

## Case Study 4 – The Thyroid System

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1. *How can technology be used to inform patients regarding the interpretation of their thyroid testing results?*

There are many tests which may be used to diagnose thyroid dysfunction. TSH Tests, determining TSH levels in blood, are great early warning detection test to determine a thyroid malfunction. T4 tests, determining the level of T4 hormone in the body, is a more direct test in determining the exact issue with thyroid dysfunction. A high TSH and Low T4 point to Hypothyroidism (underproduction of hormone), conversely a low TSH and a High T4 point to Hyperthyroidism (overproduction of hormone) [1].

For a patient with thyroid dysfunction, the condition is incurable, chronic, and will last a lifetime. As such, the treatment will also last a lifetime and must be constantly monitored for proper thyroid hormone levels. Patients undergoing treatment can take an active part in their health. Monitoring their test results and tracking their progress over time.

2. *How can technology be used to help doctors navigate the highly personalized future of test interpretation?*

New studies conducted on thyroid patients reveal new correlations, methodologies, treatments, and tests all the time [2]. Technology can be used to connect hospitals with research labs and clinicians to notify them of the latest drugs, technologies and treatments. Additionally, data sharing will allow doctors to observe patterns in patient groups to help prevent and identify thyroid issues earlier in a patient's medical history.

Personalized medicine, the future of medical treatment, focuses on treating each patient uniquely. All treatments, diagnoses and medicines would be individually tailored for the patient and take into account the entire patient history. Considering that thyroid function "normal" range is large and can vary from patient to patient and throughout a patient's lifetime, personalized medicine will be capable of catching and identifying thyroid dysfunction earlier in a person's life. By utilizing Electronic Medical Records, medical collaboration between research partners, and advanced technologies analyzing large datasets of patients, early diagnosis of thyroid disease will help patients get properly tailor medicine for their unique physiology.

3. *How could ML be used to help correlate patient symptoms with test results?*

Machine Learning can be applied in many different ways, from analyzing medical data to ultrasound or x-ray images. The more data that is generated or shared among researchers the more accurate Machine Learning predictions can become, often surpassing clinical diagnostics as well.

In Ultra-Sound Imaging, the experience of the diagnostician plays a key role in effectively classifying malignant tumors of the thyroid. With Machine Learning, random forest classifiers are found to have better prediction accuracy than clinicians in certain studies [3]. The benefit of a Machine Learning algorithm, in this regard, is that it is independent of clinical experience and can be applied in any hospital without any specialized staff. This fact may help with early tumor detection and treatment in areas where specialized medicine is not available or scarce.

Wearables are a recent technological trend which has allowed patients better control over their own data, and provided a plethora of data points for researchers to analyse. Determining patterns in the vast amounts of data provided can sometimes lead to novel methods of detecting diseases in certain populations simply by using the data from the wearable devices. In some studies, positive thyrotoxicosis detection has been demonstrated by monitoring patient resting vs active Heart Beat rates. Considering most modern wearables such as the FitBit or Apple Watch can monitor a user's heartrate, a clinician can determine if the patient is in possible danger of thyrotoxicosis early, non-invasively, and safely. Furthermore, the patient can be warned of possible signs of the disease by their own wearable technology without ever visiting the doctor's office in the first place [4].

## References

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