

# LAB TEST: TSH/FT3/FT4

| Test Description  |  |  |
|---|--|--|
| <b>Test Name</b>  | Thyroid Function Tests (TFT): often consisting of thyroid stimulating hormone (TSH), free thyroxine (fT4), and free triiodothyronine (fT3)   |  |
| <b>Rationale for Reducing Overuse</b>   | <p>TFTs are some of the most ordered laboratory tests worldwide.<sup>1</sup> To promote appropriate use, numerous societies (including the Canadian Society for Endocrinology and Metabolism) have adopted recommendations that a TSH alone thyroid hormone replacement adequacy in primary hypothyroidism.<sup>2,3</sup> Despite these guidelines, thyroid testing is often performed inappropriately with fT4 and fT3 when screening should be used to screen for primary thyroid pathology and to assess for and managing primary thyroid disease.<sup>4-6</sup></p> <p>Inappropriate free thyroid hormone (fTH) ordering is common<sup>7</sup> where bundling tests or standardized order sets are significant drivers of overuse in health care. The pituitary gland is very sensitive to changes in fTH levels and rapidly adjusts thyroid stimulating hormone (TSH) secretion via negative feedback pathways,<sup>4</sup> indicating TSH is a reliable indicator of thyroid function. Therefore, ordering free hormones (T3, T4) at the same time as testing TSH does not help patient management in most cases. Rather, TSH measurements are the single most reliable test to screen for all common forms of hypothyroidism and hyperthyroidism, particularly in the ambulatory setting.<sup>3,5,8</sup></p> |  |
| Scope of the Issue  |  |  |
| <input checked="" type="checkbox"/> Inpatient Setting   | <input checked="" type="checkbox"/> Outpatient Setting   | <input checked="" type="checkbox"/> Emergency Department |
| <b>Additional Details</b>   | <b>Internal Medicine</b><br><b>Family Medicine</b>   |  |
| Recommendations   |  |  |
| <b>Summary of Recommendations</b>   | <p><b>Choosing Wisely Canada Recommendation:</b></p> <p>Don't use Free T4 or T3 to screen for hypothyroidism or to monitor and adjust levothyroxine (T4) dose in patients with known primary hypothyroidism unless the patient has suspected or known pituitary or hypothalamic disease.<sup>2</sup></p> <p><b>Societies which endorse this recommendation:</b></p> <p>-The Canadian Society of Endocrinology and Metabolism<sup>2,9</sup></p>   |  |
| <b>Additional Information</b>   | <p>T4 is converted into T3 at the cellular level in virtually all organs. Intracellular T3 levels regulate pituitary secretion and blood levels of TSH, as well as the effects of thyroid hormone in multiple organs. Therefore, in most people a normal TSH indicates either normal endogenous thyroid function or an adequate T4 replacement dose. TSH only becomes unreliable in patients with suspected or known pituitary or hypothalamic disease when TSH cannot respond physiologically to altered levels of T4 or T3. These patients should have access to additional testing, as required.<sup>2</sup></p> <p>System changes (e.g., algorithm processing changes) resulting in reflexed fT4/fT3/T3 did not result in an increase in repeat testing but rather, a statistically insignificant decrease in repeat blood draws and significant reduction in unnecessary testing.<sup>4</sup></p> <p>Studies conducting the proposed interventions reported no unintended adverse consequences.<sup>4,10,11</sup></p>   |  |
| <b>Summary of existing metrics/indicators for appropriate use (further details below)</b><br>(e.g., PT/PTT, % time test conducted, if applicable) | Thyroid tests were decreased 30-66% across hospitals in Toronto. <sup>4,10,11</sup>  |  |

## Success Stories

| Highlights  | Summary of Implementation Strategy  | Barriers to Change and Facilitators of Success  |
|---|---|---|
| <p><b>Women's College Hospital, Toronto, Ontario: fT4 tests per week decreased 34%, fT3 tests per week decreased 64%. Overall, free thyroid testing decreased 49% reduction and ~\$16k was saved in the first 25 weeks of implementation.</b><sup>4</sup></p> | <ul style="list-style-type: none"> <li>PDSA cycle 1: focused on providing physicians with education regarding appropriate fT4/fT3 testing indications (via lectures, emails, clinical workspace postings)</li> <li>PDSA cycle 2: implemented a forced function reflex fT4 system where fT4 was only processed if the TSH was outside the laboratory's reference range or if a clinical justification was provided on the lab requisition</li> <li>fT3 was not reflexed with the forced function system, it was only processed if a clinical justification was provided on the requisition.</li> <li>fT4 processing via reflex system was automatically done by lab equipment if the TSH values were outside the reference range</li> <li>fT3 and fT4 based on clinical judgement were manual tasks where laboratory technicians had to identify requisitions containing clinical judgement to proceed</li> </ul>  | <p><b>Identified Barriers to Change or Enablers of the Status Quo:</b></p> <p>Not specified</p> <p><b>Areas of Success:</b></p> <ol style="list-style-type: none"> <li>Essential to build a strong quality improvement team</li> <li>Essential to engage relevant stakeholders from front lines, senior management and lab personnel.</li> <li>Limited resources were required and the intervention was sustainable long-term.</li> </ol>   |
| <p><b>St. Michael's Hospital, Toronto, Ontario: fT4 was decreased by 39% and fT3 by 47%, ~ \$30k was saved over the 3-year initiative.</b><sup>10</sup></p>   | <ul style="list-style-type: none"> <li>Conducted at a tertiary care hospital</li> <li>Baseline analysis was conducted to assess inappropriate fT3 and fT4, defined as fT3 and fT4 processed when TSH was within a normal range</li> <li>PDSA1: Model for Improvement Framework guided change implementation. 2 Changes were made during PDSA cycle 1: 1. A forced function reflexive testing algorithm was applied (Figure 1) where endocrinology, neurosurgery and obstetrics were granted unrestricted access, and other physicians were able to request tests from clinical biochemists. 2. Removal of fTH testing from all inpatient order sets except following trans-sphenoidal surgery and primary pituitary pathology</li> <li>PDSA2: physicians were consulted regarding these changes via lectures, rounds and written communication. This resulted in a third change: 3. Including a TSH only option (Figure 1) and refinement to current changes included fT3 was only reflexed when fT4 was normal and TSH was low.</li> </ul> | <p><b>Identified Barriers to Change or Enablers of the Status Quo:</b></p> <ol style="list-style-type: none"> <li>68% of fTH tests were considered inappropriate at baseline (defined as having a normal TSH)</li> <li>Added time to processing samples (reflex algorithm is based on receiving TSH results adding an additional 45 mins to fTH processing times)</li> </ol> <p><b>Areas of Success:</b></p> <ol style="list-style-type: none"> <li>Implementation of forced function reflex</li> <li>Modification to physician test requisition</li> <li>Continuous monitoring of data post-implementation allowed optimization of outcomes and error detection</li> </ol> |

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**SickKids Hospital, Toronto, Ontario: fT4 decreased 30% (from 154 to 107 tests per week) and T3 decreased 66% (from 11 to 4 tests per week), representing ~\$43K saved per year<sup>11</sup>**

- Occurred at an academic pediatric tertiary care hospital
- Baseline analysis of TSH, fT4 and T3 was conducted from the hospital's outpatient laboratory and inpatient units
- Intervention consisted of (Figure 2):
  1. Reflex fT3 where fT4 is automatically reported if TSH is outside of the normal range
  2. Forced function for thyroid hormone ordering where the appropriate indication for fT4 or fT3 must be indicated prior to ordering
  3. Physician decision support tool message is displaced when ordering thyroid function tests (Figure 3)
- Lab data was audited to determine the mean number of fT4 and T3 tests performed per week as well as the indications for testing
- To determine indications for appropriate
- fT4 and T3 the improvement team (representatives of endocrinology and medical biochemistry) conducted a literature review and obtained feedback from key stakeholders.
- 1 week before implementation all hospital providers received notice outlining changes to thyroid testing.

**Identified Barriers to Change or Enablers of the Status Quo:**

Not Stated.

**Areas of Success:**

Not Stated.

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## Tips on Implementation

### Feasible tips or suggestions for [initiating] implementation

(Per recommendation type, e.g., uncoupling, test reduction, etc.)  
 - Most common effective strategy

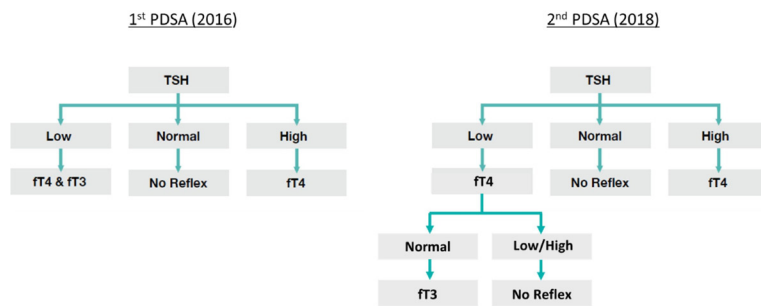
- Implementation of a hospital-wide laboratory and forced-function system with a reflex FT4/FT3
- Using stakeholder feedback to improve and refine changes
- Education of physicians regarding appropriate indications for ordering FT4/FT3
- Clinical justification on electronic medical records

### Choosing Wisely Canada Applicable Toolkits

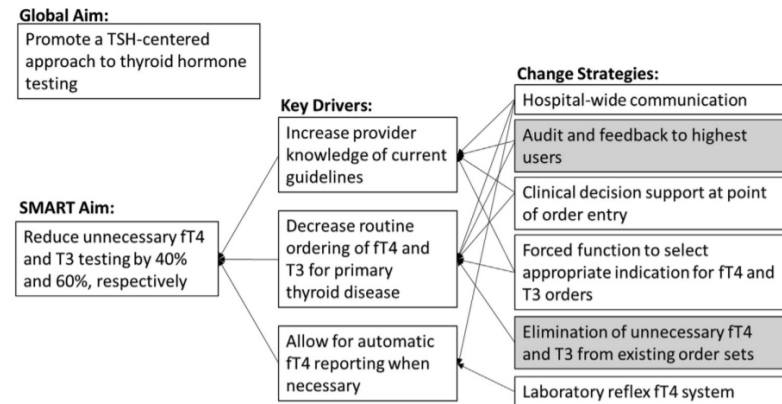
[Understand the Gland<sup>12</sup>](#)

### Figures

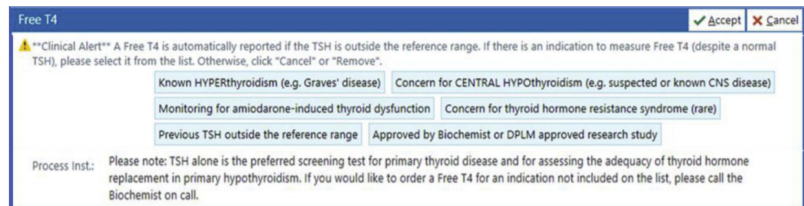
**Figure 1: PDSA cycles at St. Michael's Hospital**



**Figure 2: change strategies for TFT intervention**



**Figure 3: Clinical decision support tool**



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