

## Review Article

# “Telethyroidology”: Managing thyroid disorders through telemedicine

### ABSTRACT

The recent coronavirus disease 2019 pandemic has brought telemedicine to the forefront in India. Also guidelines by the Board of Governors of the Medical Council of India have paved the way for the practical application of telemedicine. Thyroid disorders in endocrinology are best suited for the use of telemedicine, for which we have coined the term “telethyroidology.” In this review, we discuss the application of telemedicine to specific thyroid disorders such as hypothyroidism (subclinical and overt), thyrotoxicosis, thyroid nodules, thyroid cancer as well as pregnancy-associated thyroid diseases. “Telethyroidology” covers the entire spectrum of the utility of telemedicine diagnosis, multidisciplinary approach with the involvement of teleradiology and telecytology, forward triage of patients needing in-person consults, postthyroidectomy care as well as long-term monitoring. Adoption of telethyroidology can reduce the burden of in-person consultation for endocrinologists at the same time ensuring that their expertise is available to all – ultimately improving diagnosis, treatment, and compliance in thyroid disorders.

**Keywords:** eConsults, forward-triage, hypothyroidism, online consultation, thyroid cancer, thyrotoxicosis, virtual consultation

### INTRODUCTION

Telemedicine is defined by the World Health Organization as “the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities.” Telehealth is a more broad term which includes services provided by other health care and allied professionals such as pharmacists, nurses, and psychologists apart from physicians.<sup>[1]</sup>

We do not have a formal definition of a virtual consultation. Broadly, any consultation that is generated out of the use of telemedicine without “physical” presence of the doctor in the same room as the patient can be called a virtual consultation. Terminologies such as “remote consultation,” “eConsults” or “online consultation” may be used interchangeably.<sup>[2]</sup>

The increasing burden of chronic health conditions, improvement in technology, and an endorsement by the Board of Governors of the Medical Council of India provide a perfect opportunity to enhance the use of telemedicine in the field of endocrinology.<sup>[2]</sup>

With the better use of diagnostic facilities, thyroid disorders are increasingly being diagnosed across the country. Endocrinologists are often consulted for the management of thyroid disorders. At present, the number of doctors who

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complete formal training in endocrinology is around 80,<sup>[3]</sup> while it is estimated that more than 42 million patients suffer from thyroid disease in India.<sup>[4]</sup> Clearly, it is difficult for a trained endocrinologist to reach every corner of the country and treat all patients suffering from thyroid diseases. Thyroid disorders may range from simple subclinical hypothyroidism (SCH) to complex thyroid cancers. In such a case, the use of telemedicine in thyroid disorders may prove to be helpful.

In this article, we have given suggestions on how telemedicine could be used by endocrinologists in the management of specific thyroid disorders. We have also suggested a new term for the process called “telethyroidology.”

### FORWARD TRIAGE FOR SUBCLINICAL HYPOTHYROIDISM USING TELEMEDICINE

An important term called “Forward triage” is proposed in the context of telemedicine.<sup>[5]</sup> The terminology means that the patients are sorted before they come to the hospital for physical consultation using telemedicine. This reduces the burden on the health-care system, and the patients who need more attention can be given more time and resources.

SCH is defined as thyroid-stimulating hormone (TSH) values above the normal range with normal thyroxine levels, but this is a biochemical definition with no guidance for treatment. The prevalence of SCH in an iodine-sufficient population in South India was found to be 3.4%. Given the large population of India, when these numbers are extrapolated, the overall disease burden of SCH turns out to be sizeable.<sup>[4]</sup>

Wiersinga *et al.*<sup>[6]</sup> have suggested grading of hypothyroidism. Patients with SCH are assigned Grade I which is further divided into Grade IA (TSH between 4 and 10 mIU/L) and Grade IB (TSH > 10 mIU/L). The two groups can be assorted by forward triage using telemedicine prior to consultation in the clinic, with individuals belonging to Grade IB, who requires treatment as per current guidelines, being given preference for earlier and in person consultation.

To decide whether treatment is needed for Grade IA, we propose an online questionnaire to be filled by triaging physicians to ascertain (1) whether associated thyroid pathology is present and (2) presence of factors which would necessitate treatment.<sup>[5]</sup> Documentation of thyroid pathology helps to rule out nonthyroidal illness, whereas risk factor analysis is needed to estimate the risk–benefit ratio for the initiation of levothyroxine (LT4) treatment. Figure 1 depicts a sample online questionnaire drafted by the authors, which

can be used for this purpose; it however requires validation in future studies.<sup>[7]</sup> This is necessary as cases are often referred for a specialist opinion, whereas in the absence of any thyroid pathology or significant risk factors, simple follow-up and biochemical monitoring would have sufficed. Many times, LT4 is inadvertently started in situations where it is not recommended, which increases treatment burden and also has long-term financial implications.

Thus, there is a great opportunity for triaging physicians to use telemedicine to decide which patient needs a teleconsult and who will benefit from a clinic visit. We propose the following triage system [Figure 2].

### LONG-TERM FOLLOW-UP OF PATIENTS WITH OVERT HYPOTHYROIDISM

Management of hypothyroidism broadly has three steps. The first step is to diagnose the condition and decide whether the patient needs to be treated or not. The second step is the titration of the dose of LT4 to achieve TSH within the normal target range. The third step is long-term follow-up once the TSH level is normalized.

The third step that is follow-up of hypothyroidism who are well controlled can easily be done using telemedicine. One of the biggest concerns with long-term follow-up of individuals with hypothyroidism is poor compliance.<sup>[8]</sup> Applications can be developed to improve compliance or simple reminders may be given in the form of text messages from the electronic medical record systems itself. We suggest a prospective study to measure the impact of telemedicine in improving compliance in hypothyroidism. Table 1 enumerates various situations in hypothyroidism, where telemedicine can prove to be useful.

### DIAGNOSTIC AND THERAPEUTIC APPROACH TO THYROTOXICOSIS USING TELEMEDICINE

Thyrotoxicosis not uncommonly gets misdiagnosed and mismanaged. It is imperative to understand that all thyrotoxicoses are not Graves’ disease and there are conditions like thyroiditis which do not warrant antithyroid drugs.<sup>[9]</sup> This problem arises because of the limited availability of endocrinologists for the management of thyrotoxicosis. A clinical scoring system called Wayne’s index was used earlier to diagnose hyperthyroidism.<sup>[10]</sup> In modern-day medicine, its application remains limited due to the wide availability of hormonal assays, but it might still act as a guide to order tests in resource-limited settings.<sup>[11]</sup>

Figure 1: Shows a sample online questionnaire for forward triage of patients with subclinical hypothyroidism with thyroid-stimulating hormone of 4–10 mIU/l. (a) Basic information (b) questions specific to women of reproductive age having subclinical hypothyroidism (c and d) questions regarding atherosclerosis risk factors

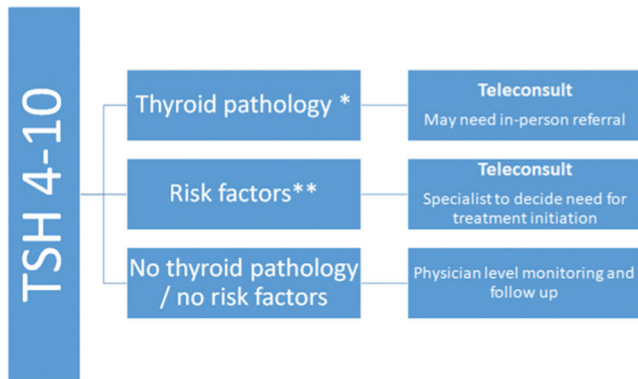


Figure 2: Forward triage for patients with Grade IA subclinical hypothyroidism. \*Thyroid pathology – clinical examination for goiter and thyroid antibodies, ultrasonography suggestive of diffuse hypoechoogenicity \*\*Risk factors – Younger age, female gender, planning pregnancy/already pregnant/infertility, hypertension, dyslipidemia, and cardiovascular disease

Once the diagnosis of thyrotoxicosis is established from clinical and laboratory findings, a direct or online opinion from an endocrinologist can help to establish the etiology and define the subsequent treatment strategy. Graves’ disease is the most common etiology of hyperthyroidism and unless overt signs like Graves’ ophthalmopathy (GO) are present, further tests like radionuclear studies or TSH

Table 1: Etiology of refractory hypothyroidism

Dialogue	Suboptimal relationship between patient and physician, leading to poor adherence/persistence
Diagnosis	Incorrect diagnosis of disease, for example, inability to recognize central hypothyroidism, sick euthyroid syndrome, obesity-related thyroid dysfunction, thyroid resistance, and pregnancy physiological increased demands
Definition of endpoint	Inappropriate choice of endpoint, for example, testing TSH at short intervals, testing only TSH in central hypothyroidism, and testing T4 in states of hypoalbuminemia
Disturbance in assay	For example, due to concomitant medication like biotin, due to wrong timing of sampling, due to use of inaccurate assays, and presence of TSH heterophile antibodies
Drug intake (L-thyroxine)	Lack of adherence to the suggested therapeutic regimen Concomitant administration of medication which may impair absorption (antacids, iron, and calcium) or increase the metabolism of L-thyroxine
Disease (comorbid)	Comorbid disease, for example, malabsorption syndromes, renal/liver impairment, and hypocortisolemia

TSH: Thyroid-stimulating hormone, T4: Thyroxine

receptor antibody estimation will be required to confirm the diagnosis.<sup>[12]</sup> Table 2 enumerates the conditions where an endocrinologist can provide an online opinion for the

**Table 2: Screening for biomedical causes of refractory hypothyroidism**

Malabsorption syndromes	Anti-tissue transglutaminase antibodies, endoscopic biopsy
Atrophic gastritis	Gastroscopy with biopsy, gastric pH, gastric acid measurement, and parietal cell antibody/intrinsic factor antibody
<i>Helicobacter pylori</i>	Invasive methods like histology, culture, and rapid urease test on endoscopic biopsy specimens Noninvasive tests like urea breath test and stool antigen test
Renal/liver disease	Renal function tests and liver function tests including serum albumin, urine albumin: creatinine ratio
Addison's disease	8 am serum cortisol, ACTH levels

ACTH: Adrenocorticotrophic hormone

diagnosis and management of Graves' disease. In severely thyrotoxic patients, the Burch–Wartofsky Point Scale and Japan Thyroid Association Scoring System can guide the clinician about the probability of thyrotoxic crisis.<sup>[13,14]</sup> Any possibility of a thyroid storm will require immediate referral to appropriate centers equipped to manage such emergencies.

GO accompanies Graves' disease in one-third of cases and it is moderate to severe in 5% situations.<sup>[15]</sup> Clinical activity score for GO has been used to assess disease activity and NO SPECS mnemonic to delineate its severity. These scoring systems can be utilized during video consultation to arrive at a therapeutic decision. Moderate-to-severe GO requires a multidisciplinary approach along with an ophthalmologist and sometimes other specialties such as otolaryngology, radiation therapy, plastic surgery, and endocrine surgery. Telemedicine can act as an appropriate platform for web conferencing of doctors from multiple specialties in complicated cases.

Individuals with toxic multinodular goiter can also benefit from web-based multidisciplinary approach where endocrinologists, radiologists, pathologists, and the endocrine surgeons can coordinate to reach management decisions. Cases of toxic autonomous nodule can be diagnosed by reviewing the thyroid radionuclear images online and the treatment strategy can be planned in conjunction with nuclear medicine specialist. Subclinical hyperthyroidism remains undertreated in many individuals in spite of specific recommendations for its treatment and such cases might benefit from opinion from an endocrinologist through telemedicine.<sup>[12]</sup> There are no randomized controlled trials that compare online versus clinic consultation for management of various hyperthyroid conditions. Such studies might pave the way for the appropriate management of resources in this situation.

## ASSESSMENT AND TRIAGE OF THYROID NODULES USING TELEMEDICINE

Assessment of thyroid nodules would be an ideal use of telemedicine. With the increasing use of neck ultrasound, more incidental cases of thyroid nodules are being recognized. High-resolution ultrasound can detect thyroid nodules in 19%–68% of individuals. Only 7%–15% of cases of thyroid nodules are malignant.<sup>[16]</sup> It is important that an endocrinologist is involved in the assessment of thyroid nodule to avoid unnecessary surgeries.

An online form can be generated which captures the data of the patient which are relevant to the assessment of thyroid nodule. The patient can be examined by the local physician or surgeon. The local doctor can be provided a set of points that they need to observe in clinical examination and note it in the online patient form. A video demonstrating the examination technique can be made by the endocrinologist and shown to the local doctor. Thyroid function test and any other relevant investigations can be done locally and data shared with the endocrinologist. A local radiologist can perform a neck ultrasound. The image can be reviewed by a radiologist in a tertiary care center experienced in dealing with thyroid nodules if necessary. The radiologist classifies the nodule based on thyroid imaging reporting and data system and American Thyroid Association classifications.<sup>[16]</sup>

All the data are then reviewed by the endocrinologist using telemedicine. A video consultation to dispel the fears of the patient can be performed. The endocrinologist decides whether the patient needs a fine-needle aspiration cytology (FNAC) based on the current guideline recommendations.<sup>[16]</sup> An FNAC can be performed by a local radiologist under ultrasonography (USG) guidance. A local pathologist reviews the FNAC. Images of the same can be shared with an expert cytopathologist in a tertiary care center using telecytopathology.<sup>[17]</sup> The cytopathologist classifies the FNAC findings based on the Bethesda System for Reporting Thyroid Cytopathology.<sup>[18]</sup> Once the results of the tests are available, the endocrinologist reviews all the data and gives his recommendations. Again, a second video consultation with the patient can be done. If it is decided that the patient needs surgery, the patient can be called to meet an experienced thyroid surgeon. If it is decided to manage conservatively and follow-up the patient at regular intervals, the follow-up can be performed using telemedicine.

Khurana *et al.* have successfully demonstrated the use of telecytopathology in evaluation of thyroid nodule.

The technique described by them is easy to develop and follow. The study showed the use of telecytology was extremely accurate in the correct diagnosis of thyroid nodule pathology. In places where the above technology may not be available, the local pathologist can courier the slides to an experienced cytopathologist for an expert opinion.<sup>[17]</sup>

Popov *et al.* have shown that it is feasible to transmit sonographic images from a remote location using low-bandwidth Internet connection.<sup>[19]</sup> In some countries, it is not uncommon for the ultrasound being performed by a “sonographer” who is a technician while the images are later reviewed by an expert radiologist.<sup>[20]</sup> A sonographer is defined as a “highly skilled medical imaging professional who uses ultrasound to perform specialized diagnostic examinations.”<sup>[21]</sup> We do not have recognized sonographers in India. However, local radiologists can use similar technology to seek an expert opinion of an expert radiologist who is more familiar with thyroid ultrasounds.

### **FOLLOW-UP OF THYROID CANCER PATIENTS USING TELEMEDICINE**

Telemedicine can play an important role in the entire management course of differentiated thyroid cancer from diagnosis, postoperative care, monitoring, and patient counseling. Telemedicine can be especially useful in postoperative care of thyroid cancer.

In differentiated thyroid cancer, after total thyroidectomy, there is a lag period ranging from 3 to 4 weeks till TSH becomes elevated. At this time, once TSH crosses 30 mIU/L, radioiodine therapy can be initiated.<sup>[16]</sup>

In resource-constrained settings, where patients travel from distant places for surgery, early discharge with follow-up by teleconsultation (with primary care physician coordinating care) can be done.

Teleconsultation can be used in postoperative management for monitoring of serial calcium and TSH level, monitoring of bothersome symptoms of hypothyroidism, looking for delayed onset of hypocalcemia and the appropriate institution of active Vitamin D and calcium for the same, and giving special attention to elderly who are at risk of myxedema coma.

Instructions for radioiodine therapy can be transmitted telephonically and appointment fixed before the patient needs to travel back. This reduces the unnecessary financial burden for outstation patients.

Once mandatory isolation after radioiodine therapy is over, patients can travel back home. Further follow-up to monitor for appropriateness of LT4 suppression (TSH <0.1 or as advised) and side effects of the suppressive therapy can be done by teleconsultation.

The side effects of suppressive LT4 therapy can be significant, especially in those patients who have preexisting cardiac disease or hypertension (arrhythmia, worsening of hypertension, heart failure, or cardiac ischemia). Telemonitoring which can assess vitals such as heart rate, blood pressure, heart rhythm, and respiratory rate can be useful in the follow-up of these patients.<sup>[22]</sup> Devices such as the new Apple Watch can monitor the heart rate and the cardiac rhythm and alert the clinician regarding tachycardia, bradycardia, or cardiac arrhythmias. This could be helpful for monitoring these patients who are started on LT4.<sup>[23]</sup>

Telemedicine could be a boon for long-term follow-up of these patients. In differentiated thyroid cancer, there is more frequent follow-up mandated in the first few years, while later on, annual follow-up suffices. Due to the low aggressiveness of most differentiated thyroid cancers and risk of recurrence even many years after apparent remission, failure to conform with monitoring and diagnostic scans and poor compliance to LT4 therapy can be hazardous.<sup>[24]</sup> Often, long wait times or distances may act as deterrents for follow up.

Patients on stable LT4 suppressive therapy in the absence of any features of recurrence can be managed with telemedicine with specialists to allay patient fears and provide pragmatic counseling.

### **THE USE OF TELEMEDICINE FOR THYROID DISORDERS IN PREGNANCY**

Telemedicine is vital when it comes to pregnancy and hypothyroidism. Depending on the prevailing local practices, most pregnant women are usually screened by TSH for thyroid disorders in their first antenatal visit. In many cases, obstetricians need to seek the opinion of an endocrinologist for the diagnosis and management of thyroid disorders in pregnancy. Telemedicine would be ideally suited for this purpose. It would reduce the travel and waiting time for pregnant women. Furthermore, this will definitely help obstetricians in diagnostic decision-making.

Telemedicine can also be used for forward triage in this case. Many of these women may require personal consultation with the endocrinologist. Using telemedicine, the endocrinologist

can decide which pregnant patients need to travel for a physical consultation.

## CONCLUSIONS

Anderson *et al.*<sup>[25]</sup> showed that: eConsults” were able to decrease the need for face-to-face visits significantly and enabled primary care practitioners to address specialty-related issues in primary care. A majority of eConsults were for thyroid. They concluded that widespread adoption of eConsults could be a potential solution for major challenges in health care.

Disorders of thyroid are best suited for telemedicine practice. Adoption of telemedicine for thyroid disorder can reduce the burden of physical consultation for endocrinologists at the same time ensuring timely consultation and compliance for thyroid disorders. The new guidelines on telemedicine in India could also open up avenues for research in the field of telemedicine for use in thyroid disorders. Adoption of telemedicine for thyroid disorder could create a new and exciting subspecialty of endocrinology which we would like to call as “Telethyroidology.”

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