

An Analysis of Current Thyroid Function Test Requests

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Abstract: ***Background:** Unnecessary and excessive Thyroid function testing can lead to added economic burdens in an era of rising healthcare costs, whilst only minimally having any significant clinical benefit. I set out to analyse the current practice at the health centre with comparisons against international guidelines, with a view to reducing patient exposure to unnecessary test and to increase thyroid testing cost effectiveness. **Methods:** A record of all Thyroid Function Test (TFT) requests was extracted from electronic medical records, over the period of November 2019 and a random sample of 100 patients was further analysed to assess indications for testing. **Results:** A thorough and detailed analysis showed that for 20/100 of patients a valid justification was found in terms of patients presenting with symptoms suggestive of thyroid disease (Diagnosis). A further 7/100 sample had a known thyroid disease and were being appropriately tested (Monitoring). 16/100 patients were correctly tested for associated conditions (Screening). Overall, there was a valid justification for 43% of the 100 Random Sample analysed. **Conclusion:** In summary I found that inappropriate requesting of thyroid function tests is common. In an era of rising healthcare costs, inappropriate thyroid function testing is an ideal target for efforts to reduce laboratory over utilization*

Keywords: thyroid function test, hypothyroidism, healthcare costs

1. Introduction

It has been seen that there is often a whole array of invasive blood tests requested by patients and staff, which are on many occasions unnecessary and even contrary to guidelines. One such area of concern is the requesting of thyroid function tests.

Excessive or unnecessary testing can lead to added healthcare costs in an era of rising economic burden, whilst minimally contributing to the management or diagnosis of thyroid disease.

Thyroid disorders including overt and subclinical hypothyroidism and hyperthyroidism are amongst the most prevalent of medical conditions, especially in older women (1).

Whilst there are limited studies of prevalence of thyroid disorder in Qatar, the epidemiology in the Arab world was looked at in a systematic review in 2016. It concluded that the prevalence varied from 6.18% to 47.34%, in Libya and Saudi Arabia respectively (2). A more recent cross-sectional study conducted in Jordan showed the prevalence of any hypothyroidism was 17.2% in females and 9.1% in males (3). Comparatively the prevalence in the UK is 1-2% (4) and the US is 3.82% (5).

With such ranging but common prevalence's the ordering of thyroid function tests is also common, as observed subjectively whilst here in Qatar. International data reveals that in the UK, there are almost 10 million thyroid function tests requested annually with an estimated cost of £30 million (6).

Furthermore, thyroid function testing can be considered from varying perspectives including that of the patient, physician and laboratory.

From a patient perspective, where they are now generally better informed with regards to health and wellbeing, they find it difficult to comprehend that there is often no clear cut off point for the diagnosis of thyroid disorders and that different patients will respond differently to treatment.

A physicians view point is often concerned with borderline cases, where the tests neither confirm or exclude the diagnosis. In such cases, maximum laboratory information with regards to interpretation of the results is expected.

The laboratory has its own position in that these tests can be relatively expensive and therefore they rely heavily on the physicians judgement especially in the absence of clinical information when requests are made.

With this in mind, there becomes an essential need for national guidelines when considering the use of thyroid function test, ensuring that there are standardized and evidence-based indications for requesting such tests.

There is also existing evidence from other literature that supports this view (7,8)

The current practice allows the use of international and local guidelines interchangeably, which can have varying outcomes, depending on the guideline used. Therefore, to develop such guidelines, a current analysis of TFT requests is mandatory.

I set out to analyse the current practice at the health centre with a view to reducing patient exposure to unnecessary tests and in effect to increase thyroid testing cost effectiveness.

2. Methods

I set out to analyse the current practice at my local health centre in November 2019 with comparison against international guidelines (9-12)

The coding team extracted a list of all patients that underwent Thyroid function testing in November 2019 from the electronic medical records.

The Thyroid function tests specifically provided were the number of TSH (Thyroid Stimulating Hormone), FT4 (Free Thyroxine), FT3 (Free Tri-iodothyronine) and TPO (Anti Thyroid Peroxidase) and TGAb (Anti Thyroglobulin antibody).

The following inclusion and exclusion criteria were applied:
Inclusion: All adults (age 18 and above) with suspected or known thyroid disease

Exclusion: Pregnant ladies, paediatric patients (age less than 18)

From the total number of patients (1182) the data variables requested for each individual patient were: Age, Gender, Nationality, date of Thyroid function test performed, and the date of Thyroid function test Ordered

This study was a Retrospective, descriptive study as detailed below.

There was an Initial analysis of total results (demographic data) followed by a more detailed analysis on a randomly selected sample.

A more thorough analysis was conducted on a 100 randomly selected patient sample from the total 1182 TSH tests. The sample was selected from an Excel Spreadsheet using a PRNG (Pseudorandom number generator) algorithm.

Thereafter, individual patient notes analysis was carried out manually.

The basic demographic data, such as age, gender, nationality was defined with regards to this sample.

The patient notes were thoroughly examined and re-examined to ascertain the number of patients that met the correct indications for TFT requesting with comparison against international guidelines (9-12). These guidelines were used as a basis for formulating the criteria used in this audit as detailed in Appendix A.

Specifically, the following areas of the patient notes were studied; the documentation records, the results review page, home medications as well as order details for test requests.

For each individual patient they were categorized according to the following indications:

- Diagnosis – those patients that present with symptoms suggestive of thyroid disease e.g., fatigue, constipation, dry skin...
- Screening – those patients that have conditions which are associated with thyroid disease e.g., Dyslipidaemia, Atrial Fibrillation
- Monitoring - those patients that have a known thyroid disease

3. Results

The initial data collected from between the 1st November to 30th November 2019 were analysed in terms of demographics to reveal the total number of any test (TSH, FT4, FT3, TPO, TgAb) requested was 2356. The predominant test ordered was TSH (50% of total tests requested), followed by FT4 (40 % of total test requested).

The following chart reflects a breakdown of each subcomponent thyroid test.

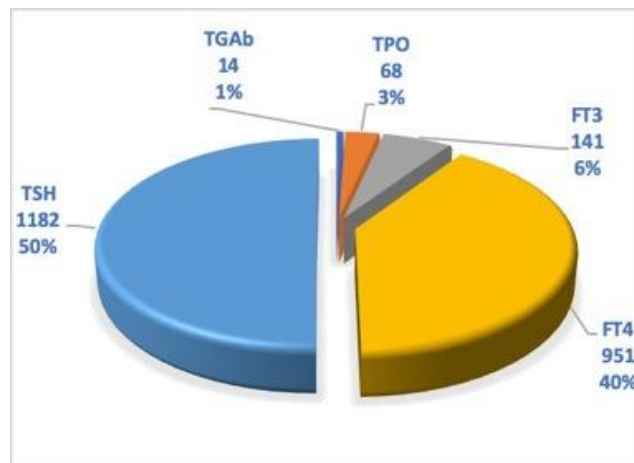


Figure 1: Breakdown of each subcomponent thyroid test

Test Name	Percentage	Number of Tests
TGAb	1%	14
TPO	3%	68
FT3	6%	141
FT4	40%	951
TSH	50%	1182
Total	100%	2356

Furthermore, there were 13 duplicate TFT blood test performed within the month of November. Also, Anti thyroglobulin antibody, a costly test, was requested and performed in 14 individuals.

A breakdown of the TSH test requested showed a female predominance with 68% (n= 798) of test requested in women and 57% (n=676) requests in Qatari nationals.

The following graph illustrates the age groups in which tests were requested, with the least test being requested in those over 65 and this being the same group that would have the longest wait period before the test was performed, on average 36.6 days.

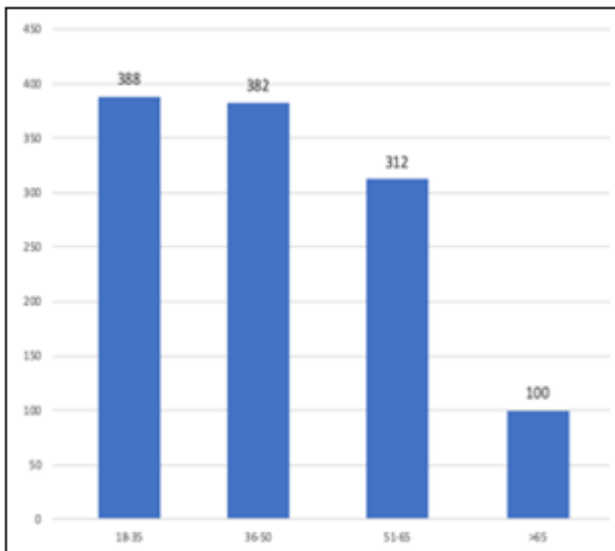


Figure 2: The Number of TSH test performed by Age group

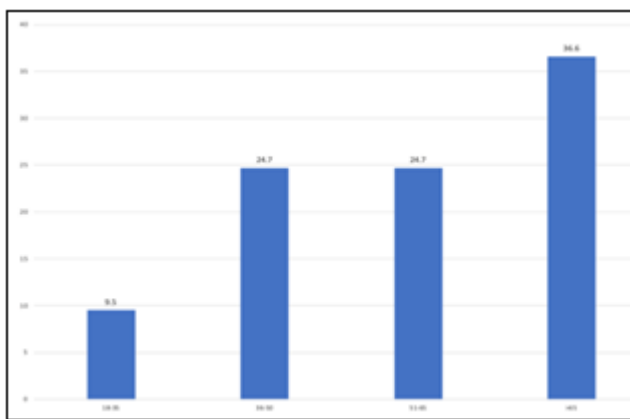


Figure 3: The Average days waited between test request and test performed by Age group

The randomly selected 100 sample had similar demographics with the TSH test requested showing a female predominance of 71 % and 63% of test being in Qatari nationals. The age groups also reflected a similar picture to that of the total data results, with 29, 32 and 31 being the number of TSH test performed in 18-35, 36-50 and 51-65 age group respectively and only 8 tests performed in those over 65.

Thereafter each individual request was studied with a view to analysing the criteria used for requesting the TSH test.

The following graph illustrates a breakdown of the different indications for requesting TSH tests, namely ‘Diagnosis’, ‘Monitoring’, ‘Screening’ or ‘Patient Request’.

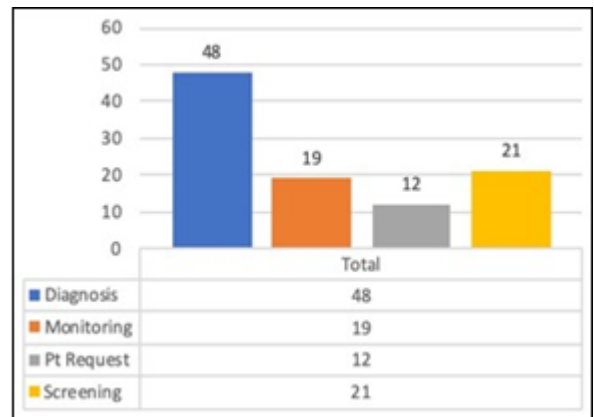


Figure 4: Graph illustrating the different indications for TFT requests from the 100 sample.

18% of tests were conducted and documented as ‘patient request’. This would be defined as those patients that request testing, but do not meet the criteria for Screening or have any symptoms meeting the criteria for Diagnosis.

48% of test had symptoms meeting the criteria for Diagnosis. Notably 4 out of the 48 test done were abnormal (8%) and the remaining test were normal (92%)

21% of test met the criteria for Screening. From these tests 2 out of the 21 test done were abnormal (9%) and the remaining test were normal (91%)

19% of tests were in those patients known to have a thyroid disease and so met the criteria for Monitoring.

Further analysis of the TFT Requests for Monitoring (n=19) shows that 7 had a valid justification as illustrated in the graph below.

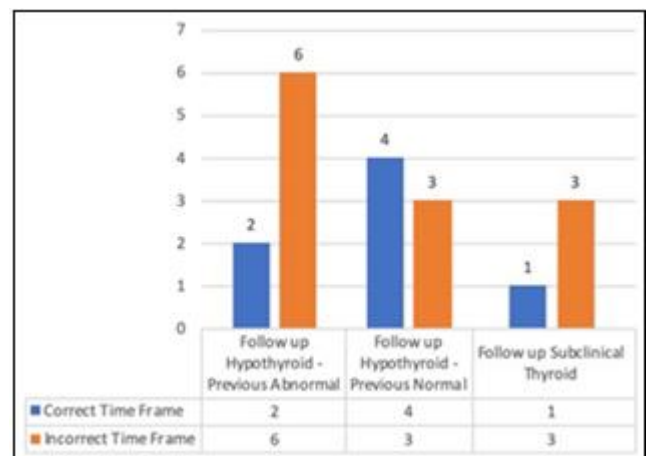


Figure 5: Monitoring indications: Graph illustrating correct / incorrect time frames with reference to previous normal / abnormal TFT's / subclinical hypothyroid disease.

From the 19 patients with a monitoring indication: 15 were for follow up of Clinical Hypothyroid disease, of which 7 had previous normal TFTs (4 test were done correctly at 6 months and 3 were done between 6-12 months).

8 of those with Clinical Hypothyroid disease had previous abnormal TFTs (2 test were done correctly at 6-8 weeks; 5 were done at 3-6 months and 1 was done at 6-12 months)

4 were for follow up of Subclinical Hypothyroid disease. From this group 1 test was done within 1 month; 1 was done at 6-8 weeks and 2 were done at 3-6 months. All had Anti TPO checked (3 raised, 1 normal) but only 1 patient with a raised level was initiated on treatment.

Further analysis of the TFT Requests for Diagnosis (n=48) shows that 20 patients had a justifiable indication for requesting the test as illustrated below

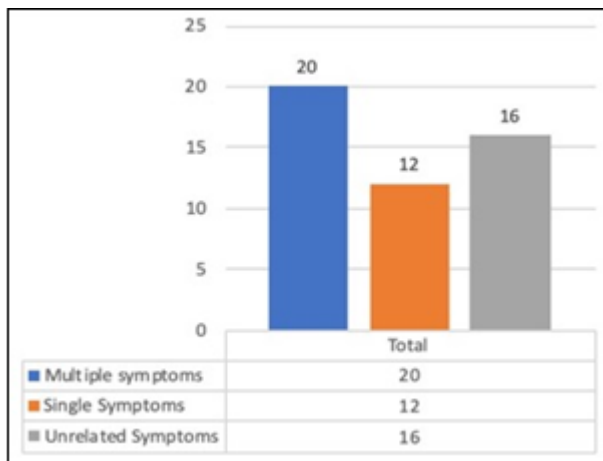


Figure 6: Diagnosis Indications: Graph illustrating the number of patients that present with multiple / single or unrelated symptoms

From the 48 patients with a diagnosis indication (i.e., symptomatic patients): 20 had multiple symptoms (more than 1 symptom related to thyroid disease), 12 had a single symptom related to thyroid disease and 16 had unrelated symptoms 8% of TFTs done for Diagnosis were abnormal (4 out of 48), the remaining 92% were normal. Furthermore, the abnormal results were with those patients with multiple symptoms (4 out of 20).

Further analysis of the TFT Requests for Screening (n=21) shows that 16 patients had a valid justification for test request as shown in the graph below.

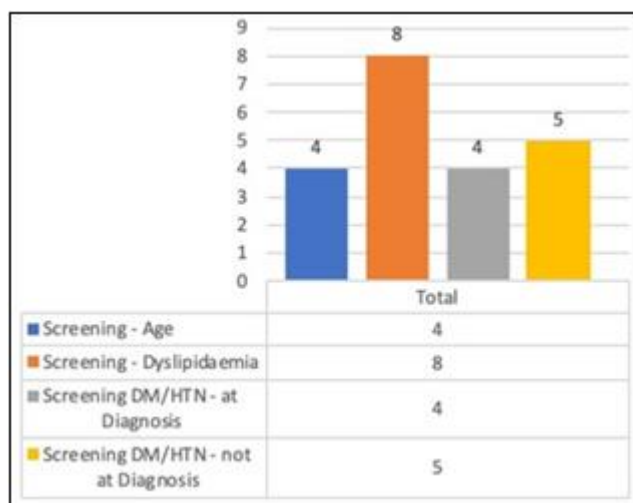


Figure 12: Screening indications: Graph illustrating the number of patients with associated screening conditions

From the 21 patients with a screening indication: 4 were for screening in Elderly patients (>65 years); 8 were for

screening in Dyslipidaemia (defined as a raised LDL or total cholesterol / on statin therapy / confirmed diagnosis in documentation) and 9 were for screening in Diabetes Mellitus or Hypertension (DM/HTN; but only 4 of these were at Diagnosis).

9% of TFTs done for Screening were Abnormal (2 out of 21), the remaining 91% were normal. The Abnormal results were in 1 Elderly patient and 1 dyslipidaemia patient.

The cumulative overall result showed that there was a justifiable indication in 43% of the 100 random sample analysed (Breakdown - Diagnosis: 20% + Monitoring: 7% + Screening: 16%)

4. Discussion

The results and analysis have highlighted a number of learning points. As a centre there is extensive and widespread ordering of thyroid function tests, which according to the audit can be justified in only half the sample analysed.

This in turn has a significant cost impact to the centre and if the study was to be extended to other centres, then to a region as a whole.

Furthermore, the different thyroid tests are being used without any evidence of discrepancy. As earlier shown in the results, expensive tests such as Anti Thyroglobulin antibodies are requested without any reasonable justification. Also, TSH and FT4 / FT3 are often requested in tandem. This was the case for 6% of the total tests requested.

The American Thyroid Association and the British Thyroid Association as well as local Ministry of Public Health have all suggested a high sensitivity of TSH alone as a screening tool, nonetheless, in 50% of patients TSH was used with another TFT despite the recommendations.

There is some suggestion in Nice guidelines (9) that FT4 should be analysed when TSH is abnormal and so it can be argued that this may be the reason why these two tests are often requested together. However, this can be averted with a system which allows laboratory autonomy to add on the test if required, known as reflex testing. This is currently not performed at the health centre, but may reduce the burden of unnecessary testing.

The high prevalence of subclinical hypothyroidism in elderly persons has previously been confirmed in community studies (13,14), which have shown almost 10% of those over 60 years old having a TSH above the normal range. Interestingly, analysis of the data has demonstrated that the least test are requested in the highest age risk group, i.e., over 65 and that it is this same group that on average has the longest interval between test request and test completion.

The results have however shown a female predominance with almost two thirds of test requested in women. This is in line with previous international data from the UK which

has shown that the prevalence of spontaneous hypothyroidism is up to ten times more common in women than in men (1)

Uniquely, the data underwent a more detailed analysis of a random sample. This analysis showed that almost half the tests were requested in those presenting with symptoms. However, less than half of these test were for those presenting with multiple symptoms and only 8% of these tests were abnormal, requiring further follow up. This suggests that closer adherence is needed to the recommendation that TFT should be requested in the presence of multiple symptoms, i.e., more than one symptom (9).

Analysis of the test requested for monitoring of existing thyroid disease showed a variation with regards to follow up time intervals. Most physicians seem to be following local guidelines from the MOPH, which allow for test to be requested between 6-8 weeks of a previously abnormal result and at 6 months for a previously normal result (12). Accordingly, 7 out of the 19 tests requested for monitoring purposes had a justifiable indication.

The third group analysed were those tests requested for screening purposes, such as age, dyslipidaemia etc. From these results, it can be seen that the majority (16 out of 21) had a justifiable indication and that 9% of these had an abnormal TFT result requiring follow up.

The cumulative overall result showed that there was a justifiable indication in 43% of the 100 random sample analysis. Within the region, there has previously been a similar study conducted in Oman in 2019 (8), which showed comparable rate of 46%.

Admittedly there are limitations, which include the time frame and sample size as well as being based at one centre. This is predominantly a Health Centre that serves Qatari nationals, who by in large are well educated with more health awareness and understanding. This goes some way to explain the subgroup of tests (12%) requested under the banner of 'patient requests', as this group of individuals have a higher level of insight into their health and wellbeing.

A truer picture could be gained if the analysis was extended to many different health centres in Qatar and preferably over a longer period of time.

Also, the current system does not require for any one guideline to be adhered to, which further opens up the scope of interpretation when requesting tests. A clear recommendation to the health centre from this study would be to adopt a single guideline and for this to be disseminated to all physicians. Whilst there will still be an element of clinical judgement, it will however minimise such variations.

Following on from the initial audit results, the below recommendations can be considered

1) To Increase awareness and training about TFT indications and thyroid disease monitoring, in order to increase cost effectiveness of test requesting.

- 2) To consider standardized local guidelines or at least specification of a favoured international or local guideline.
- 3) Increase patient health education, to minimize unnecessary exposure to testing.
- 4) To allow some degree of laboratory autonomy, so that in the very least repeat testing should not be conducted within a month of previous tests. Additionally, reflex testing should be considered for implementation.

I hope that after some or all of the above recommendations are implemented, there will be a marked improvement in the number of tests that meet the correct criteria. Hence, improving the cost effectiveness of the test and reducing patient exposure to unnecessary tests.

5. Acknowledgements

I would like to thank the coding team for their invaluable input and to the Clinical Leads for their support and guidance.

6. Disclosures

I wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Appendix A

Check TSH if

1) Diagnosis:

- a) Patients with more than **one** thyroid disease symptom
 - Fatigue
 - Dry skin
 - Hair loss
 - Cold intolerance
 - Constipation
 - Impaired Memory / concentration
 - Nerve entrapment syndromes / numbness
 - Ataxia / Poor balance
 - Muscle weakness / cramps
 - Bradycardia
 - Hoarseness / deep voice
 - Weight gain
 - Galactorrhoea
 - Menstrual irregularities – menorrhagia, oligomenorrhoea, amenorrhoea
 - Decreased Libido / Subfertility
 - Depression
 - Shortness of breath
 - Deafness
 - Recurrent miscarriage
- b) Goitre / thyroid nodule

2) Screening

- Patients with new onset Atrial fibrillation, Dyslipidaemia, Osteoporosis
- Type 1 Diabetes (annual check)
- Past History of Post-Partum Thyroiditis

- Type 2 Diabetes at diagnosis
 - Other autoimmune diseases - vitiligo, pernicious anaemia, adrenal insufficiency, coeliac, Sjogren's
 - Elderly (65 years old and above)
 - Post-menopausal women with nonspecific symptoms
 - Depression / unexplained anxiety / psychiatric disorders
 - Down syndrome / Turners
 - Cognitive impairment
 - Patients on Amiodarone, Lithium
 - Post neck irradiation
 - Radioiodine / Thyroidectomy
 - Family history of thyroid disease / goitre
- 3) Monitoring**
- a) Anti-thyroid drugs (Propylthiouracil, Carbimazole) at 1-3/12, then annually
 - b) Levothyroxine therapy
 - If a blood TFTs result is abnormal or dose change / tx initiated then check after 6-8/52
 - If a blood TFTs result is normal then minimum 6/12
 - c) Subclinical – repeat after 6-12/52 to exclude transient cause

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