the night might reveal an underlying pathology. If nothing is found, the nocturnal perspiration is considered benign (*A.J. Viera et al., 2003*). *Su 2007, Smetana 2006, Chambliss 1999*, clarify this diagnostic protocol is only based on consensus opinion of various authors. None of these approaches is evidence-based.

### Q-strip

Since no specific evidence-based approach for diagnosing nocturnal perspiration exists, a direct measurement could serve a purpose. By introducing the Q-strip, a device which quantitatively measures nocturnal perspiration, this could be acquired. The Q-strip, shown in figure 2 ([www.qstrip.nl](http://www.qstrip.nl)) is an easy device that directly measures humidity and thus sweat during sleep. It is placed underneath the fitted sheet in bed on breast height to target the many lymphnodes present in this area.

The Q-strip could serve a purpose in increasing the efficiency of diagnosing nocturnal perspiration without being intrusive. Literature on direct perspiration measures is scarce. Although there is a call for the development of special techniques, such as the Q-strip, to introduce a more useful health sensing system (*S. Li & C. Chiu, 2018*). The quality of sleep affects the patient's health. Therefore, daily sleeping information from the Q-strip is helpful for health-professionals in decision-making for a specific diagnose and treatment.



Figure 2: The Q-strip  
(*D. van der Werf, 2017*)

In addition to its health sensing potentials, the Q-strip makes it possible to visualise nocturnal perspiration patterns. *Salvesen et al., 1988* describes a relation between forehead sweating patterns and (psycho)pathologies. These findings are somewhat comparable with the earlier described single case study. Furthermore, Q-strip measurements indicate a relation between the duration of sleep and nocturnal perspiration patterns. In addition, a baseline can be drawn from this data that represents the 'normal' nocturnal perspiration pattern of an individual. Using this to identify deviations from future nocturnal perspiration patterns, is a potential to examine the quality of sleep in a non-invasive manner. Since literature on this subject is scarce, it is recommended to investigate its prognostic potential in future research.

### Summary

This report analysed literature about nocturnal perspiration and the link between various pathologies, drugs and alcohol. In addition to the single case study, further research is needed to support the hypothesis that perspiration patterns, measured using the Q-strip could serve as a prognostic marker for different pathologies. Furthermore, literature shows that a health sensing system like the Q-strip could be beneficial in the procedure of diagnosing nocturnal perspiration by ruling out and therefore revealing underlying pathologies. This confirms its ability and need to serve as an indicator for diagnosing nocturnal perspiration. It is recommended to investigate these potentials in future research.

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