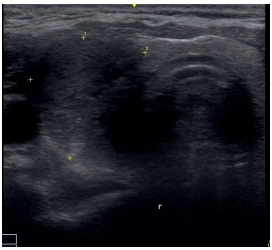
What are Thyroid Nodules?
A thyroid nodule is a radiologically distinct entity that appears different to the surrounding thyroid parenchyma usually on ultrasound scan. Nodules can be solid, cystic or a combination of both.

What Causes Thyroid Nodules?
Thyroid nodules are very common appearing in 3–5% of the population as a palpable lump and in 20–70% on neck ultrasound. They are more common in women and with increasing age. 5–12% of thyroid nodules will be cancers. Benign nodules are more common in areas of iodine deficiency, in patients with a background of (Hashimoto's) thyroiditis and also in those who have had radiation exposure to the thyroid gland. Thyroid nodules occur in families indicating that, at least in some cases, there is a genetic basis to their development.

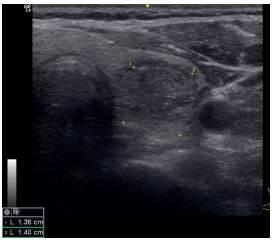
Symptoms of Thyroid Nodules.
Small nodules are often asymptomatic but as they increase in size they can cause compressive symptoms and patients will complain of the sensation of pressure on the trachea (windpipe), the sensation of a lump associated with swallowing and even a gagging sensation. These symptoms are usually associated with nodules over 3 cm in size. As the nodules become even larger and particularly in the setting of a multi nodular goitre (MNG), patients may experience further compression that can lead to shortness of breath, cough and wheeze. The voice can frequently be altered in this situation and patients can also have pain if there is bleeding into thyroid nodules. Occasionally thyroid nodules can be metabolically overactive and a patient will present with symptoms of hyperthyroidism including tremor, tachycardia, sweating, anxiety, heat intolerance and agitation. As lymphocytic thyroiditis is a precursor for thyroid nodularity patients with thyroid nodules may also have symptoms of hypothyroidism.

How are Thyroid Nodules Investigated?
The important primary investigations for a patient with a known or suspected thyroid nodule include and ultrasound scan and thyroid function tests.

Ultrasound Scan
Ultrasound is a highly accurate investigation for looking at the details of a nodule and for assessing its risk for being a cancer. The scoring system used in Auckland is The TIRADS system from the American College of Radiology (ACR). This system scores thyroid nodules based on shape, margin, echogenicity, density, and whether there are calcifications within the nodules. Scores range from TR1 (benign) through TR5 (suspicious) and then size is used to make recommendations regarding FNA.



A TIRADS TR5 nodule that is solid, hypoechoic, taller than wide, has an irregular margin and contains punctate echogenic foci (PEF) it is over 1 cm in size and biopsy is recommended.



TIRADS TR3 nodule that is isoechoic, spongiform, wider than tall shape, has an irregular margin and no calcifications. As it is >1.5cm (in vertical dimension not shown) observation is recommended.

Fine Needle Aspiration (FNA) Biopsy
FNA is an important second line investigation in the management of thyroid nodules. The assessment tool used for FNA here in Auckland is The Bethesda System developed by the NIH and adopted by the American Thyroid Association. There are six categories with Bethesda 1 being non diagnostic and Bethesda 6 diagnostic of malignancy. See table 1.

Category	Risk of malignancy in 2009 Bethesda system (%)	Risk of malignancy in 2017 Bethesda system (%)
VI. Malignant	97-99	97-99
V. Suspicious for malignancy	60-75	50-75
IV. Follicular neoplasm or suspicious for a follicular neoplasm	15-30	25-40
III. Atypia of undetermined significance or follicular lesion of undetermined significance	~5-15	~10-30
II. Benign	0-3	0-3
I. Nondiagnostic or unsatisfactory	1-4	5-10

Adapted from Cibas ES, et al. Am J Clin Pathol 2009;132:658-665 [8].

Table 1. The Bethesda System for thyroid cytopathology with associated risk of malignancy per category in 2009 and 2017.

There is a risk of malignancy associated with each category as shown in table 1.