Laboratory Testing Guidelines

Guideline Responsibilities and Authorisation

Department Responsible for Guideline	General Medicine
Document Owner Name	Dr Paul Reeve
Document Owner Title	Head of Medicine
Sponsor Title	Stephen du Toit
Sponsor Name	Clinical Director Laboratory
Disclaimer: This document has been developed by Waikato District Health Board specifically for its own use. Use of this document and any reliance on the information contained therein by any third party is at their own risk and Waikato District Health Board assumes no responsibility whatsoever.	

Guideline Review History

Version	Updated by	Date Updated	Description of Changes
V4	Dr Paul Reeve/ Stephen du Toit	14 July 2016	Up-dated links and transferred to new format Minor modification on Inherited thrombophilia testing section

Contents

Departments

Purpose

To help support and guide users for when requesting Laboratory tests.

Key Points

These laboratory testing guidelines apply to Waikato DHB hospitals and clinics. Their main purpose is to reduce wastage and patient harm by ensuring that there is a good clinical rationale for each laboratory test ordered. These guidelines also put some limits around the access to the most expensive laboratory tests by requiring that an appropriate senior medical officer is involved in the decision to request such tests and by providing acceptable indications for the tests.

The guidelines focus on tests that are:

- commonly requested but have limited or no clinical benefit;
- commonly repeated unnecessarily;
- expensive and will require SMO authorisation.

Draft guidelines were circulated widely and extensive feedback has been incorporated. They have been endorsed by the Waikato Leadership Group and Clinical Directors' Forum.

The laboratory will review requests using the guidelines and develop testing rules based on them.

Remember: guidelines are just that, guidelines. There may always be reason to vary from them.

"Guidelines are for the guidance of wise men and the blind obedience of fools"

If you are concerned that a necessary test will not be done please discuss with the laboratory.

Principles of Testing

The National Radiology Access Criteria note: ***"a useful investigation is one in which the result – positive or negative – may alter management and improve the outcome for the patient"***.

The same reasoning applies to laboratory testing. Always ask whether an investigation meets these criteria. A significant number of laboratory investigations do not fulfil these aims.

Try and avoid repeating tests that have recently been performed. Check what tests have been done; this should include reviewing Path Lab results which are now readily available. Consider whether the test actually needs to be repeated and if the results will change management.

The **Best Practice Advocacy Centre** (BPAC) has an excellent summary of the general principles of laboratory investigations in primary care. These also apply to hospital practice.

The BPAC emphasize **"Testing, testing: one, two, three"**

1. **Think twice before you test**
2. **Select the right test, at the right time, for the right patient**
3. **Ask yourself: can I improve my testing?**

The BPAC site also has a series of very good articles on laboratory testing.

Routine screening, for example for thyroid disease, is best left to GPs. Screening for some conditions is inappropriate in sick patients as tests can be falsely positive or misleading.

Note that unnecessary tests are not just a waste of resources but can also cause harm:

- A recent study of 1900 patients undergoing cardiac surgery published in the Annals of Thoracic Surgery found the average patient had 115 tests and 454 mL of blood drawn!
- Another study showed the finding of bacteriuria from doing MSUs in asymptomatic elderly patients led to inappropriate antibiotic prescribing exposing patients to side effects.
- Chasing incidental findings on unnecessary tests can cause harm to patients.

Guideline Development

The guidelines are based on **DHB Shared Services** and **Choosing Wisely** recommendations.

In the interests of space we have abbreviated the recommendations to the key points.

Where no guideline exists we have tried to get a consensus from senior clinicians in the DHB.

DHB Shared Services Laboratory Test Referral Guidelines recommendations are in **green font**

Choosing Wisely recommendations are in **red font**

Our own recommendations are in **bold black font**

The **Laboratory Schedule Test List** developed by the DHB Shared Services was updated in 2015. In the schedule, tests are categorised as 'Tier One' and 'Tier Two'. A 'Tier One' test can be ordered by any doctor; a 'Tier Two' test requires the clinician to have appropriate vocational registration.

Laboratory Test Referral Guidelines were also developed by the DHB Shared Services. This 73 page document provided an overview of the indications for testing, referral criteria and recommendations on frequency of testing, but only for some of the tests on the schedule.

It was noted these guidelines do not override established local care pathways or guidelines which represent local consensus but the authors hoped local clinical pathways were consistent with the guidelines, and the guidelines would be used to inform them, which we have done.

The **Laboratory Schedule Test List** also includes comprehensive guidelines on genetic testing and emphasize that clinicians seek advice before requesting tests. The **BPAC site** also has a very useful document summarising the available genetic tests and their role in primary care.

Choosing Wisely

The American Boards in Internal Medicine have started an initiative to rationalise management.

The ABIM note:

"W*aste and overuse are widespread in US medicine, affecting both the quality of care (up to 30,000 deaths annually from overuse) and costs to the health care system."*

Over 70 specialty societies have now created lists of tests or treatments that are overused, with the aim of avoiding unnecessary care.

Similar initiatives are being undertaken in Australasia as 'Choosing Wisely Australia' including the Royal Australian College of Physicians which has established the 'Evolve' program.

We have included all the relevant 'Choosing Wisely' recommendations in these guidelines.

If more than one speciality society has made similar recommendations, they are combined.

The general recommendations are listed here:

General Recommendations from Choosing Wisely:

Do not order repeated laboratory tests for patients transferred into the ED who have laboratory results within reference range available from the outside hospital.

Do not order screening laboratories (e.g. CBC, chemistry studies) for patients with uncomplicated gastroenteritis or viral syndromes.

Don't do regular testing but test in response to clinical questions.

Don't do repeat CBC and biochemistry if clinically stable.

Don't obtain baseline laboratory studies in patients without significant systemic disease undergoing low-risk surgery; specifically complete CBC, basic or a metabolic panel, or coagulation studies when blood loss (or fluid shifts) is/are expected to be minimal.

Note Waikato has a Guideline for pre-operative investigations for elective surgery

See the following links for further information:

America's Epidemic of Unnecessary Care - The New Yorker

Choosing Wisely American Boards in Internal Medicine

Choosing Wisely Website (with search engine)

Choosing Wisely Recommendations Australia ACEM 2015

Choosing Wisely in the UK BMJ 2015

Triage Bloods in the Emergency Department (ED)

The following tests will normally be requested (if clinically indicated) by the triage nurses for patients with the following conditions or referred to inpatient teams:

General Medicine

- CBC, Creatinine, Urea, Na, K, Glucose, *(*but **not** lipids*).*
- LFTs, Calcium and Phosphate will also be requested if indicated or the diagnosis is unclear.

Overdose

- CBC, Creatinine, Urea, Na, K, LFTs, Glucose, Paracetamol level, Ethanol level (if intoxication suspected), bHCG (if pregnancy possible).

Cardiology

- CBC, Creatinine, Urea, Na, K, Trop T, Glucose.

Abdominal pain

- CBC, Creatinine, Urea, Na, K, LFTs, Lipase.

Trauma

- As for abdominal pain plus Ethanol level.

PV bleed

- CBC, Glucose, bHCG, Group and Save.

Specific additional tests (listed alpabetically) that will also be ordered by ED staff include:

bHCG in all women of child bearing age where pregnancy is possible **and** it is clinically relevant to quantify with a serum bHCG

Blood Gases and **Blood Cultures** will be performed if indicated (see page 9 and 21 for details).

BNP if new heart failure is suspected and a quantitative result will affect management.

CK if rhabdomyolysis is suspected.

Coagulation studies will only be done for specific indications such as patients on anticoagulants, significant liver disease and if a suspected coagulopathy in unwell patient.

CRP will **only** be done by ED for assessment of occult infective and inflammatory conditions. The CRP is not a de facto measurement of “unwellness” and will not be done for routine conditions or infections. See the costs and indications on page 10 for more details.

D-dimer will only be done in patients with low to intermediate probability VTE (DVT/PE).

Ethanol levels will be checked if suspected intoxication or in undifferentiated overdose, abnormal behaviour or decreased LOC.

TFTs will only be done if suspected thyroid disease (TSH only first).

Troponin T will only be be done if cardiac ischaemia suspected.

Urate if gout is suspected and cannot be diagnosed by joint aspirate, remembering that if the urate is not elevated it does not rule out gout and if elevated does not rule it in.

Note the 'EMERG' label should not be used outside of ED or by non-EM specialities in ED

Requesting Tests

All tests ordered must have the name of the responsible consultant (SMO) or team.

Every test ordered on behalf of an SMO is the responsibility of that SMO or their delegated team to electronically acknowledge. See the **Electronic Acknowledgement Policy**.

As noted above, the 'EMERG' label should not be used outside of ED or by non-EM specialities in ED or results may not be directed to the appropriate team.

It is important to correctly complete the request form and include adequate details:

- Date and time of collection: for reporting serial samples in the correct order, sample stability
- Authoriser: name and contact details should the laboratory need to contact the authoriser
- Clinical information: guides microbiology and serology testing to answer the clinical question

While in an ideal world we would never have to wait for tests, we do not live in an ideal world.

Routine tests should not be requested after 1630hrs or at weekends.

Out of hours tests should only be requested if the results are needed to make decisions.

For some urgent tests the relevant laboratory department will need to be contacted.

Tests may be held for processing later subject to SMO approval or further details.

Special care must be taken when requesting blood tests for transfusion.

A doctor **must** sign the request form and get consent for the patient to receive blood products.

If a patient requires a test to determine if they can go home please indicate this to the nursing staff so it can be done first thing in the morning.

Note that “add on” testing is time consuming and it is better to try and get it right first time.

Correct collection of samples is critical. See **http://lab.waikatodhb.health.nz/collection-guides/**

Please refer to the on line **Laboratory Website** for:

- Contact names and numbers
- Departmental hours of service
- Collection and labelling of specimens
- Directory of tests, indications, normal ranges

Common Tests and Indications

Tests are grouped under departments ☼: **Haematology**, **Biochemistry**, **Immunology** and **Microbiology**. In each section we have listed the tests in alphabetical order:-

i. The ‘**Choosing Wisely**’ recommendations are shown in **red**

ii. DHB Shared Services **Laboratory Test Referral Guidelines** recommendations are in **green**

iii. Where there is no ‘Choosing Wisely’ or Shared Services recommendation or more details are needed we have made comments in black font and specific recommendations in **bold black**

☼ Haematology

Blood count (Cost approximately $9)

A CBC is the single most costly test performed in Waikato. Nearly 200,000 tests are done every year, costing almost $2 million a year. Many tests are repeated unneccessarily.

The Choosing Wisely recommendations include the following relevant general recommendations which will apply to CBCs:

Don't do regular tests but test in response to clinical questions.

Don't do repeat tests if clinically stable; repeat only when clinically indicated.

Do not repeat laboratory tests for patients transferred into the ED who have laboratory results within reference ranges available from outside hospital.

Don't do screening tests in low risk patients undergoing low risk surgery.

B12 and Folate ($5)

These are commonly requested and repeated without good clinical indications. We recommend:

Do not do B12 and folate unless there is a suspicion of deficiency or malabsorption, for example peripheral neuropathy or macrocytic anaemia, or in unexplained dementia.

Coagulation screen ($10)

The Choosing Wisely recommendations include the following:

Avoid coagulation studies unless there is a clearly defined specific clinical indication, such as for monitoring of anticoagulants, in patients with suspected severe liver disease or coagulopathy.

Cross- match ($54) Group and Screen ($44 plus $80 if an antibody found) and Transfusion

'Group and Screen' tests currently costs Waikato DHB about $1,160,000 a year.

Many patients who have a 'Group and Screen' never get transfused. A recent audit found only 10% of patients who had 'Group and Screen' requests were actually given blood.

The Choosing Wisely Canada include the following transfusion recommendations:

Don't transfuse blood if other non-transfusion therapies or observation would be just as effective.

Don't transfuse more than one Red cell unit at a time when transfusion is required in stable, non-bleeding patients.

Don't transfuse plasma to correct a mildly elevated (<1.8) international normalized ratio (INR) or activated partial thromboplastin time (aPTT) before a procedure.

Don't routinely transfuse platelets for patients with chemotherapy-induced thrombocytopenia if the platelet count is greater than 10 X 10^9/L in the absence of bleeding.

Don't routinely use plasma or prothrombin complex concentrates for non-emergent reversal of vitamin K antagonists.

Don't order unnecessary pre-transfusion testing (type and screen) for all pre-operative patients.

Don't routinely order perioperative autologous and directed blood collection.

Don't transfuse O negative blood except to O negative patients and in emergencies for female patients of child-bearing potential of unknown blood group.

Don't transfuse group AB plasma to non-group AB patients unless in emergency situations where the ABO group is unknown.

We recommend:

Do not do a 'Group and Screen' unless the patient is likely to require an urgent blood transfusion (major surgery or actively bleeding).

Do not do a 'Group and Screen' in stable patients with a chronic anaemia or 'just in case'.

Do not 'Group and Screen' for patients having elective surgery without reference to the Guidelines for 'Group and Screen' investigation for elective surgery.

Do not do a cross match unless the patient is going to be given blood for active bleeding and/or is very likely to require an urgent blood transfusion.

Do not 'prescribe two if one will do'.

Blood is a precious and expensive product. Many patients who have a cross-match are never transfused so the dollars spent on cross-matching are wasted. Unneccessary transfusions are common. There is a project underway to streamline the process and monitor costs and wastage.

There is a very comprehensive **Blood Resources** site on the intranet. Click on the link.

D-dimer ($28)

D-dimer has limited specificity and will be positive in many hospitalised patients without VTE.

We recommend that testing should be restricted to those patients with a high enough clinical suspicion of VTE to merit further investigation, not to rule out the remote possibility of VTE:

Do a D-dimer only in patients with low to intermediate probability VTE (DVT/PE) where there is a high enough suspicion to justify further investigation for VTE by imaging.

Do not do a D-dimer in post-operative patients.

ESR ($8)

The Choosing Wisely recommendations include the following:

Don't order an ESR to look for inflammation in patients with undiagnosed conditions.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

The ESR should not be used to screen for plasma cell dyscrasias; if these conditions are suspected, protein electrophoresis and/or serum free light chains should be used.

The CRP is the preferred test for the assessment of possible inflammatory or infective disorders.

It is seldom appropriate for both an ESR and CRP to be performed on the same sample.

However, the CRP and ESR are driven by different inflammatory processes and can be useful together in selected patients but **only** requests from SMOs will be processed.

The ESR may have some advantages in the assessment of the following conditions:

- Systemic lupus erythematosis;
- Rheumatoid arthritis;
- Kawasaki disease;
- Rheumatic fever;
- Hodgkin's lymphoma.

Haemachromatosis studies ($100)

Haemachromatosis testing costs over $100,000 a year. Many tests are not indicated.

The commonest cause of hereditary haemochromatosis is mutations in the HFE genes. The known genes are carried by Caucasians and non-Caucasians are unlikely to test positive.

Most patients (90%) with a high ferritin will not have iron overload.

Testing is appropriate for investigation of hyperferritinaemia but **only** if there is one or more of:

- persistent hyperferritinaemia that is not explained by the more common causes such as alcohol intake, fatty liver, liver pathology or inflammation, or
- severe hyperferritinaemia (persistently >1000 without severe inflammation), or
- hyperferritinaemia with fasting iron saturation >0.50.

Testing is also indicated in screening of relatives a patient with confirmed haemachromatosis.

Do not do HFE genotype testing for hyperferritinaemia without these indications.

JAK2 V617F Mutation ($190)

JAK2 tests cost over $60,000 a year. Testing should always be discussed with a haematologist.

JAK2 mutations are associated with the myeloproliferative disorders; polycythaemia vera (PV), essential thrombocythaemia (ET) and myelofibrosis.

Testing may be indicated in the presence of sustained erythrocytosis (Hb > upper normal limit) and/or thrombocytosis (platelets >600) if not explained by other causes (for chronic hypoxia, inflammation). Venous thrombosis (particularly mesenteric) is occasionally with these conditions.

Do not test for JAK2 mutations without first consulting a Haematologist.

Inherited thrombophilia testing (the costs of a typical screen are over $200)

These recommendations are for **inherited** thrombophilia. There are other indications for testing for acquired thrombophilic factors such as antphospholipid antibodies. Seek consultant advice.

The Choosing Wisely recommendations include the following:

Don't test for thrombophilia in adult patients with venous thromboembolism (VTE) occurring in the setting of major transient risk factors (surgery, trauma or prolonged immobility).

Don't do an inherited thrombophilia evaluation for women with histories of pregnancy loss, intrauterine growth restriction (IUGR), preeclampsia and abruption. (Specific testing for antiphospholipid antibodies, when clinically indicated, should be limited to lupus anticoagulant, anti-cardiolipin antibodies and beta 2 glycoprotein antibodies).

The DHB Shared Services **Laboratory Test Referral Guidelines** suggest testing only in

- Idiopathic (unprovoked) VTE in young patients (<45 years) * but see next page
- Warfarin-induced skin necrosis
- Children presenting with purpura
- Siblings of patients with homozygous FVL, homozygous PT20210A or compound heterozygotes
- Thrombosis in unusual sites (e.g. cerebral, mesenteric, portal) * but see next page

* Note that the latest UK and US guidelines (NICE, BCSH, ACCP) now restrict thrombophilia testing in young patients with idiopathic VTE to those who also have a first degree family history of unprovoked VTE and no longer recommend testing for thrombosis in unusual sites.

The DHB Shared Services Laboratory Test Referral Guidelines go on to note:

Testing for other reasons should only be performed after consultation with a Haematologist.

Testing is also not indicated in patients who already have an indication for extended therapy in VTE.

Testing may also be useful in women with a VTE not provoked by hormonal therapy and who may get pregnant. Always discuss testing in such patients with a Haematologist.

Consider referral of patients with the following to Haematology for advice or follow up:

- Unprovoked VTE
- All pregnant patients or patients with previous VTE planning pregnancy
- Recurrent VTE if compliant with treatment and despite a therapeutic INR
- Recurrent VTE if not being treated and not previously investigated by Haematology
- Identified thrombophilia
- Active malignancy
- Uncertainty about the duration of anticoagulation

Refer to the General Medicine **DVT guidelines** for further details of who to refer.

☼ Biochemistry

Blood gases ($17)

Blood gases are the third most costly blood test done in Waikato costing over $700,000 a year.

We recommend:

Do not do bood gases to get a quick set of electrolytes.

Do not do arterial blood gases if venous blood gases will give the answer.

Do not do blood gases except for a specific indication and/or in very ill patients.

Blood gas analysis is time-consuming and relatively (to creatinine/electrolytes) more expensive taking laboratory staff away from other duties and so affects timeliness of other work. Doing an arterial stab is also more painful and can cause complications; don't do an ABG if a VBG will do.

In suspected metabolic conditions like DKA, lactic acidosis or bowel ischaemia a venous blood gas (VGB) guides management as well as an arterial blood gas (ABG). A venous pCO_2 of <6 kPa on an ABG effectively rules out hypercapnia.

However if the venous pCO_2 is >6 kPa, VBGs will overestimate arterial pCO_2 and in a respiratory patient this may lead to incorrect decision making. In this situation an ABG should be performed if considering BiPAP or invasive ventilation

An ABG is also needed if the arterial pO_2 or A-a gradient is required for decision making.

BNP ($44)

NT-Pro BNP testing costs nearly $400,000 a year. Many tests add little to patient management.

The DHB Shared Services Laboratory Test Referral Guidelines note:

The natriuretic peptides are extremely useful for evaluation patients with non-specific symptoms of early chronic heart failure. In particular, the strong negative predictive value of a normal result is very useful and enables evaluation and treatment to be directed elsewhere.

A clearly high result supports heart failure, although in most acute cases this is clinically obvious through other means and measurement adds little to management or prognosis.

The value is much less well established for guiding ongoing anti-failure treatment, and at present they have a secondary role only. NICE guidelines (UK) recommend their use for this purpose be restricted to difficult patients under specialist management. Current NHF/NZGG guidelines do not specifically restrict their use in this setting but have not encouraged it.

We recommend:

The BNP should be used in patients with suspected but undiagnosed heart failure.

Do not do a BNP if the result will not change management.

Do not use the BNP routinely to monitor therapy in heart failure.

The laboratory will not process repeated BNP requests within 48 hours.

Calcium, Magnesium and Phosphate ($2.5)

We recommend these should be requested selectively (for example in malignancy or CKD):

Do not do Calcium, Magnesium and Phosphate unless clinically indicated.

Cholesterol and Lipids ($5.5)

The Choosing Wisely recommendations include the following:

Do not routinely test for hyperlipidaemia in those with a limited life expectancy.

We also recommend:

Do not do 'screening' lipids during an acute hospital admission.

Do not request lipid studies within a short period after of previous testing.

Creatinine, Urea and Electrolytes ($2.5)

Routine testing is not indicated in all admissions. Many tests are repeated unneccessarily.

As noted under the general recommendations from Choosing Wisely:

Don't do regular tests but test in response to clinical questions.

Don't do repeat tests if clinically stable; repeat only when clinically indicated.

Do not repeat laboratory tests for patients transferred into the ED who have laboratory results within reference ranges available from outside hospital.

Don't do screening tests in low risk patients undergoing low risk surgery.

We also recommend:

Do not repeat the creatinine and electrolytes if they were normal unless there are clinical indications to suggest a likely change (eg hypotension, reduced urine output).

CRP ($8)

CRP testing costs about $600,000 a year and many tests add little to patient management.

We recommend:

Do not request CRP unless it is clinically indicated.

Do not repeat the CRP without a good reason.

The CRP is not a de facto measurement of "unwellness".

If clear indications exist, a CRP can be used to detect occult inflammation.

A CRP does not help in the ongoing management of an obvious infection such as cellulitis and the clinical progress of a patient is a much better guide to management of most patients.

There is never justification for daily CRPs!

Ferrritin and Iron (Ferritin is $7, Iron and TIBC $4)

Iron studies rarely provide additional information to a ferritin in iron deficency. In working up patients with suspected iron deficiency and a hypochromic microcytic picture do a ferritin alone.

We recommend:

Do a ferritin in the initial investigation of patients with suspected iron deficiency.

Do iron saturation in the investigation of suspected haemachromatosis.

FSH ($10)

The Choosing Wisely recommendations include the following:

Do not perform FSH levels in women in their 40s with irregular/abnormal bleeding.

HbA1C ($12)

HbA1C testing costs over $200,000 a year. More tests are being done as HbA1C is used for diagnosis as well as monitoring but many tests are repeated too frequently. We recommend:

Do not repeat the HbA1C within 3 months of previous testing in Type 2 Diabetes.

Repeat testing (within 3 months) may be helpful in selected patients with very poorly controlled Type 1 diabetes and in pregnancy but the laboratory will not repeat the HbA1C within 28 days.

Homocysteine ($44)

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

Plasma homocysteine may be elevated in vitamin B12 or folate deficiency, or genetic defects of B12 or folate metabolic pathways. Raised homocysteine levels are associated with increased risk of cardiovascular disease and stroke. However, homocysteine lowering interventions (e.g. folate and vitamin B6 supplementation) do **not** modify cardiovascular risk, despite lowering homocysteine levels. This suggests that homocysteine does not have a causative role in vascular disease so routine homocysteine testing is not recommended as part of CV risk assessment.

LFTs ($2.5)

We recommend:

Do not request routine LFTs in all patients admitted to hospital.

Do LFTs only if clinically indicated.

Do not repeat LFTs without a good clinical reason.

Do not repeat LFTs too frequently (and virtually never within 24 hours).

With very mildly abnormal LFTs in sick patients a full screen of tests for all possible causes of liver disease is not indicated. It is often better to ask the GP to repeat the LFTs after an interval.

If chronic viral hepatitis is a possibility consider requesting HBsAg and Anti-HCV antibody.

Prolactin ($14)

The Choosing Wisely recommendations include the following:

Do not perform prolactin levels in infertility investigation if normal menses.

PTH ($28)

PTH testing costs over $120,000 a year. Many tests are repeated. We recommend:

Do not repeat the PTH more frequently than 3 monthly in patients with CKD.

PTH-related peptide **($136)** is an expensive send-away test; it requires special tubes and must be pre-approved. The result rarely changes management of malignant hypercalcaemia.

Thyroid Function Tests ('TFTs') (TSH is $7, Thyroxine $7)

The Choosing Wisely recommendations include the following:

Don't order multiple tests in the initial evaluation of a patient with suspected non-neoplastic thyroid disease. Order thyroid-stimulating hormone (TSH), and if abnormal, follow up with additional evaluation or treatment depending on the findings.

Don't order T3 levels when assessing levothyroxine (T4) dose in hypothyroid patients.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

Free T3 measurement is useful only in specific clinical settings:

- Evaluation of possible or established hyperthyroidism. It can identify the severity and also patients with low TSH but normal FT4 (either 'T3 toxicosis' or early recurrence)
- Monitoring of patients on thyroid replacement in two specific circumstances:
  - patients with hypopituitarism, sometimes as an adjunct to measurement of free T4, because the TSH is typically unreliable in such patients.
  - sometimes in monitoring of patients on suppressive treatment for thyroid cancer
- Rare clinical settings of TSH secreting pituitary tumours or defects in thyroid hormone metabolism or action (e.g. congenital deiodinase deficiency, hormone resistance)

We also recommend:

Do not do TFTs as a screening test in hospital admissions.

Do not do TFTs unless there is a clinical indication (for example new AF).

Do not repeat TFTs without a good reason.

Do not repeat TFTs within 4 weeks of starting or changing treatment of thyroid disease except in patients with severe thyrotoxicosis (who should be under Endocrinology).

Our laboratory adds the FT4 if the TSH is elevated and both FT4 and FT3 if the TSH is low.

TSH receptor antibody tests ($72)

TSH receptor antibody tests cost the DHB over $160,000 a year. Ten times as many tests are currently done as than the annual incidence of new cases of thyrotoxicosis. We recommend:

Do not do TSH receptor antibody tests except in newly diagnosed thyrotoxicosis unless recommended by a Medical SMO.

TSH receptor antibody tests are useful in the work-up of patients with newly diagnosed thyrotoxicosis to identify patients with Grave's disease. They are used in monitoring selected patients on treatment, patients with thyroid eye disease and in patients with previously treated Grave's disease who get pregnant. The laboratory will not test specimens more often than 4 weekly. Repeat testing needs the support of an Endocrine SMO.

Troponin ($9)

Troponin elevation has limited specificity and is common in very sick patients. We recommend:

Do not do a Troponin unless an acute coronary syndrome is strongly suspected or needs to be excluded.

Tumour markers (CEA is $15, CA 125 $18, CA19-9 $18, PSA $10)

The Choosing Wisely recommendations include the following:

Do not perform serum tumour marker tests except for the monitoring of a cancer known to produce these markers.

Do not perform PSA screening in men with no symptoms and life expectancy is less than 7 years.

The DHB Shared Services **Laboratory Test Referral Guidelines** have recommendations for a number of specific tumour markers. They note tumour markers are **not** indicated for

- screening of an asymptomatic low risk population,
- investigation of non-specific symptoms, when the probability of malignancy is low,
- investigation of other suspected malignancies.

CEA testing costs $15, and, with over 6,000 tests a year costs us more than $100,000/year.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

CEA is elevated in patients with a wide range of malignancies including colorectal, gastric, pancreatic, lung, breast, and medullary thyroid cancer. It is also elevated in non-malignant disorders; ulcerative colitis, pancreatitis, cirrhosis, pleural inflammation, chronic renal failure and in smokers. It is most widely used in monitoring colorectal cancer (CRC) but is not sufficiently sensitive to be used in screening and not selective enough to be used in diagnosis.

It is indicated in/for:

- patients with symptoms or signs associated with high suspicion of CRC,
- at diagnosis of CRC (to provide prognostic information),
- after treatment of CRC (to monitor response and detect relapse),
- in some cases of breast cancer to monitor response after treatment and detect relapse.

CA125 testing costs $18, and, with 3,000 tests a year, costs us more than $50,000/year.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

CA 125 is elevated in patients with a wide range of malignancies including ovarian, pancreatic, lung, breast, endometrial, non-Hodgkin's Lymphoma and hepatocellular. It is also elevated in non-malignant disorders such as acute and chronic liver diseases, acute and chronic pancreatitis, rheumatoid arthritis, ulcerative colitis, endometriosis, menstruation, non-malignant ascites and pleural effusions, and SLE. It is most widely used in monitoring serous epithelial ovarian cancer and it may provide prognostic information. Its role in screening is still under evaluation but it may be useful in diagnosis in patients with high probability of ovarian cancer

It is indicated in/for:

- Patients with features associated with high suspicion of ovarian cancer: persistent continuous or worsening unexplained abdominal or urinary symptoms and pelvic mass.
- Case detection in patients at high risk of familial ovarian cancer.
- At diagnosis of ovarian cancer to provide prognostic information
- After treatment to monitor response and detect relapse

CA 19-9 testing costs $18, and, with over 2,000 tests a year costs us $40,000/year.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

CA 19-9 is elevated in patients with a wide range of malignancies including pancreatic, gastric, colorectal, hepatic and ovarian. It is also elevated in non- malignant disorders such as acute and chronic liver disease, acute and chronic pancreatitis, biliary diseases, diabetes and irritable bowel syndrome. It is most widely used in monitoring pancreatic cancer but is not sufficiently sensitive to be used in screening and not selective enough to be used in diagnosis. It may provide prognostic information at time of diagnosis.

It is indicated for:

- patients with symptoms or signs associated with high suspicion of pancreatic cancer: progressive obstructive jaundice with weight loss and/or pain in the abdomen or mid back,
- at diagnosis of pancreatic cancer to provide prognostic information,
- after treatment of pancreatic cancer to monitor response and detect relapse .

CA 15-3 testing costs $18, and, with over 1,000 tests a year costs us $20,000/year.

The DHB Shared Services **Laboratory Test Referral Guidelines** note:

CA 15-3 is elevated in patients with a wide range of malignancies including breast, pancreatic, colorectal, lung, endometrial, liver and ovarian. It is also elevated in non-malignant disorders such as cirrhosis, benign breast disease and gynaecological disorders and pregnancy. It is most widely used in monitoring breast cancer patients after treatment although evidence this improves outcomes is weak. It does not have the required sensitivity or specificity to be used as a screening or diagnostic test. At diagnosis of breast cancer the level of CA 15-3 can provide information about the likelihood of metastases.

It is indicated:

- At diagnosis of breast cancer to provide prognostic information
- After treatment to monitor response and detect relapse

Vitamin D levels (25-hydroxyvitamin D) ($26)

The Choosing Wisely recommendations include the following:

Do not perform population based screening for Vitamin D deficiency.

The DHB Shared Services **Laboratory Test Referral Guidelines** include:

Vitamin D tests were developed for investigation of rickets, osteomalacia and other metabolic bone disorders. In recent years the number of requests for tests has increased dramatically.

Most of these requests are unrelated to metabolic bone disease, and have arisen because of reported associations between various disorders (cancers, cardiovascular disease, diabetes, autoimmune disorders and infectious diseases) and lower vitamin D concentrations.

However, a causal link with vitamin D has yet to be demonstrated for any of these conditions. The Institute of Medicine, concluded that "*For extra skeletal outcomes, including cancer, cardiovascular disease, diabetes, and autoimmune disorders, the evidence was inconsistent, inconclusive as to causality, and insufficient to inform nutritional requirements. Randomised clinical trial evidence for extra skeletal outcomes was limited and generally uninformative*".

A recent comprehensive literature review for the Ontario Ministry of Health has concluded that there is little evidence that it is useful to test vitamin D concentrations in patients without symptoms of metabolic bone disease.

It is not necessary to routinely measure vitamin D in patients with low bone density. It is reasonable to routinely provide vitamin D supplements (1.25 mg or 50,000IU cholecalciferol per month) without testing vitamin D to frail housebound or institutionalized elderly people, or those in the community who practise sunlight avoidance for cultural or medical reasons.

The DHB Guidelines go on to say that testing is indicated in the following circumstances:

- Specific high risk groups for rickets/osteomalacia (cystic fibrosis, proven malabsorption),
- When ordered for the investigation of rickets/osteomalacia, osteoporosis/osteopenia, disorders of calcium and phosphate metabolism, elevated ALP, hepatitis C,
- Refugees,
- Patients on anticonvulsants.

We recommend:

Do not test for 25-hydroxyvitamin D unless these indications are present.

Do not repeat tests for 25-hydroxyvitamin D to monitor the response to Vitamin D therapy

Vitamin D levels (1,25-dihydroxyvitamin D)

Testing for 1,25-hydroxy Vitamin D has an even more limited role.

Choosing Wisely note:

Do not routinely measure 1,25 dihydroxyvitamin D unless the patient has unexplained hypercalcemia or decreased kidney function.

Choosing Wisely add:

Many practitioners become confused when ordering a vitamin D test.

Because 1,25-dihydroxyvitamin D is the active form of vitamin D, many think that measuring 1,25-dihydroxyvitamin D is an accurate means to estimate vitamin D stores and test for vitamin D deficiency, which is incorrect.

Serum levels of 1,25-dihyroxyvitamin D have little or no relationship to vitamin D stores but rather are regulated primarily by parathyroid hormone (PTH) levels, which in turn are regulated by calcium and vitamin D. In vitamin D deficiency, 1,25-dihydroxyvitamin D levels go up, not down.

Unregulated production of 1,25-dihydroxyvitamin D (in sarcoidosis and granulomatous diseases) is an uncommon cause of hypercalcemia; it should be suspected if blood calcium levels are high and PTH levels are low and confirmed by measurement of 1,25-dihydroxyvitamin D.

The enzyme that activates vitamin D is produced in the kidney, so levels of 1,25-dihydroxyvitamin D are sometimes of interest in patients on dialysis or with end-stage kidney disease.

There are few other circumstances, if any, where 1,25-dihydroxyvitamin D testing is helpful.

Serum 25-hydroxyvitamin D levels may be overused, but when trying to assess vitamin D stores or diagnose vitamin D deficiency (or toxicity), 25-hydroxyvitamin D is the correct test.

☼ Immunology

ANA ($25)

ENA Screen ($30)

The Choosing Wisely recommendations include the following:

Don't test for ANA sub-serologies unless ANA positive and clinical suspicion or evidence of rheumatic disease.

Don't repeat ANA if established JIA or SLE.

We recommend:

Do not request ANA unless there are features suggestive of a connective tissue disease.

Do not repeat ANA within 12 months of previous tests unless the result does not fit the clinical picture or there has been evolution in the clinical picture.

Do not repeat ENA testing unless there has been a change in the clinical picture.

ANA should only be performed when there is a high index of suspicion for a connective tissue disease as the test is not specific and can be positive in other situations such as organ specific autoimmune disease, infection and malignancy. In addition it can be positive in healthy individuals for more than 10 years before the development of a connective tissue disease. Indiscriminate testing frequently leads to unnecessary additional testing, medical assessment and anxiety, and should be avoided.

ENA results do not usually change significantly with treatment and repeat testing is therefore not useful unless there has been a change in the clinical picture suggesting evolving disease.

The laboratory will not repeat ANA or ENA tests within 12 months without SMO discussion.

ANCA ($24)

The DHB Shared Services **Laboratory Test Referral Guidelines** recommend the following are indications for an ANCA:

1. Glomerulonephritis (especially RPGN),
2. Pulmonary haemorrhage (especially pulmonary renal syndrome),
3. Cutaneous vasculitis with systemic features, multiple lung nodules,
4. Chronic destructive disease of the upper airways,
5. Longstanding sinusitis or otitis,
6. Subglottic tracheal stenosis,
7. Mononeuritis multiplex or other peripheral neuropathy,
8. Retro-orbital masses,
9. Monitoring response to treatment (more controversial).

We recommend:

Do not do an ANCA unless a patient has one of these indications.

Anti-CCP ($55)

We recommend:

Do not do anti-CCP unless there is a clinical suspicion of an inflammatory polyarthritis that might be rheumatoid arthritis. In an inflammatory mono-arthropathy only do anti-CCP if other causes such as infection, gout and reactive arthritis are considered to be unlikely.

Do not repeat anti-CCP or Rheumatoid Factor without careful consideration.

Think carefully before repeating rheumatology and immunology tests. Do not repeat immunology tests in known positive patients (for example ANF, RF, ANF) on every admission.

If the test is strongly positive there is little benefit in repeating it ever. If a weak positive it could be repeated at 6 months. If negative we might repeat again at 6 months if we felt RA was likely.

Once decided if positive or negative for a patient there is no reason to repeat the test unless there is some major clinical change.

Coeliac Abs ($33)

We test for coeliac disease using a screening test that detects IgG antibodies to deamidated gliadin peptide and IgA antibodies to tissue transglutaminase. This combination is highly sensitive.

Testing costs the DHB over $60,000 a year. We recommend the following:

Do not test for coeliac disease unless there are good clinical reasons (for example unexplained iron deficiency or symptoms of malabsorption).

Faecal Calprotectin ($105)

Calprotectin tests cost over $300,000 a year. We have now restricted testing to SMO requests.

The laboratory will not repeat calprotectin testing within 28 days.

The DHB Shared Services **Laboratory Test Referral Guidelines** have the following:

Faecal calprotectin is a marker of intestinal mucosal inflammation that can be useful in differentiating between irritable bowel syndrome (IBS) and inflammatory bowel disease (IBD) in symptomatic patients. In IBD, levels correlate with disease activity and a concentration <50 µg/g is considered to be a good negative predictor (published negative predictive values 70-90%) and to help triage patients for colonoscopy. Levels >50 µg/g are associated with a risk of relapse.

The guidelines note the following indications and referral criteria:

- In patients presenting with diarrhoea, first line tests to exclude pathology may include CBC, CRP, ferritin, TFTs, stool culture and ova and parasites if travel history.
- Faecal calprotectin is a second line investigation if there is a concern about possible IBD, although may be a first line investigation if there is a family history of IBD. It may be particularly helpful in paediatric IBD when other investigations may be normal.
- In the presence of “red flags” (e.g. unexplained iron deficiency anaemia, rectal bleeding, weight loss or family history of colon cancer), faecal calprotectin testing may incur unnecessary delay in referral to a gastroenterologist and especially where there is likely consideration for colonoscopy.

Free light chains ($52)

Free light chain testing costs over $120,000 a year. The test measures the total amount of immunoglobulin light chain in the serum that is unbound (“free”) to immunoglobulin heavy chains. An imbalance of kappa v lambda isotypes is suggestive of monoclonal plasma cell dyscrasia. The test can be used instead of urinary Bence Jones Protein in screening and diagnosis.

The DHB Shared Services **Laboratory Test Referral Guidelines** have the following:

The International Myeloma Working Group guidelines suggest that Serum Free Light Chains are used for prognostic purposes in patients with monoclonal gammopathy of unknown significance (MGUS) and also smouldering multiple myeloma, active multiple myeloma and amyloidosis.

The test is indicated if the patient:

- has known or suspected myeloma or MGUS
- has known or suspected amyloidosis
- has unexplained renal impairment or proteinuria
- has unexplained peripheral neuropathy

Should only be performed with a maximal frequency of once every 4 weeks. It is anticipated testing is needed no more frequently than every 3 months unless on active chemotherapy.

Our multiple myeloma guidelines suggest the acronym CRAB is a helpful guide to investigation for myeloma. Test if any of the following are unexplained:

Calcium elevation	**R**enal impairment (acute or chronic)
Anaemia (< 100g/L or > 20g/L below normal)	**B**one (lytic lesion, crush fractures, osteopenia)

IgE ($41)

IgE specific testing costs over $300,000 a year. The test should be done selectively.

The Choosing Wisely recommendations include the following for immunoglobulin testing:

Don't perform unproven diagnostic tests, such as immunoglobulin G (IgG) testing or an indiscriminate battery of immunoglobulin E (IgE) tests, in the evaluation of allergy.

Food specific IgE testing should not be performed without a clinical history suggestive of IgE mediated food allergy.

IgE testing is indicated when there is a suspicion of an allergic reaction; the suspected allergen should be identified by detailed history and specified for testing. Indiscriminate batteries of IgE tests for foods are expensive and not useful, potentially leading to erroneous diagnoses and inappropriately restrictive diets.

IgG, IgA and IgM ($8 each)

Immunoglobulin levels cost $20,000 a year. These tests should be done selectively.

Testing is indicated to quantify immunoglobulin levels in patients with multiple myeloma/monoclonal gammopathy or when immune deficiency is suspected; for example in patients with recurrent infections or an unexplained significant bacterial infection.

Procalcitonin ($26)

Testing costs more than $50,000 a year. We were using the procalcitonin in the work-up of patients with suspected meningococcal sepsis but no longer recommend it in undifferentiated sepsis. Procalcitonin should be used very selectively.

Quantiferon Gold ($54)

See TB testing in the Microbiology section

Tryptase ($100)

Tryptase testing costs over $40,000 a year. Requests must be endorsed by a SMO.

Trytpase measurement is indicated when a mast cell disorder is suspected. It can also be useful for confirmation of anaphylaxis when the diagnosis is not clear, for example in collapse immediately following an IV injection or sting, without development of mucocutaneous features of histamine release, or bronchospasm. It is particularly useful in anaesthesia when several things may account for collapse.

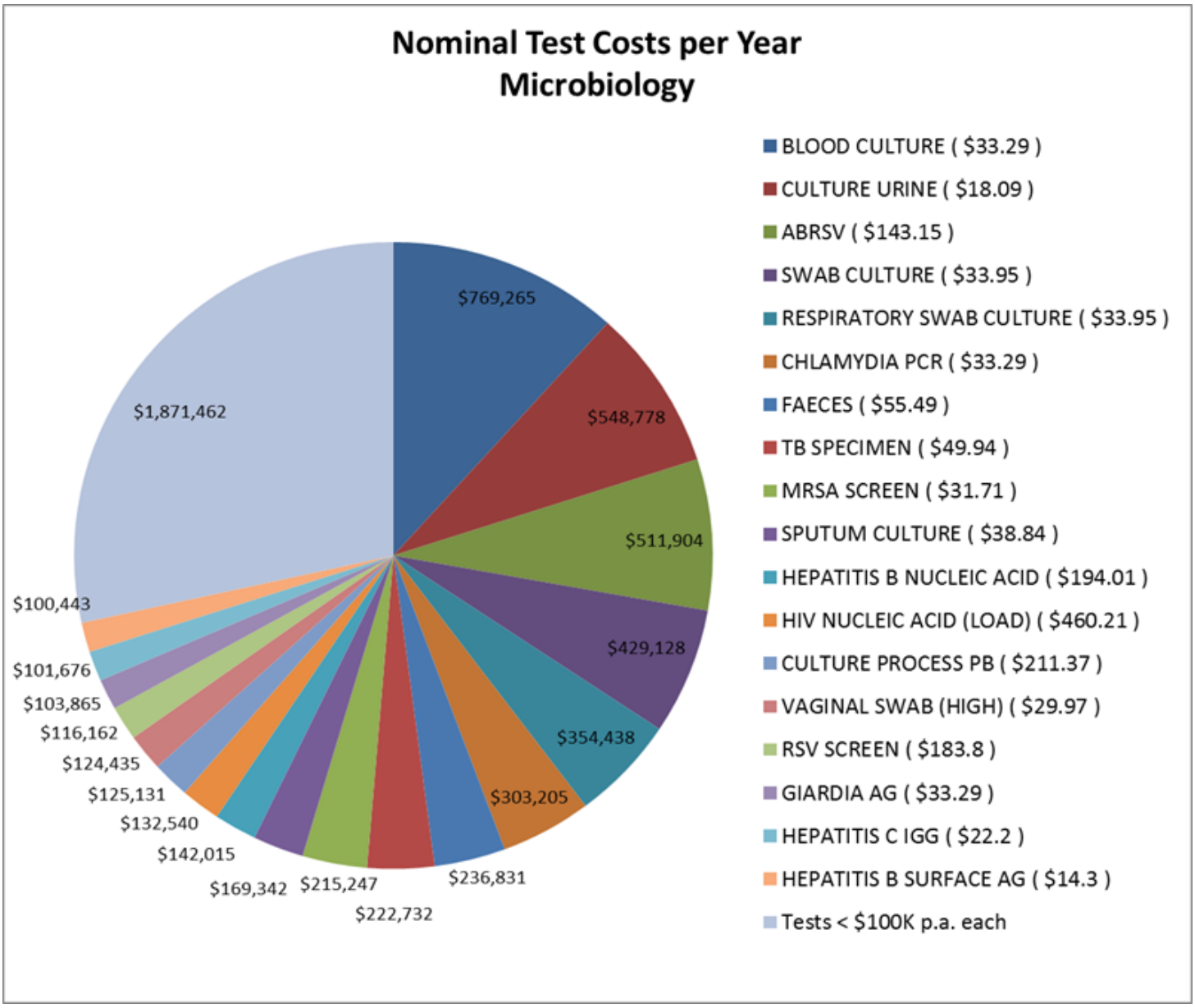
Tryptase is not elevated in all anaphylaxis; it often does not increase in food allergy so if the diagnosis is clear there is no added benefit of doing the test. In patients presenting with recurrent anaphylactic like-symptoms the tryptase may be useful to confirm that anaphylaxis is occurring.

Tryptase half-life is 2 hours, so there is no point doing the test the next day. If the tryptase is raised then a repeat level should be taken > 24 hours later to ensure it returns to normal. If it remains elevated, then a mast cell disorder is likely. A single normal tryptase is often unhelpful. It is possible to have significant anaphylaxis (with a doubling of tryptase from baseline) but where the elevation from baseline remains within the normal range.

For cases of suspected anaphylaxis in patients undergoing anaesthesia there are **ANZAAG guidelines** on testing which recommends testing 1, 4 and 24 hours post reaction. House surgeons on the ward can request these under the direction of the treating anaesthetist.

☼ Microbiology

The estimated annual costs of microbiological testing in Waikato are shown below:



Correct collection of microbiology samples is critical.

See http://lab.waikatodhb.health.nz/collection-guides/

Blood Culture ($33)

Blood cultures are the second most costly blood test performed at Waikato costing $760,000/yr.

Choosing Wisely has the following:

Do not do blood cultures in patients who are not systemically septic or who have a clear source of infection and in whom a direct specimen for culture (urine, aspirate or sputum) is possible.

Do not order blood cultures for patients with a skin infection (cellulitis, abscess) without sepsis.

Do not order blood cultures for patients with a urinary source of infection without sepsis.

We also recommend:

If endocarditis is a possibility do repeated cultures (x3 sets of 2 cultures) before starting antibiotics and only start antibiotic treatment after discussing with a SMO.

If endocarditis is not suspected do 2 sets (4 bottles) of blood cultures simultaneously.

Except in patients with staphylococcal bacteraemia do not repeat cultures after starting antibiotics just because the fever continues. If 2 sets have been done that is adequate. A specimen taken directly from the suspected site will be more definitive.

New sets of blood cultures may be needed if there is a clear second episode of sepsis, with a different suspected site and organism. (eg IV line infection after pneumonia). Do not collect repeat blood culture sets less than 48 hr apart.

As a general rule (except in suspected endocarditis) do blood cultures only if patients with sepsis do not have a clear cause of their infection and are sick enough to require IV antibiotics.

Sepsis = confirmed or suspected infection **and** 2 or more SIRS criteria:

T >38C or <36C, HR>90, RR>20 or PaCO2<4.3 kPa , WBC>12,000 or <4000 or “left shift”

Severe sepsis = sepsis **+** new organ dysfunction **+/or** hypoperfusion **+/or** hypotension

MSU/CSU ($18)

Urine cultures cost over $600,000 a year and many tests are not clinically indicated.

Choosing Wisely has the following:

Do not order urine cultures for healthy patients with uncomplicated urinary tract infection.

Do not perform surveillance urine cultures (or treat bacteriuria) in elderly patients in the absence of symptoms or signs of infection.

Avoid surveillance cultures for screening and treatment of asymptomatic bacteriuria in children.

We also recommend:

Do not do a MSU unless there are symptoms of urosepsis or sepsis of uncertain cause.

Do not request a routine MSU in a confused or unwell elderly patient who has another clear cause or causes of their delirium or un-wellness.

Do not repeat the MSU if it was contaminated and antibiotics have already been given.

Do not do a CSU unless a catheterised patient has features of sepsis.

Do not send urinary catheter tips for culture.

Do not do urine culture in suspected kidney disease without sepsis (do microscopy alone)

Note:

Half of urine samples have significant contamination so are unhelpful and put the patient at risk of unneccessary and inacurate treatment. Coach the patient in how to collect a clean MSU.

In the elderly asymptomatic bacteriuria is common (up to 30%) and should not be treated.

Catheter colonisation is the norm; treatment is only indicated if a patient has features of sepsis. CSUs frequently show polymicrobial colonisation and seldom establish a diagnosis of UTI.

Patients with undiagnosed kidney disease (new AKI or CKD and a raised creatinine, haematuria or proteinuria) will require urine examination for casts, cells and protein but do not require culture.

Sputum Culture

Sputum cultures cost over $160,000 a year. They are not indicated in every patient with a cough!

We recommend:

Do not do routine sputum cultures in every patient with a cough (be selective).

Note:

Half of sputums are significantly contaminated, putting patients at risk of inaccurate teatment.

Carefully coach the patient in collection technque to ensure a high quality specimen.

Results of most sputum cultures rarely change management. Sputum cultures should be done selectively (for example in patients with bronchiectasis or COPD but not in asthma or bronchitis).

Do not repeat sputum cultures after antibiotics have been started. Do it once: do it right.

Stool specimens ($55 and C difficile $39)

Choosing Wisely only have one recommendation:

Do not repeat stool examination for C difficile to confirm “cure” if symptoms have resolved.

The DHB Shared Services **Laboratory Test Referral Guidelines** have this summary:

Specific investigations are not routinely required in the majority of patients with acute diarrhoea of up to 14 days duration. Enteric pathogens may not be amenable to treatment; however in some situations they pose a public health risk.

A laboratory diagnosis is useful for people who:

- may have an infection* that could benefit from specific therapy;
- are at risk of severe complications e.g. intestinal failure and short bowel syndrome;
- are at risk of spreading infection**; or
- are involved in an outbreak and may have a common source of infection.

* For example in severe dehydration or with abdominal pain or if surgery is being contemplated, where detection of Campylobacter, Yersinia or enteric adenoviruses can change management.

** For example food handlers.

Stool culture also has a role in selected patients with suspected IBD to exclude infectious causes and in individuals who have recently travelled to coutries with poor water of food services.

We recommend:

Do not send stool for culture in every admission with, or who develops, diarrhoea.

Do not send stool for culture unless there are good clinical indications.

Stool testing for a range of pathogens is a particularly complex, resource intensive process.

Stool cultures have a low rate of pick up for identifying the likely pathogenic organism.

The laboratory have establised a number of rules for stool testing:

- Only one faecal specimen a day will be processed.
- If diarrhoea develops after 3 days in hospital the laboratory will only test for C. difficile.
- Repeat testing of a patient who is positive for C.difficile toxin is not indicated within a 28 day period. A negative C.difficile toxin test may be repeated once if symptoms persist. Further testing is not indicated during the same episode of diarrhoea.
- FOB testing is not performed on inpatients. Patients with symptoms or signs of gastrointestinal bleeding require definitive investigations.
- Parasite examination has been limited to Giardia/Cryptosporidium. Full parasite work-up will only be performed when clinical details indicate the patient is a food handler or has:
    - recently travelled to countries with poor food or water services,
    - recently immigrated,
    - eosinophilia with diarrhoea lasting more than 15 days ,
    - immunocompromised status.

Serology

For serological tests it is critical that clinical details are provided and this affects the quality of patient care. Serological diagnosis for infectious diseases may require:

- Selection of the best tests for the current clinical question
- Interpretation based on prior probabilities and the time course of the illness
- Reference to any known and relevant previous results
- Follow up testing

In some cases 2 or 3 words is enough, for example “suspected acute viral hepatitis” or “rash, arthralgia, not immunized, possible rubella”.

For more complicated cases, the travel history, immunization status, antibiotic use, occupation, exposure to known cases, pregnant status can be very helpful to decide on what test to do.

Serology samples referred without clinical information will not be tested until it is provided and a report will be given to that effect. Samples will be stored for one month.

Swabs and other cultures ($34)

Swab cultures cost over $400,000 a year and respiratory swabs over $350,000.

We recommend:

Send material (fluid or tissue) if available for culture, not swabs.

Do not do send swabs for culture unless part of an accepted protocol (eg neutropaenic sepsis or throat infection) or if antibiotic therapy has failed.

Many swab results add little to patient management. The decisions to treat or not with antibiotics and with what antibiotic are made before swab cultures are available.

If available, material like pus or tissue (put in a urine container, without formalin!) rather than a swab should be sent for culture.

Nasal swabs are not informative for sinusitis and will not be cultured.

For respiratory virus testing, collect a formal nasopharyngeal swab using a special virus swab.

MRSA screen ($32)

MRSA screening costs over $200,000 a year. Please ensure it is indicated for infection control.

TB testing ($50 per specimen)

TB testing costs $200,000 a year. It is important never to miss TB but tests should only be requested in patients where TB is a possible diagnosis or in the screening of risk patients.

Culture is the test of choice. Quantiferon is not a suitable screening test in low probability situations such as lymphadenopathy, feer of unknown origin or chronic fatigue.

Quantiferon Gold ($54)

Quantiferon Gold or Interferon Gamma Release Assay (IGRA) testing costs over $50,000 a year.

The test has a very limited role in the diagnosis of TB. It should not be performed except in screening for latent TB infection in patients going on biologic therapy, or starting other immunosuppressants, or in the screening of TB contacts.

The DHB Shared Services **Laboratory Test Referral Guidelines** has the following on screening for latent TB (LTBI):

Contact screening for LTBI

Contacts aged 7 years and under: use a Mantoux test.

Contacts > 7 years: use a Mantoux test or IGRA or Mantoux followed by IGRA (if Mantoux +ve) *

Healthcare worker screening for LTBI

Use IGRA to screen health care workers for LTBI

Refugee screening for LTBI

Refugee children aged 7 years and under: use a Mantoux test

Refugee children aged 8- 15 years: Mantoux test or IGRA or Mantoux followed by IGRA (if +ve) *

Refugees aged 16 and older: use either a Mantoux Test or IGRA

Screening for LTBI in immune-compromised people

Use IGRA

In some situations a clinician may elect to use both a Mantoux test and IGRA

An IGRA is particularly recommended in the following:

- BCG vaccinated people
- Immune-compromised people
- When it is considered a high risk the person will not return for the reading of their Mantoux
- When it is impractical for the person to make repeat visits for sequential testing

***We recommend IGRA only if Mantoux is +ve and the individual has had a previous BCG.**

Virology

Viral studies can be very expensive:

- HIV nucleic acid load costs $460, Hepatitis B nucleic acid $194, Hepatitis C load $170
- HCV genotyping is $134, HIV resistance studies cost $641

Viral load and genotype testing (HIV, HBV, HCV) is generally only performed on request of a Infectious Diseases physician, Gastroenterologist or as part of an agreed departmental protocol.

Viral PCR on CSF (HSV, VZV, enterovirus) will be cancelled if the WBC and protein results come back within normal limits. Exceptions should be discussed with Microbiology.

Choosing Wisely only have this one specific recommendation on virological testing:

Don't repeat the viral load in HCV unless on therapy.

The DHB Shared Services **Laboratory Test Referral Guidelines** have this on **hepatitis** testing:

- Clinicians should try to identify patients with raised LFTs due to chronic viral hepatitis,
- All HBsAg-positive pregnant women should have their HBV viral load measured,
- There is somewhat of a hiatus in treating HCV infection, pending the availability of newer agents, but all HCV PCR-positive patients should be referred to a specialist,
- Many HBsAg-positive patients are not being properly followed up or referred, and stand the risk of developing preventable liver disease.

The guidelines note regarding serological diagnosis:

Hepatitis A and E

These are the simplest to diagnose:

The **IgM** is almost always positive at the time the transaminases are raised.

The **IgG** is used to determine immunity, or show seroconversion if IgM results are inconclusive.

Note that Hepatitis E is not present in New Zealand but can be acquired overseas.

Hepatitis B

HBsAg is present in almost all actively infected persons with HBV and is the first test that should be requested if HBV infection is suspected.

HBV surface antibody is a test that should really only be ordered for adults in occupational health settings, preferably within a few months of the final dose of vaccine: those who develop a clear response will be protected for life.

HBV e antigen predicts high titres of virus, but its absence does not exclude high viral loads, especially in adults who were infected in childhood.

HBV DNA measurement is an essential part of assessment and management

Note that we screen with HBsAg, anti-HBs and anti-HBc to reduce the need for repeat testing. HBc IgM may help in selected cases for Public Health to determine if the infection is acute.

Hepatitis C

Anti-HCV antibody is present in almost all those infected with HCV, but depending on the age and sex at acquisition, only 70-80% will have active viral replication.

A viral load test is needed to identify actively infected patients.

Like HIV, the antibodies are non-neutralising, i.e. do not control infection.

The emphasis in Hepatitis C management is to identify and refer patients with raised ALT who are keen to engage in treatment.

Do not repeat HBV or HCV studies without considering the significance of prior testing

Expensive Tests Requiring SMO Approval

The appendix show a lists of tests costing more than $100 a test. The costs shown are approximate. They have been listed in alphabetical order to make it easier to find them.

We are recommending that tests costing over $100 should be supported by a SMO and any tests over $500 will require CD endorsement. We will be introducing laboratory rules to ensure tests are not done without a named SMOs recommendation unless part of an agreed protocol.

While there will be saving from preventing inappropriate expenisve tests, most of the cost of laboratory testing in Waikato is in the high volumes of cheaper tests. Many of these tests are also repeated unneccessarily. Always ask whether a test needs to be repeated and how soon.

The top 20 most expensive send-away tests in quarter 2 of 2015 were:

Test	No	Cost
MARR ($1000)	26	26,000
BCR-ABL (RT-PCR) ($376.99)	57	21,488
BRCA SCREEN ($3108.91)	6	18,653
ELASTASE 1 (PANCREATIC) FAECES ($139.56)	101	14,096
CHROMOGRANIN A ($172.08)	74	12,734
6TGN (RBC) ($162)	68	11,016
CYSTIC FIBROSIS SCREEN ($335.94)	25	8,399
ORGANIC ACIDS URINE ($146.77)	55	8,072
CARBOHYDRATE DEF TRANSFERRIN ($118.44)	53	6,277
DNA EXTRACTION ($139.07)	45	6,258
CLOZAPINE ($38.76)	156	6,047
FRAGILE X ($423.49)	13	5,505
NEUROMYELITIS OPTICA IGG ($777.44)	7	5,442
AMINO ACIDS URINE (CHROM) ($118.83)	45	5,347
NEURONAL ABS ($120.72)	39	4,708
CALR ($400.46)	11	4,405
STEATOCRIT FAECES ($121.78)	34	4,141
CONNEXIN 26 ($339.85)	12	4,078
25 HYDROXYVITAMIN D ($25.95)	155	4,022
6MMP (RBC) ($118.68)	31	3,679

The top 10 most expensive non-histology tests in quarter 2 of 2015 were:

Test	No	Cost
COMPLETE BLOOD COUNT ($9.44)	46,726	441,093
BLOOD CULTURE ($33.29)	5,777	192,316
BLOOD GAS ($16.65)	10,871	181,002
CRP ($8.17)	18,588	151,864
INR ($10)	14,551	145,510
CREATININE AND ELECTROLYTES ($2.5)	56,365	140,913
CULTURE URINE ($18.09)	7,584	137,195
PCR PANEL: INFLUENZA A & B, RSBV , hMPV ($143.15)	894	127,976
SWAB CULTURE ($33.95)	3,160	107,282
BNP (NT PRO) ($44.38)	2,191	97,237

LIST OF TESTS COSTING MORE THAN $100 IN ALPHABETICAL ORDER

11-DEOXYCORTISOL	$250.83
14-3-3 PROTEIN	$364.02
2,4,5-T	$125.77
6MMP (RBC)	$136.48
6TGN (RBC)	$186.30
7-DEHYDROCHOLESTEROL	$833.72
ACADM GENE	$939.40
ACETYLCHOLINE RECEPTOR ABS	$166.96
ACTINOMYCES (CULTURE)	$102.08
ACUTE MYELOID LEUKAEMIA PROBE	$486.14
ADAMTS13	$402.91
ADENOVIRUS VIRAL LOAD	$182.94
ADIPONECTIN	$105.64
ADRENOLEUKODYSTROPHY (X LINK)	$1,543.32
ALAGILLE SYNDROME	$186.45
ALANINE	$301.89
ALANINE CSF	$129.67
ALP ISOENZYMES	$171.97
ALPHA 1 ANTITRYPSIN FAECES	$378.60
ALPHA AMINO ADIPIC SEMIALDEHYDE	$469.70
ALPHA THALASSAEMIA GENE STUDY	$382.64
AMINO ACID CSF	$136.75
AMINO ACIDS	$145.46
AMINO ACIDS URINE (CHROM)	$136.65
AML MOLECULAR PANEL	$493.38
AMNIOTIC FLUID KARYOTYPE	$574.56
ANEUPLOIDY (FISH SCREEN)	$421.30
ANEUPLOIDY 5,9,15 FISH	$469.70
ANGELMAN SYNDROME	$658.33
APOLIPOPROTEIN E (GENOTYPE)	$179.18
ATAXIA TELANGIECTASIA	$480.28
AVP GENE	$186.45
AVP RECEPTOR 2 GENE	$1,064.45
B2 TRANSFERRIN CSF	$265.75
BARTONELLA (PCR)	$326.99
BCR/ABL FISH	$486.14
BCR-ABL	$382.64
BCR-ABL (RT-PCR)	$433.54
BECKWITH-WIEDEMANN SYNDROME	$595.87
BK VIRUS NUCLEIC ACID	$192.10
BONE MARROW	$229.96
BONE MARROW (DNA)	$116.55
BONE MARROW (REFERRED)	$669.32
BONE MARROW KARYOTYPE	$804.37
BOTULINUM TOXIN TYPE A AB	$408.44
BOWEL CANCER	$1,234.71
BRCA SCREEN	$3,575.25
BUTYRYLCHOLINESTERASE GENOTYPE	$250.83
C1 ESTERASE (FUNCTION)	$178.12
CA 72-4	$164.15
CALCIUM CHANNELOPATHY 1A	$853.29
CALCIUM SENSING RECEPTOR GENE	$1,680.88
CALCULUS	$136.20
CALCULUS (X-RAY DIFFRACTION)	$136.20
CALPROTECTIN FAECES	$121.02
CARBOHYDRATE DEF TRANSFERRIN	$136.20
CARNITINE	$157.63

CARNITINE (ACETYL)	$194.76
CARNITINE (ACYL) (GUTHRIE)	$293.56
CARNITINE PALMITYL TRANSFERASE	$214.96
CEBPA	$382.64
CFTR POLYT ALLELES	$342.53
CHITOTRIOSIDASE	$263.29
CHOLINESTERASE PHENOTYPE	$250.83
CHORIONIC VILLI (CYTOGENETICS)	$657.93
CHROMOGRANIN A	$197.89
CLL FISH	$1,372.52
CLOPIDOGREL	$150.40
CMV DNA (LABPLUS)	$197.37
CMV DRUG RESIST AND GENETIC ANLYS	$1,120.11
CMV NUCLEIC ACID	$184.94
CMV NUCLEIC ACID VIRAL LD	$180.27
CMV RNA	$187.71
CMV UL54 GENOTYPE	$473.84
CMV UL97 GENOTYPEX	$399.04
COCCIDIOIDOMYCOSIS AB	$129.17
CONGENITAL ADRENAL HYPERPLASIA	$732.57
CONNEXIN 26	$390.82
CORTICOTROPHIN RELEASING HORM	$109.95
COXIELLA SEROLOGY	$190.87
CREATINE/CREATININE RATIO	$728.04
CRYOGENZA A MATRIX PCR	$109.38
CULT PROCESS TISSUE	$547.20
CULTURE PROCESS CANCER	$322.93
CULTURE PROCESS PB	$243.08
CYSTIC FIBROSIS SCREEN	$386.34
D13S319 FISH	$469.70
DENTATORUBRALPALLIDOLUYSIAN AT	$375.40
DIHYDROTESTOSTERONE	$429.86
DIPTHERIA IGG	$118.39
DNA EXTRACTION	$159.93
DNA ISOLATION	$193.72
DRUG CONFIRMATION	$140.48
DRUG INVESTIGATION URINE/FLD	$153.14
DYSTROPHY (MYOTONIC)	$754.04
EBV NUCLEIC ACID (QUAL)	$160.49
ELASTASE 1 (PANCREATIC) FAECES	$160.50
ELECTRON MICROSCOPY	$577.73
ELN FISH	$234.85
EMA BINDING	$293.56
ENTEROVIRUS NUCLEIC ACID	$186.76
EPISODIC ATAXIA (TYPE 2)	$440.94
ETHYLENE GLYCOL	$106.77
EUGLOBULIN LYSIS TIME	$176.14
EVEROLIMUS	$578.45
EXON 12 OF JAK2	$434.07
FACIOSCAPULOHUMERAL MUSC DYST	$859.45
FACTOR IX (GENETIC ANALYSIS)	$222.62
FACTOR VIII (GENETIC ANALYSIS)	$264.21
FACTOR VIII (GENETIC ANALYSIS,L)	$222.62
FACTOR X	$107.20
FACTOR XIII	$127.62
FAMILIAL ADENOMATOUS POLYPOSIS	$641.49
FAMILIAL AMYLOID POLYNEUROPATH	$768.03
FAMILIAL HYPERALDOSTERONISM 1	$251.52
FAMILIAL MEDITERRANEAN FEVER	$363.65

FERROPORTIN GENE MUTATION	$454.96
FGFR3 TARGETED SEQUENCING	$501.57
FIBROBLAST GROWTH FACTOR	$836.77
FIP1L1-PDGFRA	$344.40
FISH CANCER	$809.16
FISH TEST FOR CERBB2	$469.70
FLECAINIDE	$157.63
FLT3 NPM1	$456.81
FLUOXETINE	$435.98
FNA	$245.54
FNA (BREAST - BY OTHER PATHOLOGISTS)	$114.80
FNA (BREAST)	$140.91
FNA (FLOW CYTOMETRY)	$303.84
FRAGILE X	$487.01
FRIEDREICH'S ATAXIA	$347.85
FROZEN SECTION	$143.26
GABA AMPA12 AB	$370.21
GALACTOCEREBROSIDASE (BETA)	$189.07
GALACTOSIDASE ALPHA	$469.70
GELSOLIN	$791.97
GLIVEC	$214.51
GLUCURONIDASE (BETA)	$186.30
GLYCINE RECEPTOR AB	$361.62
GLYCOLIPID AB	$406.40
H NONPOLYPOSIS COLORECTAL CA	$380.01
HAEMOCHROMATOSIS	$115.46
HAEMOGLOBINOPATHY SCREEN	$242.46
HAEMOGLOBINOPATHY SCREEN +HBH	$306.27
HAEMOPHILIA (GENETIC TESTING)	$1,182.73
HEPARIN (ASSAY, ANTI-FXA)	$103.31
HEPATITIS B DRUG RESISTANCE	$322.23
HEPATITIS B NUCLEIC ACID	$223.11
HEPATITIS C (LOAD)	$195.25
HEPATITIS C AG	$125.77
HEPATITIS C NUC ACID LOAD (L)	$347.57
HEPATITIS C VIRUS GENOTYPE	$154.46
HEPATITIS D VIRUS NUCLEIC ACID	$196.60
HEPATITIS E VIRUS NUCLEIC ACID	$289.02
HERPES SIMPLEX (PCR)	$200.29
HHV6 NUCLEIC ACID	$185.67
HHV8 IGG	$123.58
HHV8 NUCLEIC ACID	$185.67
HIPPURATE URINE	$107.55
HIRA FISH	$218.41
HIRA INTERPHASE	$859.45
HIT (PLATELET AGGREGATION)	$153.14
HIV ANTI-RETROVIRAL RESISTANCE	$737.45
HIV NUCLEIC ACID (LOAD)	$529.25
HIV VIRAL LOAD (LD, REF)	$365.15
HLA-B 5701	$150.45
HMMA URINE 24H	$102.51
HSV NUCLEIC ACID	$151.92
HSV/VZV (PCR)	$200.29
HUMAN PAPILLOMA NUCLEIC ACID	$203.28
HUNTINGTON'S DISEASE SCREEN	$487.01
HVA URINE	$199.45
HVA URINE 24H	$132.01
HYDROGEN BREATH TEST (BASE)	$214.39
HYPERTROPHIC CARDIOMYOPATHY	$3,917.56

IGH BREAKAPART FISH	$532.17
IGH CCND1-MYEOV FISH	$550.80
IGH FGFR3-MMSET FISH	$469.70
IGH GENE REARRANGEMENT	$308.92
IGH/BCL2 (PCR)	$377.03
IMMUNOPHENOTYPING (ACUTE 1)	$293.56
IMMUNOPHENOTYPING (HAIRY CELL)	$187.88
IMMUNOPHENOTYPING (NK CELL)	$187.88
IMMUNOPHENOTYPING (T CELL)	$188.47
IMMUNOPHENOTYPING CSF	$223.11
INFLUENZA AH1 PCR	$114.86
INFLUENZA B PCR	$114.86
INHIBIN B	$136.48
INHIBITOR (SCREEN)	$102.08
INHIBITOR (SPECIFIC FACTOR)	$191.42
INTERLEUKIN 28B	$222.62
ITRACONAZOLE	$214.96
JAK2 V617F MUTATION	$219.07
JC VIRUS NUCLEIC ACID	$203.28
J-CHAIN CLONALITY PCR STUDIES	$486.14
JUNCTOPHILIN 3	$750.80
KARYOTYPE PERIPHERAL BLOOD	$486.14
KARYOTYPE PERIPHERAL BLOOD CANCER	$669.32
KARYOTYPE TISSUE	$410.99
KENNEDY DISEASE	$278.30
LEBERS OPTIC NEUROPATHY	$557.23
LEGIONELLA PCR	$133.69
LEISHMANIASIS AB	$109.52
LEPTOSPIROSIS CULTURE	$111.03
LESCH-NYHAN SYNDROME	$2,038.82
LONG QT SYNDROME	$379.67
LUPUS ANTICOAGULANT	$111.66
LYMPHOCYTOSIS (MARKER PANEL)	$408.36
MAG IGM	$821.98
MARFAN SYNDROME	$2,069.00
MATERNAL SERUM SCREEN	$105.68
MEASLES NUCLEIC ACID	$319.30
MEN-1 SYNDROME	$1,161.96
METANEPHRINES (FREE)	$179.67
METHYLHIPPURATE URINE	$107.55
METHYLMALONATE	$114.65
METHYLPHENIDATE URINE	$128.97
METHYLTETRAHYDROFOLATE REDUCT.	$138.09
MICROARRAY	$1,174.25
MICROARRAY FOLLOWUP FAMILY	$293.56
MICROARRAY FOLLOWUP FISH	$587.13
MODY3	$1,323.90
MOTOR NEURONE DISEASE	$634.94
MPS (ELECTROPHORESIS)	$134.07
MPZ GENE ANALYSIS	$1,099.06
MUCOPOLYSACCHARIDES UR	$134.07
MUSCULAR DYSTROPHY PROBE	$476.21
MUSK AB	$344.81
MYC BREAKAPART FISH	$469.70
MYC/IGH FUSION (FISH)	$939.40
MYCOPHENOLATE	$171.97
MYELOMA FISH PANEL	$422.73
MYOPATHY (MITOCHONDRIAL)	$1,878.81
MYOSITIS AB	$213.80

NEUROFIBROMATOSIS (TYPE 1)	$715.05
NEUROFIBROMATOSIS (TYPE 2)	$214.65
NEUROMYELITIS OPTICA IGG	$894.05
NEURONAL ABS	$138.83
NEUTROPHIL FUNCTION	$147.00
NMDAR RECEPTOR AB	$383.74
NOTCH 3	$369.38
NPM1	$450.09
ORGANIC ACIDS URINE	$168.78
PARASITE SEROLOGY	$107.55
PARVOVIRUS NUC ACID (B19)	$203.28
PCR CSF PANEL	$203.28
PDGFR (BETA)	$821.21
PENDRED SYNDROME	$1,310.93
PENTACHLOROPHENOL URINE	$204.69
PHAEOCHROMACYTOMA GENE PANEL	$2,583.36
PHENOL URINE	$119.77
PLASMINOGEN	$234.85
PLASMINOGEN ACTIVATOR INHIB	$194.45
PML-RAR	$382.64
PMP22 GENE ANALYSIS	$293.42
PNH (IMMUNOPHENOTYPING)	$107.20
PORPHYRIN CONFIRMATION BLD/URINE	$362.09
PORPHYRIN CONFIRMATION FAECES	$191.13
PRADER-WILLI SYNDROME	$708.45
PROGENITOR CELL	$446.64
PTH RELATED PEPTIDE	$136.48
PYRUVATE KINASE	$370.05
RESPIRATORY PANEL PCR	$175.35
RET PROTO-ONCOGENE	$994.66
RETINOBLASTOMA (UNILATERAL)	$267.64
RETT SYNDROME	$506.21
RNA EXTRACTION AND STORAGE	$193.72
RSV SCREEN	$211.37
RUNX1T1/RUNX1 FUSION (FISH)	$872.51
S. CEREVISIAE AB	$204.69
SCLERODERMA AB	$223.11
SCLERODERMA AB (REFERRED)	$234.85
SDHB	$953.40
SDHD	$476.70
SEROTONIN	$250.83
SMITH-MAGENIS (FISH)	$859.45
SOTOS SYNDROME	$1,439.20
SPASTIN SPG4	$1,404.15
SPINAL MUSCULAR ATROPHY	$883.58
SPINOCEREBELLAR ATAXIA	$697.18
STEATOCRIT FAECES	$140.04
STRONGYLOIDES SEROLOGY	$100.33
SULFATIDE AB	$454.15
SULPHONYLUREA	$286.80
T CELL GENE REARRANGEMENT	$364.71
TAY-SACHS DISEASE	$119.17
TB DNA (DIRECT)	$145.84
TB IDENTIFICATION	$146.43
TB PCR TESTING	$164.40
TB SENSITIVITIES	$242.46
T-CELL GENE REARRANGEMENT	$540.16
THAP1 MUTATION	$643.55
THYROID RECEPTOR GENE	$953.40

TISSUE (ONCOLOGY)	$493.19
TOPIRAMATE	$201.49
TOR1A SEQUENCE	$342.36
TOXOCARA AB	$136.20
TOXOPLASMA (PCR)	$203.28
TP53 FISH	$486.14
TPMT GENOTYPE	$141.93
TR AB	$361.62
TRICHINELLA	$103.37
TRYPTASE	$114.86
TUBEROUS SCLEROSIS	$1,604.10
TUMOUR NECROSIS FACTOR	$357.53
UROPORPH:COPROPORPHYRIN URINE	$148.01
VERY LONG CHAIN FATTY ACIDS	$541.34
VG CALCIUM CHANNEL AB	$306.68
VG POTASSIUM CHANNEL AB	$305.90
VITAMIN A	$107.55
VITAMIN B2	$100.33
VITAMIN D (1,25 DIHYDROXY)	$179.67
VITAMIN E	$107.55
VITAMIN K	$121.89
VON HIPPEL-LINDAU SYNDROME	$670.37
VON WILLEBRAND (MULTIMER)	$293.12
VON WILLEBRAND DISEASE	$127.62
VORICONAZOLE	$304.92
VZV (PCR)	$402.44
VZV DNA (REFERRED)	$200.29
WARFARIN (PLASMA)	$196.35
WHITE CELL ENZYMES	$885.03
Y MICRODELETION	$387.05

Many are these tests are genetic tests which are only rarely performed. As noted, the **DHB Laboratory Schedule Test List** includes comprehensive guidelines on genetic testing and emphasizes that clinicians seek advice before requesting tests. The **BPAC site** also has a useful document summarising the available genetic tests and their role in primary care

Audit

To try and rationalise the use of investigations.
See the audit tool for General Medicine.