Choosing Wisely Canada™

UNDERSTAND THE GLAND

A toolkit for appropriate ordering practices of free thyroid hormone testing

Version 1.1
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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.

Canadian Society of Endocrinology and Metabolism,
Choosing Wisely Canada recommendation # 3

Inspiration for this toolkit:

The pituitary gland is very sensitive to changes in free thyroid hormone levels and quickly adjusts TSH secretion via a negative feedback pathway. Given this tightly controlled physiologic mechanism, the American Thyroid Association (ATA) recommends a TSH-centred strategy rather than measurements of free thyroid hormone levels for assessment of primary thyroid pathology[1]. This approach is also recommended by the Canadian Society of Endocrinology and Metabolism via Choosing Wisely Canada[2].

While measures of free T4 (fT4) and free T3 (fT3) have replaced previous measurements of total T4 and total T3 levels, they are only indicated in certain clinical instances. At Women's College Hospital (WCH) in Toronto, 65% of fT4 and 59% of fT3 measurements were ordered in the setting of a normal TSH. This high proportion of potentially "unnecessary" free thyroid hormone tests inspired the creation of a resource stewardship intervention aimed at reducing fT4/fT3 testing by 50% to promote high-value care.

Firstly, an educational program was rolled-out to engage and inform health care professionals of appropriate indications for free thyroid hormone testing. Secondly, a laboratory reflex-fT4 system was implemented, in which fT4 was only processed if the TSH was outside of the laboratory reference range or clinical justification was provided on the laboratory requisition; fT3 was only processed if justification was provided. Overall, free thyroid hormone testing was reduced by 54%, which was sustained over 6 months. The hospital has benefited from significant cost-savings, physician satisfaction has been high, and patient outcomes have not been adversely affected. The successes of this project have led to its expansion to other institutions in Toronto, including St. Michael's Hospital (SMH) and University Health Network (UHN).

Reference:

Gilmour JA, Weisman A, Orlov S, Goldberg RJ, Goldberg A, Baranek H, Mukerji G. Promoting resource stewardship: Reducing inappropriate free thyroid hormone testing, J Eval Clin Pract. 2017. doi: 10.1111/jep.12698

This toolkit was co-authored by Dr. Julie Gilmour and Dr. Geetha Mukerji, two of the leaders behind this initiative.

Contents

There are 2 modules in this toolkit. Module 1 can be implemented on its own. Module 2 requires pre-intervention education and therefore, should be implemented in conjunction with module 1.

Education intervention to promote appropriate ordering practices of free thyroid hormone testing

The goal of this module is to provide strategies for implementing an educational strategy that provides health care professionals with appropriate indications for ordering fT4 and fT3 in addition to, or irrespective of, TSH measurement.

Introduction

This module was created to support the implementation of interventions designed to reduce unnecessary free thyroid hormone testing in your hospital or clinical ambulatory program. It can be used by physician/nurse practitioner groups, medical laboratory or administrative leadership; similar steps can be considered for other laboratory tests to promote high-value care.

Make sure this toolkit is right for you

This toolkit would be helpful to you if you have identified that a significant proportion of free thyroid hormone tests at your institution are ordered unnecessarily. Prior research has shown that clinicians more commonly order a combination profile of fT4, fT3, and TSH compared to TSH alone and that the majority of combination profiles (77%) are entirely normal[3]. There are many reasons why a physician may order an unnecessary free thyroid hormone test; examples include: lack of knowledge on appropriate indications for testing, desire to avoid a repeat blood draw if the TSH is outside of target range, and patient request. **Of course, there are circumstances when free thyroid hormone tests are clinically important and therefore, these tests should be available but judiciously used.**

Key Ingredients of this intervention

If this description accurately reflects the environment at your institution, this module will help your institution learn more about free thyroid hormone testing and may reduce the frequency of fT4/fT3 ordered.

- Understand the current free thyroid hormone ordering practices at your institution
- Achieve physician consensus on appropriate indications for free thyroid hormone testing
- Engage important stakeholders in developing an education plan

Examine Current Free Thyroid Hormone Ordering Practices

Conduct a baseline analysis to understand the magnitude of the problem with unnecessary free thyroid hormone testing at your institution. The first step is to connect with leaders in your laboratory to develop a plan for data extraction. Laboratory leaders may include the head of biochemistry or the laboratory Information Technology (IT) coordinator. You should avoid mining individual physician's charts for this data, as it is time consuming and the information is almost always easily accessible from the laboratory records and can be de-identified.

Meet with laboratory leadership to discuss your goal of reducing free thyroid hormone testing through the development of a clinician-targeted educational intervention. Explain the importance of understanding the current gaps in free thyroid hormone testing and highlight benefits of this intervention to the laboratory. Prior to your meeting, develop a list of questions you would like to discuss; this may include:

1) How many fT4, fT3, and TSH tests are currently being ordered?
Tip: For the baseline analysis, collect data retrospectively over a significant period of time; for example, at WCH, data was collected for 1 year. This will eliminate concerns related to seasonal variation in ordering practice (e.g. laboratory closed over the December holiday season).

2) How many fT4 or fT3 tests are being ordered in conjunction with a normal TSH?
Tip: This is a helpful way to operationalize the definition of an "unnecessary" test. Use your institutions reference range to define a "normal" TSH. It is important to recognize that this may be an overestimate of unnecessary testing, as it does not take into account the clinical reasoning behind ordering the test. For example, it is possible that the health care provider was concerned about central hypothyroidism from pituitary dysfunction and therefore, ordered a fT4 and a TSH; this is a clinically appropriate reason for ordering a fT4, but would be identified as an "unnecessary" test using the definition described above. In order to understand the clinical reasoning behind ordering a free thyroid hormone test, a chart review would need to be conducted.

3) Which health care providers order free thyroid hormone tests most frequently?
Tip: Identifying the specialties that order the most free thyroid hormone tests will assist in focusing your educational intervention. The laboratory will code each test to a specific clinic or physician and therefore, this data should be readily searchable. At WCH, free thyroid hormone tests were most commonly ordered by endocrinology, family medicine, and internal medicine; therefore, additional targeted lectures were delivered to these specialty groups.

4) How much does a T4, T3 and TSH cost at your institution?
Tip: It may be difficult to ascertain the "true" cost of free thyroid hormone testing. Start by asking for the reagent cost of each test, but keep in mind that this does not take into account labour, quality control measures, and laboratory procedures for standardization. An alternative way to identify the price per test would be to access

your province's fee schedule; in Ontario, for example, the province is charged $14.47 for each T4 test and $7.75 for each T3 test[4].

Collecting and displaying local data is instrumental in creating a "burning platform" for change at your institution. It will also assist in initiating a self-reflective process amongst health care providers on their thyroid hormone ordering practices.

Achieve Physician Consensus on Appropriate Indications for Free Thyroid Hormone Testing

Seek consensus amongst physicians at your institution regarding appropriate indications for free thyroid hormone testing. When developing a list, seek input from Endocrinologists, Internists and Primary Care Providers.

Table 1 and 2 highlight situations to order and avoid free thyroid hormone measurement. These lists were originally developed at WCH and can be used at other institutions with or without modification. It is important to consider your patient population when amending or developing a list of indications for free thyroid hormone testing; this list may vary in ambulatory versus inpatient settings. For example, at UHN, malignant melanoma is commonly treated with immune checkpoint inhibitors; these medications can induce hypophysitis with resultant central hypothyroidism. Therefore, at this institution, a specific list of medical conditions was developed that necessitate free thyroid hormone assessment, independent of the TSH value.

Table 1

Indications for Free Thyroid Hormone Testing	
Common Situations for testing	**Expected Pattern**
TSH high on screening bloodwork for primary thyroid pathology (TSH above the ULL)	• TSH high with normal fT4 = subclinical hypothyroidism • TSH high with low fT4 = primary hypothyroidism
TSH low on screening bloodwork for primary thyroid pathology (TSH below the LLN)	• TSH low with normal fT4/fT3 = subclinical hyperthyroidism • TSH low with high fT4/fT3 = primary hyperthyroidism*
Monitoring response to hyperthyroidism treatment (i.e. anti-thyroid medication such as methimazole)	• fT4 and fT3 will normalize before TSH; anti-thyroid medication dosing is based on free thyroid hormone measurements, not TSH
Thyroid cancer on suppressive levothyroxine therapy	• If goal of therapy is to suppress TSH below the LLN, then fT4 can be checked to assess for excessive therapy
Rare Situations for testing	**Expected Pattern**
Secondary hypothyroidism suspected (hypopituitarism)	• Low fT4 with normal or low TSH
Secondary hyperthyroidism (pituitary disease) suspected	• High fT4 with high or normal TSH
Adjusting levothyroxine dose in individuals with secondary hypothyroidism	• Levothyroxine dose should be adjusted to fT4 level (not TSH). In this situation, TSH could be considered an “unnecessary” test.
Thyroid Hormone resistance syndrome	• High fT4/fT3 with high or normal TSH
Non-thyroidal illness (sick euthyroid syndrome)	• Low TSH is detected in a severely ill patient – associated low fT3 (fT4 normal/low) • TSH may be elevated during recovery phase • Do not routinely screen for non-thyroidal illness in hospitalized patients

** Graves’ disease can have isolated T3 toxicosis with low TSH and normal fT4*

ULN = upper limit of normal, LLN = lower limit of normal

Table 2

Situations When Free Thyroid Hormone Testing Should Not Be Routinely Ordered	
Situation	Tests That Should Not Be Ordered
Screening for primary hypo- or hyperthyroidism	• Do not order fT4 or fT3 as part of initial screening blood work
Adjusting levothyroxine dose in individuals with primary hypothyroidism	• Do not order fT4 or fT3 to assess for adequacy of levothyroxine replacement • Adjust levothyroxine dose based on TSH
TSH High on Screening Blood Work for hypothyroidism	• fT3 should not be ordered
Desiccated Thyroid Hormone or Liothyronine (T3, Cytomel) Therapy	• fT3 should not be assessed, as these preparations result in highly variable T3 values throughout the day • fT4 should not be assessed in individuals taking desiccated thyroid hormone, as it is often low • TSH is to be used for dose titration

The main goal is to get consensus from each stakeholder group of physicians for appropriate indications for free thyroid hormone assessment within the local context; this should be done prior to developing an educational plan.

Engage Stakeholders in Developing an Education Plan

Engage representatives from each stakeholder group to ensure that a plan is created to suit specific learning needs. It is key to get senior leadership support, as well as buy-in from frontline staff.

Key stakeholders include, but are not limited to:

- Representative from Endocrinology
- Representative from Internal Medicine
- Representative from Family Medicine
- Representative from Ear, Nose and Throat surgery and Neurosurgery
- Laboratory leadership personnel (for example, the head of biochemistry)
- IT leadership personnel
- Medicine Department Head

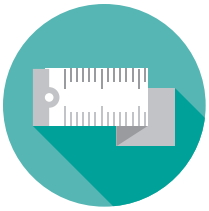
Education interventions may be multi-faceted and could include any or a combination of the following:

1) Posters in clinical work-spaces
2) Emails
3) Oral presentations (e.g. at division meetings or grand rounds)
4) Educational message provided at the time of ordering the test
5) Educational message provided with the test result

The educational intervention at WCH included postings in clinical work spaces (Appendix 1), an email to all health care providers, and focused oral presentations to Endocrinology, General Internal Medicine, and Family Medicine. When this project was adapted to UHN, the educational intervention included an email to all health care providers and an educational message provided at the time of ordering the test (Appendix 2) that was embedded in the computerized physician ordering system by Information Technology. When this project was rolled-out at SMH, education was provided via emails, focused oral presentations, and an educational message provided with the test result. Table 3 outlines factors to consider when rolling-out various types of educational interventions. With each type of intervention, solicit feedback and/or to provide individuals with an opportunity to ask questions.

Table 3

Types of Educational Intervention	Factors to Consider
Posters in clinical work spaces	• Need to get consent from administrative leadership that the posters can be hung in that work space. Some institutions have restrictions on where information can be posted. • Inform the division head of the project plan and get their approval to hang the poster.
Emails	• Find out who has an email list of all physicians at your institution. Contact that individual and ask them to send an email on your behalf with the educational content; this may involve contacting senior leadership. • Most institutions have a weekly/monthly bulletin that is sent to all health care professionals. You can consider submitting your educational content for inclusion in that bulletin.
Oral presentations	• The baseline analysis will help to focus this intervention. You could consider providing an oral presentation to the top 3 physician groups that most commonly order free thyroid hormone tests in the setting of a normal TSH. • Contact the division head and ask them if they have any availability in their schedule to accommodate your presentation.
Educational message provided at the time of ordering the test	• Consider if you enter orders electronically or by paper at your institution; this type of intervention is best for electronic order entry. • Contact laboratory leadership personnel at your institution in parallel with the IT department. You can create a short message that provides educational content to the health care professional at the time they order the free thyroid hormone test. Consider including the list of conditions in which free thyroid hormone testing would be indicated.
Educational message provided with the test result	• Consider if you receive results electronically or by paper at your institution. • Contact IT and/or laboratory leadership personnel to develop a message that is sent to the ordering physician with their test results.



Measuring your performance

Identify Your Measures:

Improvement is most commonly measured in terms of outcome, process and balancing measures[5].

1) Outcome Measures: The end result of the educational intervention.
   Total number of fT4, fT3, TSH tests processed
   - Time period can be variable (e.g. 1 year, 6 months, 1 month, 2 weeks)

2) Process Measures: Measure specific steps in the process of ordering free thyroid hormone tests.
   1. Percent of unnecessary free thyroid tests processed
      - An unnecessary test can be operationalized as a fT4/fT3 test in the setting of a normal TSH
      - Normal TSH can be operationalized as a TSH within your laboratory's reference range
        - Number of fT4 tests ordered within 2 weeks of a normal TSH test/Total number of fT4 tests
        - Number of fT3 tests ordered within 2 weeks of a normal TSH test/Total number of fT3 tests

   2. Number of people who received the educational content: opened the educational email or attended the oral presentation

3) Balancing Measures: Determine whether the educational intervention had unintended consequences.
   1. Number of abnormal fT4/fT3 measurements in the setting of a normal TSH
      - This should be considered at the time of the baseline audit; this is an approximation of the number of abnormal free thyroid hormone tests that may be missed if a TSH-centered strategy is implemented.
      - You could consider doing a chart audit to understand the clinical indication for ordering free thyroid hormone tests. You may find that many of these tests were unnecessary; for example, if a patient is on levothyroxine treatment and took their pill in close proximity to their blood draw, their TSH could be normal with a high fT4. The chart audit would also help to ascertain if the abnormal free thyroid hormone tests results were clinically suspected or picked-up incidentally.

   2. Percent of patients that required a second trip to the lab for measurement of fT4 fT3 when the screening TSH is abnormal.
      - This could be calculated over a two-week period before and after the educational intervention was rolled-out: the number of patients with blood draws on two different days within a 4-week time period.

Set an aim:

Set an attainable goal that is based on the outcome measure. For example, at WCH, the aim was to reduce free thyroid hormone testing by 50% by August 31st, 2015. Make sure to set a specific aim that includes how much you want to improve the outcome and the time period you want to do it over.

Determine a Collection Method:

Electronic bloodwork results: The laboratory will be able to provide you with the majority of the measures in an automatic fashion to minimize burden of data collection and to track improvements over time as changes are rolled out. Make sure the person collecting this data understands exactly what you need and the time period of collection. For the baseline analysis, capturing data over a 1-year period can be very helpful for putting the problem into perspective. Following the educational intervention, look at your data over time; data should be analyzed and displayed at 2-weekly or monthly time intervals on run-charts or statistical process control charts.

Survey: A survey can be sent to physicians/nurse practitioners to understand if their ordering practice changed as a result of the educational intervention; this could be paper-based or via email. Questions may include:

- Have you changed your ordering practice for free thyroid hormone testing?
  - Yes/No/NA
- Do you have a better understanding of the appropriate indications for free thyroid hormone testing?
  - Yes/No/NA
- In what way has your ordering practice changed? Pick all that apply.
  - Less T4/More T4/Less T3/More T3/More TSH/Less TSH
- On a scale of 1-10, how would you rate the effectiveness of the education you received on free thyroid hormone testing? 1 is not effective, 10 is most effective.

Chart Review: Consider reviewing selected charts of patients that were identified to have had unnecessary free thyroid hormone tests ordered. Reviewing these charts will help you to understand if there was a clinically just reason for requesting the test or if it truly was inappropriate. Chart review can also be used to understand if abnormal free thyroid hormone results were clinically suspected in individuals who had a normal TSH in the setting of an abnormal fT4/fT3.

Sustaining Early Successes

Early successes can be sustained by repeating the educational intervention at various points; this may include sending a reminder by email or volunteering to give another oral presentation. Using an educational strategy that serves as a reminder for the ordering practitioner each time they order a free thyroid hormone test, through embedding it at the

time of physician ordering, will reinforce the education. This is especially important in the setting of staff turnover (e.g. new physicians, new resident physicians). You could also make your consensus list of indications for free thyroid hormone testing an institutional policy; this could be displayed on your website, embedded into the computerized ordering system at your institution, or posted in a permanent fashion in clinical workspaces.

Laboratory intervention to reduce unnecessary free thyroid hormone testing

The goal of this module is to provide strategies for implementing a laboratory-based system that reduces free thyroid hormone testing.

This module should be used in conjunction with the first module: Education intervention to promote appropriate ordering practices of free thyroid hormone testing. Pre-intervention education is important to support uptake and acceptance of a laboratory-based change intervention.

Key Ingredients for this intervention:

If this description accurately reflects the environment at your institution, this module will help you implement a laboratory-based change intervention that may reduce the frequency of fT4/fT3 ordered.

- Engage laboratory and IT leadership from the outset
- Map out your current process
- Understand your patient population and environment
- Decide which intervention best fits your local context

Engage laboratory and IT leadership from the outset

You will have already engaged the laboratory to collect the data for your baseline audit, as laid out in Module 1. It is important that in addition to collecting key data from the laboratory, that you also understand its capabilities and the functionality of the equipment used for thyroid hormone testing.

Ask your laboratory if they are capable of doing:

1) Reflex testing: Automatic processing of a test, which is contingent on the results of another test. An “if/then” decision rule[6].
2) Specialty restricted or unrestricted testing: Allow only certain physicians or specialties to order specific tests.
3) Biochemistry approval: A test is only performed after the biochemist provides verbal/written/electronic approval.

If your institution has electronic order entry or results are available through a computer-based system, you should also engage with IT. Consider organizing and facilitating a meeting between key stakeholders in the laboratory and in IT; it is important that everyone is working towards a common goal.

Map out your current process

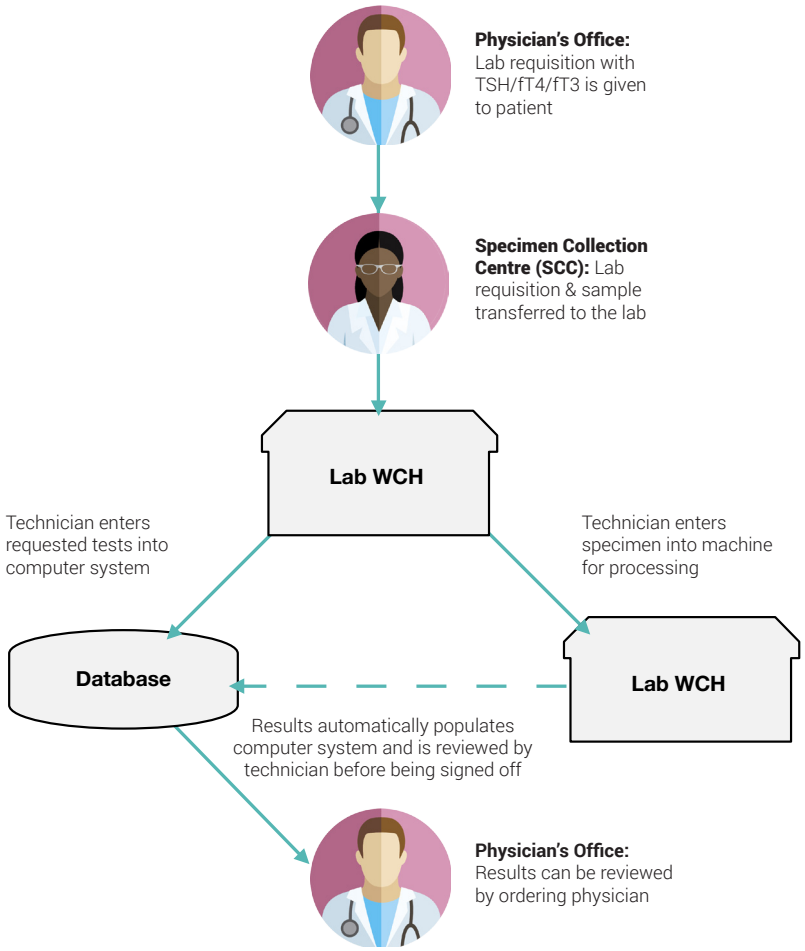
It is essential that you are familiar with the thyroid hormone ordering process at your institution; you must understand all the steps involved in getting the test result.

Consider the following:

- Do you have paper-based or electronic order entry?
- Do you get your laboratory test results electronically or as a paper copy?
- Does your institution care for both in-patients and outpatients?
- Is there a large pituitary (neurosurgery) patient population cared for at your institution?

Create a process map with members of your improvement team[7]. The improvement team will include stakeholders from: medical specialties such as endocrinology, family medicine, or internal medicine; IT personnel; and laboratory leadership staff. Figure 1 displays a Process Map that was created as part of the WCH initiative.

Figure 1



Understand your patient population and environment

In creating your process map, you should also consider your patient population. For example, WCH is a purely ambulatory care facility, while SMH and UHN have a large in-patient population. Therefore, consider whether order entry or thyroid hormone ordering practices differ between the in-patient and outpatient setting. For example, non-thyroidal illness is more common in critically ill in-patients with a low TSH compared to patients being managed in the ambulatory care setting. Institutions can also vary in the type of specialty patients they manage. For example, SMH is a quaternary referral centre for neurosurgical patients including those with pituitary tumours, while WCH manages far fewer of these patients. Patients with pituitary disease can lose their physiologic negative feedback mechanism and therefore, fT4 measurement is essential in the management of these patients, irrespective of TSH result. For this reason, physicians working with pituitary patients need easy access to fT4 testing.

Decide which intervention best fits your local context

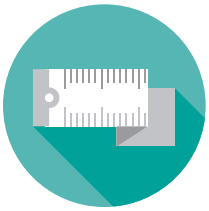
Consider your existing processes, materials, and patient population when deciding which intervention best fits your local context. The Hierarchy for Intervention Effectiveness describes different types of interventions and how likely they are to affect change[8].

Table 4 outlines examples of laboratory and IT interventions that could be considered for implementation at your institution. WCH implemented a forced-function reflex fT4 system, in addition to mandating that a clinical indication be provided for fT3 testing or fT4 testing in the setting of a normal TSH. SMH implemented a reflex fT4 and fT3 system (Appendix 3), specialty unrestricted testing for endocrinology and neurosurgery, biochemistry approval for free thyroid hormone testing in the setting of a normal TSH, and removal of fT4/fT3 from pre-populated in-patient order sets. UHN did not implement a reflex thyroid hormone system; they modified their IT ordering platform to include an educational message on free thyroid hormone testing and mandated that a clinical indication for ordering these tests be selected through their electronic-ordering platform. They also removed fT4/fT3 from pre-populated order sets. The key is to modify the intervention to fit your local context and capabilities in order to promote high-value care.

Table 4

Type of Intervention	Examples
Education & Training	• Engage Stakeholders in Developing an Education Plan
Rules & Policy	• Achieve Physician Consensus on Appropriate Indications for Free Thyroid Hormone Testing
Reminders, Checklists & Double Checks	• Provide a checklist of clinical indications for fT4/fT3 testing. • Remind physician if fT4/fT3 has recently been processed (e.g. within 2 weeks).
Simplification & Standardization[9]	• Remove fT4 and fT3 from the blood requisition. • Remove fT4 and fT3 from pre-populated order sets. • Using an electronic ordering platform, if TSH is searched, fT4/fT3 is not "resulted" (Appendix 4).

Forced-Function[6]	• Reflex fT4 – automatic fT4 if TSH is high or low. If TSH is normal fT4 is not processed, even if it is ordered.
	• Reflex fT4 and fT3 – automatic fT4 if TSH is high or low. Automatic fT3 if TSH is low. If TSH normal, fT4/T3 are not processed, even if they are ordered (Appendix 3 & Appendix 5).
	• In addition to a reflex system, the following modifications can be considered:
	  • Specialty unrestricted fT4/fT3 testing (ie: neurosurgery/pituitary clinic).
	  • Biochemical approval for fT4/fT3 tests in certain situations (telephone or email).
	  • Clinical justification required or stated at time of ordering fT4/fT3 tests (paper based or electronic), otherwise the test is not processed.
	  • Option of TSH without reflex fT4/fT3. This function could be helpful when monitoring levothyroxine replacement therapy in individuals with primary hypothyroidism.



Measuring your performance

Identify your measures:

Improvement is most commonly measured in terms of outcome, process and balancing measures[5].

Outcome Measures: The end result of the laboratory intervention.

1) Total number of fT4, fT3, TSH tests processed
   - Time period can be variable (e.g. 1 year, 6 months, 1 month, 2 weeks)

Process Measures: Measure specific steps in the process of ordering free thyroid hormone tests.

2) Number of fT4 and fT3 tests ordered
   - If a reflex system is implemented and ordered fT4/fT3 tests are cancelled by the laboratory, you could consider auditing the requisitions to understand differences in tests ordered vs. processed.

Balancing Measures: Determine whether the laboratory intervention has unintended consequences.

1) Number of abnormal fT4/fT3 measurements in the setting of a normal TSH
    - This should be considered at the time of the baseline audit; this is an approximation of the number of abnormal free thyroid hormone tests that may be missed if a reflex system is implemented.
    - You could consider doing a chart audit to understand if the abnormal free thyroid hormone tests results were clinically suspected or picked-up incidentally.
2) Frequency the patient has to repeat blood work on another day because fT4/T3 was not processed.
3) Frequency the physician had to call the laboratory to add a free thyroid hormone test.
    - This should be considered if a system is implemented where biochemistry approval is required prior to getting fT4/fT3.
4) Frequency appropriate fT4/fT3 not processed (free thyroid hormone tests not performed when TSH is abnormal)
    - If a reflex system is implemented, this measure would assess if it was working properly.
5) Frequency inappropriate fT4/fT3 is processed (free thyroid hormone tests not performed when TSH is abnormal)
    - If a reflex system is implemented, this measure would assess if it was working properly.

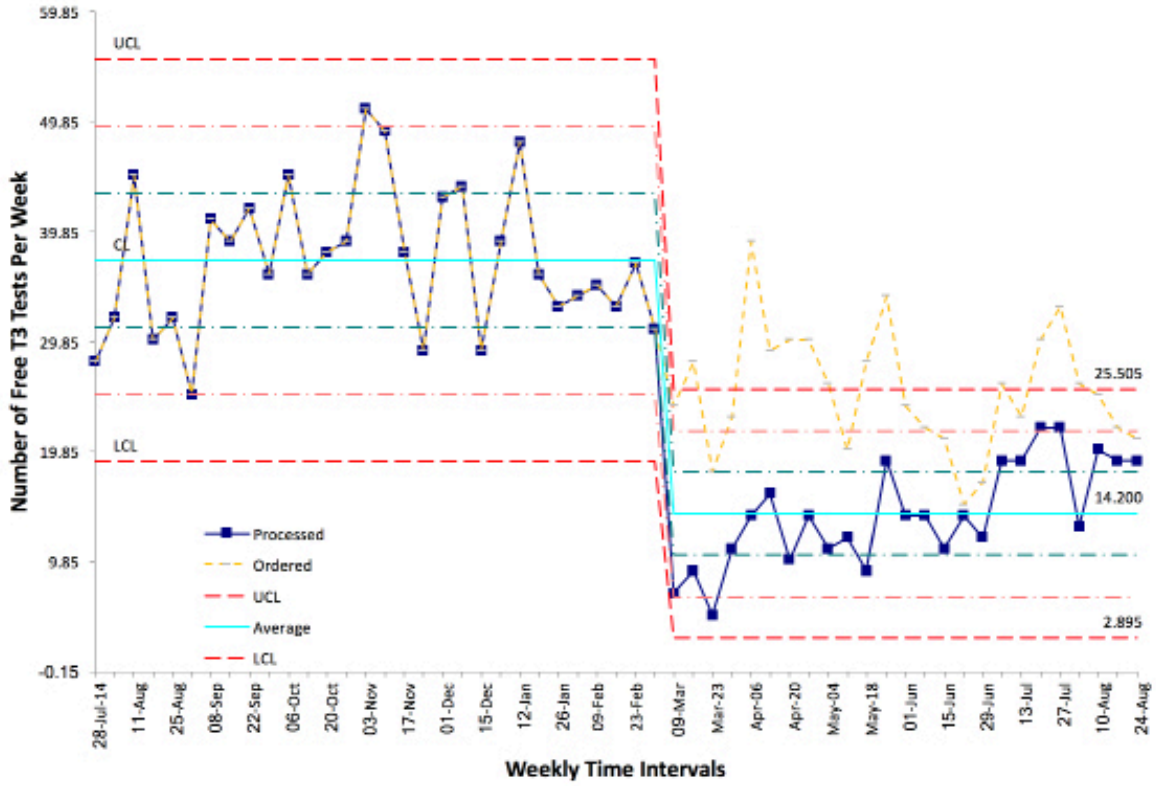
Set an aim:

Set an attainable goal that is based on the outcome measure. For example, at WCH, the aim was to reduce free thyroid hormone testing by 50% by August 31st, 2015. Set a specific aim that includes how much you want to improve the outcome and the time period you want to do it over.

Determine a Collection Method:

Electronic bloodwork results: The laboratory will be able to provide you with the majority of the measures in an automatic fashion. Make sure the person collecting this data understands exactly what you need and the time period of collection. For the baseline analysis, capturing data over a 1-year period can be very helpful for putting the problem into perspective. Following the laboratory intervention, it is helpful to look at your data over time and therefore, data should be analyzed and displayed at 2-weekly or monthly time intervals (Figure 2). This date could be displayed in a run-chart or statistical process control chart[10].

Figure 2: Statistical process control chart of number of free T3 tests at 2-weekly intervals



Survey: A survey can be sent to physicians to understand more about the process and balancing measures; this could be paper-based or via email. Questions may include:

- Have you changed your ordering practice for free thyroid hormone testing?
  - Yes/No/NA
- In what way has your ordering practice changed? Pick all that apply.
  - Less T4/More T4/Less T3/More T3/More TSH/Less TSH
- How satisfied are you with the new free thyroid hormone ordering system?
  - Scale of 1 to 10 on a Likert scale
- How often have you had to call the laboratory to add a free thyroid hormone test over the past 6 months?
  - Never, 1-2, >2
- How often have you had to ask your patient to return to the lab for a free thyroid hormone measurement over the past 6 months?
  - Never, 1-2, > 2

Chart Review: Consider reviewing selected charts of patients that were identified to have had unnecessary free thyroid hormone tests ordered or patients that had abnormal free thyroid hormone tests despite a normal TSH. Reviewing these charts can shed light on the clinical justification behind requesting these tests. If you have a computerized order entry system, you can embed a requirement for the selection of a clinical indication prior to ordering fT3/fT4. This will allow the assessment of ordering practice appropriateness and may identify target areas for future interventions.

Laboratory Requisition review: If you implement a reflex thyroid hormone system, consider auditing requisitions to understand if there is a discrepancy in tests ordered vs. processed. This will tell you whether the system truly changed ordering practice pattern (Figure 2).

Sustaining Early Successes

Early successes are much more easily sustained with a laboratory vs. an educational intervention. Once implemented, forced-functions and automations will be maintained long-term without a regular requirement for updates. Embedded education at the time of order entry and requiring selection of appropriate clinical indication and/or requiring Biochemistry approval for fT4/fT3 can also ensure sustainability, particularly in areas with high staff turnover. Mitigate problems early and seek frequent feedback in order to ensure physician buy-in and uptake of the system.

Additional Resources

Patient Resources:

Toubert ME, Chevret S, Cassinat B, Schlageter MH, Beressi JP, Rain JD. From guidelines to hospital practice: reducing inappropriate ordering of thyroid hormone and antibody tests. European journal of endocrinology / European Federation of Endocrine Societies. 2000;142(6):605-10.

Eskelinen SI, Isoaho RE, Kivela SL, Irjala KM. Actual practice vs guidelines in laboratory monitoring of older patients with primary hypothyroidism in primary care. Aging clinical and experimental research. 2006;18(1):34-9.

Canadian Agency for Drug and Technologies in Health. Rapid Response Report. April 2015. https://www.cadth.ca/sites/default/files/pdf/htis/apr-2015/RB0847%20Free%20T3%20or%20T4%20Levels%20for%20Hypothyroidism%20Final.pdf

Guidelines for the Treatment of Hypothyroidism: Prepared by the American Thyroid Association Task Force on Thyroid Hormone Replacement. Jonklaas, Bianco, et al., Thyroid 24(12): 1670-1751, 2014. https://www.thyroid.org/professionals/ata-professional-guidelines/

2016 American Thyroid Association Guidelines for Diagnosis and Management of Hyperthyroidism and other causes of Thyrotoxicosis. Ross, Burch, et al., Thyroid. Oct 2016, 26(10): 1343-1421.https://www.thyroid.org/professionals/ata-professional-guidelines/

QI resources:

Health Quality Ontario, QI Tools & Resources

https://quorum.hqontario.ca/en/Home/QI-Tools-Resources/QI-Essentials

Institute for Healthcare Improvement, Model for Improvement

http://www.ihi.org/resources/Pages/HowtoImprove/default.aspx

References:

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Approximately 60% of free thyroid hormone tests may not be needed

- Suspect primary hypo/hyperthyroidism in your patient?
- Monitoring a patient with primary hypothyroidism on levothyroxine?

ADOPT A TSH-CENTRED APPROACH!

Just start with a TSH

Examples of clinical situations to perform free thyroid hormone testing:

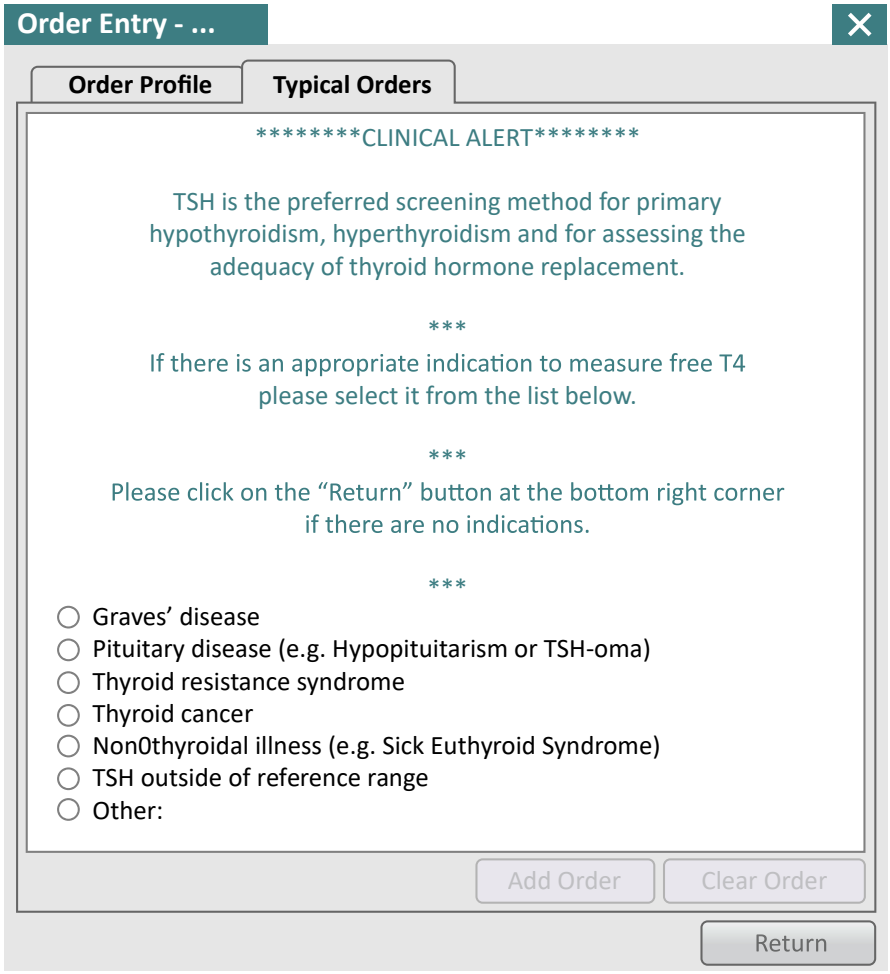
- Screening TSH is high or low
- Monitoring response to hyperthyroidism treatment
- TSHoma (central hyperthyroidism)
- Hypopituitarism (central hypothyroidism)
- Thyroid hormone resistance syndrome

For questions or concerns, contact:

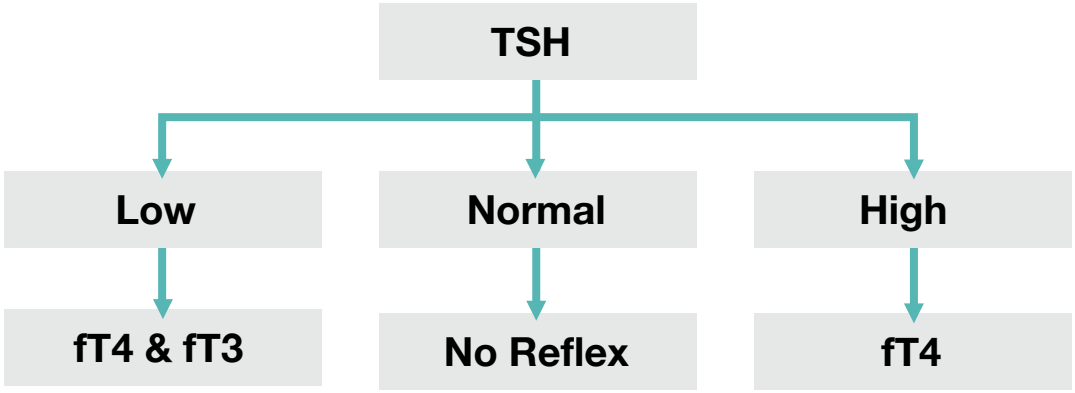
_____

Place this poster in a clinical work space where ordering clinicians will see it.

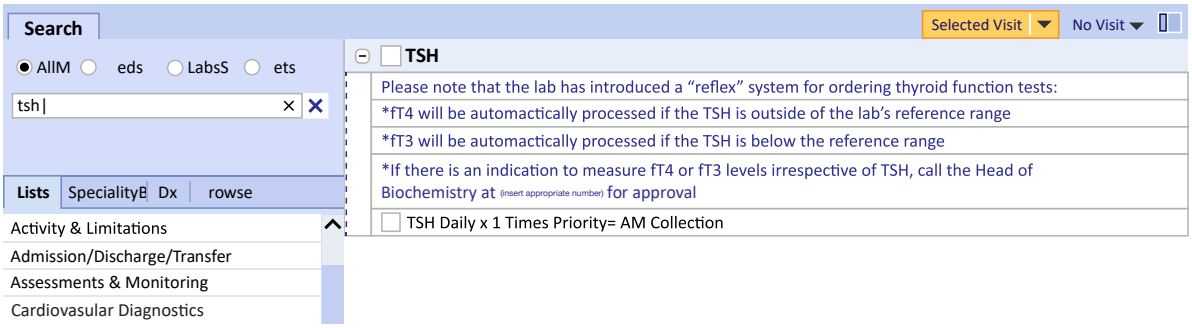
Appendix 2: Ordering Alert at University Health Network



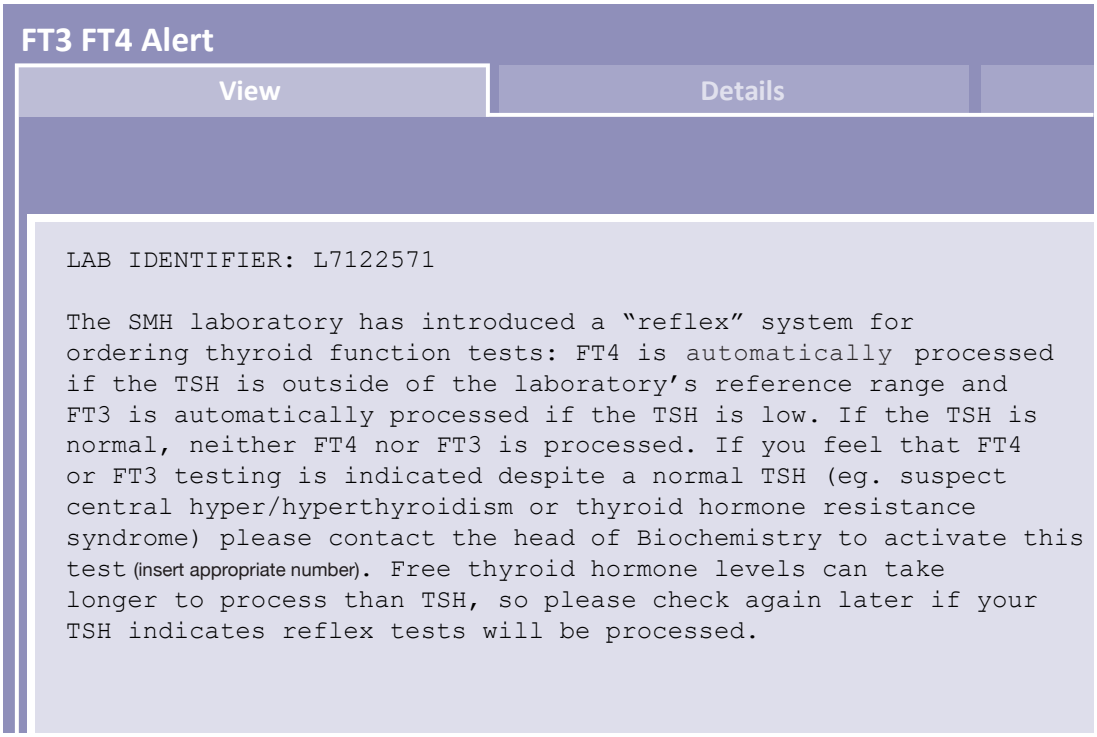
Appendix 3: Schematic reflex of fT4 and fT3 system at St. Michael's Hospital



Appendix 4: TSH search results in electronic ordering system



Appendix 5: fT4/fT3 alert at St. Michael's Hospital



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