

MEDICINEINSIGHT

An exploration of the medical tests commonly requested by GPs caring for patients who are pregnant or have selected chronic conditions

Australian Government Department of Health

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Independent, not-for-profit and evidence-based, NPS MedicineWise enables better decisions about medicines, medical tests and other health technologies.

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EXECUTIVE SUMMARY

The aim of this study is to provide information on medical tests requested in general practice for patients who are pregnant, or who have type 2 diabetes, chronic kidney disease (CKD), thyroid dysfunction or coeliac disease.

These exploratory data provide a picture of the tests requested for patients with the selected conditions. The information will inform the Diagnostic Imaging and Pathology Branch and the Quality Use of Medicines Branch of the Department of Health about medical tests that could be considered for inclusion in a 'care set' for the specified conditions.

There are a number of considerations that should be noted when interpreting the results provided.

- ▷ Patients often have multiple comorbidities or new symptoms/signs. While this report lists commonly requested tests for patients with a particular condition, some of these tests could have been requested as part of usual management of a completely different condition or for diagnostic purposes if new symptoms arise.
- ▷ The study includes test requests but not test results.
- ▷ Only tests requested by general practitioners (GPs) at MedicineInsight practices have been captured.
- ▷ For most conditions, test requests are reported over a two-year period. The exceptions are:
 - newly diagnosed coeliac disease – only requests in the year prior to and including the date of first record of coeliac disease are reported.
 - women who are pregnant – only requests in the year prior to the date of birth (3 months pre-conception and during pregnancy) are reported.

Baseline population, sub-populations and study periods

There were 6,067,329 test requests (of any kind) recorded for 1,703,338 regularly attending MedicineInsight patients (three or more GP visits in 2 years) in the study period between January 2018 and December 2019.

There were 90,252 patients with recorded type 2 diabetes, 67,078 with thyroid dysfunction, 17,635 with CKD and 6939 with existing coeliac disease (diagnosed prior to 2018) and a further 582 patients with newly diagnosed coeliac disease.

The number of test requests (of any kind) recorded during the 2-year study period included 37,410 tests for existing coeliac disease, 131,061 for CKD, 442,107 for thyroid dysfunction, and 631,205 for type 2 diabetes. For the 582 patients newly diagnosed with coeliac disease, 1,952 test requests (of any kind) were recorded in the 366 days prior to and including the date of first recorded diagnosis in 2019.

For the 11,933 patients who had a full-term birth (37 to 44 weeks of gestation) in 2019, 70,934 test requests (of any kind) were recorded in the 3 months before and the duration of their pregnancies.

Commonly recorded tests (or panels of tests)

Summary Table 1 shows the commonly recorded tests (or panels of tests) expressed as a proportion of the total number of test requests in each cohort. Each test request may have one or several different types of tests recorded on the same row. Each test-request row is counted as one test request and the different types of tests within that row are counted individually.

Routinely requested tests such as full blood count (FBC; 31.6% of test requests had at least 1 FBC recorded), electrolytes, urea and creatinine (EUC; 30.5%) and liver function tests (LFT; 28.7%) were the most commonly recorded among all the test requests for patients in the baseline population.

The commonly recorded tests for most of the conditions of interest were FBC, EUC, LFT as well as thyroid function tests (TFT) and lipid profile. HbA_{1c} was among the top 5 commonly requested tests for patients with type 2 diabetes and CKD while iron tests (including iron, ferritin, transferrin, total iron binding capacity) were among the top 5 requested tests for patients with coeliac disease and pregnant women. Among patients with thyroid dysfunction, the test requests most frequently recorded during the 2-year period were TFT (33.4% of test requests had at least 1 TFT recorded), which include thyroid-stimulating hormone, triiodothyronine and thyroxine. The commonly recorded tests for the conditions of interest are consistent with the relevant guidelines for each condition.

The commonly recorded test requests in the 3 months before and during pregnancy for patients who had a full-term birth included ultrasound scan (32.5% of test requests had at least 1 ultrasound recorded), FBC (27.5%), iron (18.1%), urine microscopy, culture and sensitivity (MCS) (14.9%), and TFT (12.9%).

For each patient with type 2 diabetes during the 2-year period, the average numbers of test requests recorded was 3.0 EUC, 2.7 HbA_{1c}, 2.5 LFT, 2.5 FBC and 1.8 lipid tests. The average number of the commonly recorded test requests in the 2-year (or relevant) period per patient for each condition and for pregnancy is shown in Summary Table 1.

SUMMARY TABLE 1. TOP 5 COMMONLY RECORDED TESTS AND THE AVERAGE NUMBER OF TESTS PER PATIENT OVER THE STUDY PERIOD AMONG ALL TEST REQUESTS FOR EACH COHORT

Cohorts	Number of patients	Total number of test requests*	Commonly recorded tests as a proportion (%) of the total number of test requests for each cohort; average number of tests per patient				
			First	Second	Third	Fourth	Fifth
Baseline population	1,703,338	6,067,329	FBC, 31.6%; 1.1	EUC, 30.5%; 1.1	LFT, 28.7%; 1.0	TFT, 18.1%; 0.6	lipids, 16.9%; 0.6
Type 2 diabetes	90,252	631,205	EUC, 42.7%; 3.0	HbA _{1c} , 38.3%; 2.7	LFT, 36.5%; 2.5	FBC, 35.1%; 2.5	lipids, 25.6%; 1.8
CKD	17,635	131,061	EUC, 42.3%; 3.1	FBC, 34.3%; 2.6	LFT, 31.9%; 2.4	HbA _{1c} , 15.8%; 1.2	lipids, 15.5%; 1.2
Thyroid dysfunction	67,078	442,107	TFT, 33.4%; 2.2	EUC, 31.5%; 2.1	FBC, 31.5%; 2.1	LFT, 28.8%; 1.9	lipids, 16.7%; 1.1
Existing coeliac disease	6,939	37,410	FBC, 32.2%; 1.7	EUC, 29.7%; 1.6	LFT, 28.3%; 1.5	TFT, 20.6%; 1.1	iron, 19.7%; 1.1
Newly diagnosed coeliac disease†	582	1,952	FBC, 37.4%; 1.3	EUC, 30.6%; 1.0	iron, 30.1%; 1.0	LFT, 30.1%; 1.0	TFT, 22.3%; 0.8
Pregnancy‡	11,933	70,934	ultrasound scan, 32.5%; 1.9	FBC, 27.5%; 1.6	iron, 18.1%; 1.1	urine MCS, 14.9%; 0.9	TFT, 12.9%; 0.8

* Note that each test request may have several different types of tests recorded.

† Note that this only includes tests requested in the year prior to and including the date of first record of coeliac disease.

‡ Note that this only includes tests requested in the year prior to birth (3 months pre-conceptions until birth).

EUC, electrolytes, urea and creatinine (includes eGFR); FBC, full blood count; HbA_{1c}, glycated haemoglobin; LFT, liver function test (s); MCS, microscopy, culture and sensitivity; TFT, thyroid function test(s).

Charlson Comorbidity Index

The mean Charlson Comorbidity Index (CCI) scores indicate that patients with the selected chronic conditions had a higher comorbidity burden than those in the baseline population. For example, the mean CCI score for patients with type 2 diabetes (2.4) or CKD (4.0) was higher than that for the baseline population (0.5). Also, the average number of test requests (of any kind) for patients with type 2 diabetes (7.0) or CKD (7.4) was higher than that for the baseline population (3.6). These findings suggest that some tests requested for patients with the specified conditions may have been requested for co-existing conditions other than the specified condition.

Commonly recorded tests (or panels of tests) where the reason for test request is relevant to the specified condition or pregnancy

To further understand the commonly requested tests for patients with each condition of interest or pregnancy, sensitivity analyses were conducted, restricting the test requests to those with a test reason relevant to the specified condition or pregnancy. However, as almost half of the test requests did not have a reason for request recorded, these findings should be interpreted with caution.

Of the 3,270,695 test requests for the baseline population with a recorded reason (53.9% of all test requests), routinely requested tests such as FBC (28.5%), EUC (27.4%) and LFT (25.8%) were also the most commonly recorded tests.

Similarly, for most conditions of interest, routinely requested FBC, EUC and LFT tests were among the commonly recorded test requests where the reason for request was relevant to the specified condition (Summary Table 2).

Among the test requests for patients with type 2 diabetes where the test reason related to type 2 diabetes, HbA_{1c} (85.8%) was the most commonly recorded test. Similarly, TFT (92.2% of test requests with test reason relevant to thyroid dysfunction had at least 1 TFT recorded) were the most recorded tests (or panel of tests) for patients with thyroid dysfunction; iron tests (55.5%) for patients with newly diagnosed coeliac disease; and ultrasound scan (43.7%) for pregnant women.

Of the test requests where the test reason related to coeliac disease, coeliac tests, which include the serological tests used in the diagnosis of coeliac disease, were the third most frequently requested tests (or panel of tests) for patients with newly diagnosed coeliac disease.

There were 78,197 test requests (for 65,733 patients) for the baseline population where fatigue or tiredness was recorded as the reason. Of these test requests, 84.9% included a request for FBC, 76.7% EUC, 74.5% LFT, 73.1% TFT and 71.7% iron tests (Summary Table 2).

SUMMARY TABLE 2. COMMONLY RECORDED TESTS AMONG TEST REQUESTS WHERE RELEVANT REASON FOR TEST IS RECORDED

Cohorts	Number of patients	Number of test requests with a relevant reason recorded*	Commonly recorded tests as a proportion (%) of number of test requests with relevant reason recorded				
			First	Second	Third	Fourth	Fifth
Baseline population	835,840	3,270,695**	FBC, 28.5%	EUC, 27.4%	LFT, 25.8%	ultrasound scan, 16.9%	TFT, 16.4%
Type 2 diabetes	37,320	113,183	HbA _{1c} , 85.8%	EUC, 72.0%	LFT, 62.0%	FBC, 55.5%	lipids, 52.8%
CKD	3,538	8,006	EUC, 74.5%	FBC, 51.5%	LFT, 47.8%	urine ACR, 19.2%	iron, 19.2%
Thyroid dysfunction	23,170	52,818	TFT, 92.2%	FBC, 49.5%	EUC, 48.5%	LFT, 46.0%	lipids, 28.9%
Existing coeliac disease	1,215	1,978	FBC, 66.3%	iron, 59.9%	LFT, 56.4%	EUC, 54.3%	vitamin B12 or folate, 47.5%
Newly diagnosed coeliac disease†	103	128	iron, 55.5%	FBC, 52.3%	coeliac test, 51.6%	EUC, 43.8%	LFT, 43.0%
Pregnancy‡	6,743	27,916	ultrasound scan, 43.7%	FBC, 25.8%	iron, 17.0%	first trimester scan†† 12.5%	urine MCS, 11.6%
Fatigue or tiredness‡‡	65,733	78,197	FBC, 84.9%	EUC, 76.7%	LFT, 74.5%	TFT, 73.1%	iron, 71.7%

* Note that each test request may have several different types of tests recorded.

** Includes test requests with any recorded test reason.

† Note that this only includes tests requested in the year prior to and including the date of first record of coeliac disease.

‡ Note that this only includes tests requested in the year prior to birth (3 months pre-conceptions until birth).

†† Includes scans performed during the first trimester eg, nuchal translucency (NT) scan, pregnancy-associated plasma protein A, antenatal scan, down syndrome, obstetric scan, viability scan, early pregnancy scan

‡‡ As fatigue or tiredness is a symptom but not a diagnosis, we identified test requests for the baseline population where the reason for request was recorded as fatigue or tiredness and from these, we determined the number of patients and the commonly recorded tests.

EUC, electrolytes, urea and creatinine (includes eGFR); FBC, full blood count; HbA_{1c}, glycated haemoglobin; LFT, liver function test (s); MCS, microscopy, culture and sensitivity; TFT, thyroid function test(s).

1. BACKGROUND

Introduction

There have been suggestions among clinicians and policy makers that it would be useful to develop a set of medical tests, also known as a 'care set', for different conditions. For example, a 'care set' could cover all pathology testing for people with diabetes or who are pregnant. Although there are evidence-based clinical guidelines that provide guidance on testing for patients with different conditions, the Department of Health (DOH) is interested in the tests requested for patients with selected conditions in general practice.

DOH has requested a MedicineInsight report on all testing performed over 24 months for people with type 2 diabetes, chronic kidney disease (CKD), thyroid dysfunction, coeliac disease and pregnancy, including the 3 months before pregnancy.

Together with the existing clinical guidelines, these exploratory data could help inform decisions about which medical tests might be included in a 'care set' for these conditions. A number of considerations should be noted when interpreting these data.

- ▷ Patients often have multiple comorbidities or new symptoms/signs. While this report lists commonly requested tests for patients with a particular condition, some of these tests could have been requested as part of usual management of a completely different condition or for diagnostic purposes, in case of new symptoms. For example, a patient with type 2 diabetes may have a liver function test requested for co-existing liver disease.
- ▷ The study includes test requests but not test results.
- ▷ Only tests requested by general practitioners (GPs) at MedicineInsight practices have been captured. Information on tests requested at non-MedicineInsight practices or in other settings, such as specialists or hospitals, is not available.

Medical tests

Medical tests are performed to: screen for disease and potential health risks; diagnose an illness; plan treatment; monitor an illness or medicine; and to prepare for treatment, such as before surgery.

Several clinical guidelines provide guidance on the recommended medical tests for diagnosis and management of specific conditions. Below is a summary of the recommended guidelines for testing patients with type 2 diabetes, CKD, thyroid dysfunction, coeliac disease and pregnancy.

Type 2 diabetes

The Royal Australian College of General Practitioners (RACGP) recommends medical tests for diagnosis and management of type 2 diabetes in general practice, which are included in the Medicare Benefits Schedule (MBS) diabetes cycle of care minimum requirements, to be conducted at least annually.

These include:^{1,2}

- ▷ glycated haemoglobin (HbA_{1c})
- ▷ blood glucose (fasting, random)
- ▷ blood lipids (total cholesterol, triglycerides, high-density lipoprotein (HDL) and low-density lipoprotein (LDL) cholesterol)
- ▷ urine albumin
- ▷ estimated glomerular filtration rate (eGFR).

Table 1 shows the recommended frequency of testing for people with type 2 diabetes, by test.

Table 1: INVESTIGATIONS AND FREQUENCY OF TESTING FOR PEOPLE WITH TYPE 2 DIABETES

Components for assessment	Assessment interval		
	Initial	Ongoing	Annual
HbA_{1c}	✓	Three- to six-monthly	✓
Lipids LDL-c, HDL-c, TC, TG	✓	Six-monthly	✓
Urinalysis <ul style="list-style-type: none"> • Urine ACR at least annually: <ul style="list-style-type: none"> – microalbuminuria ACR ≥2.5 mg/mmol (men) or ≥3.5 mg/mmol (women), or albumin concentration ≥20 mg/L – proteinuria (macroalbuminuria) ACR ≥25 mg/mmol (men) or ≥35 mg/mmol (women) 	✓	Individualised	✓
eGFR <ul style="list-style-type: none"> • Normal levels are reported as >90 mL/min/1.73m², and as specific values below; refer to the section ‘Microvascular complications: Nephropathy’ for criteria of CKD stages 	✓	Individualised if abnormal	✓
Other as appropriate for symptomatic presentation or existence of comorbidity or multimorbidity (eg B12 deficiency if on prolonged metformin therapy)			

ACR, albumin-to-creatinine ratio; CKD, chronic kidney disease; eGFR, estimated glomerular filtration rate; HDL-c, high-density lipoprotein cholesterol; LDL-c, low-density lipoprotein cholesterol; TC, total cholesterol; TG, triglyceride

Source: RACGP. Management of type 2 diabetes: a handbook for general practice. <https://www.racgp.org.au/clinical-resources/clinical-guidelines/key-racgp-guidelines/view-all-racgp-guidelines/diabetes/introduction>

Chronic kidney disease

Kidney Health Australia’s guidelines for CKD management in general practice recommend medical tests for people with CKD based on their eGFR and albuminuria.³ These guidelines include colour coded clinical action plans (red, orange and yellow) that outline management goals. Recommended monitoring and frequency of monitoring vary according to the stage of CKD. For patients with less severe CKD, monitoring can be undertaken on a yearly basis but, as severity increases, monitoring is recommended more frequently, every 1–3 months. Table 2 shows the recommended medical tests for evaluating and managing people with CKD.³

Table 2: ASSESSMENTS AND FREQUENCY OF TESTING FOR PEOPLE WITH CKD

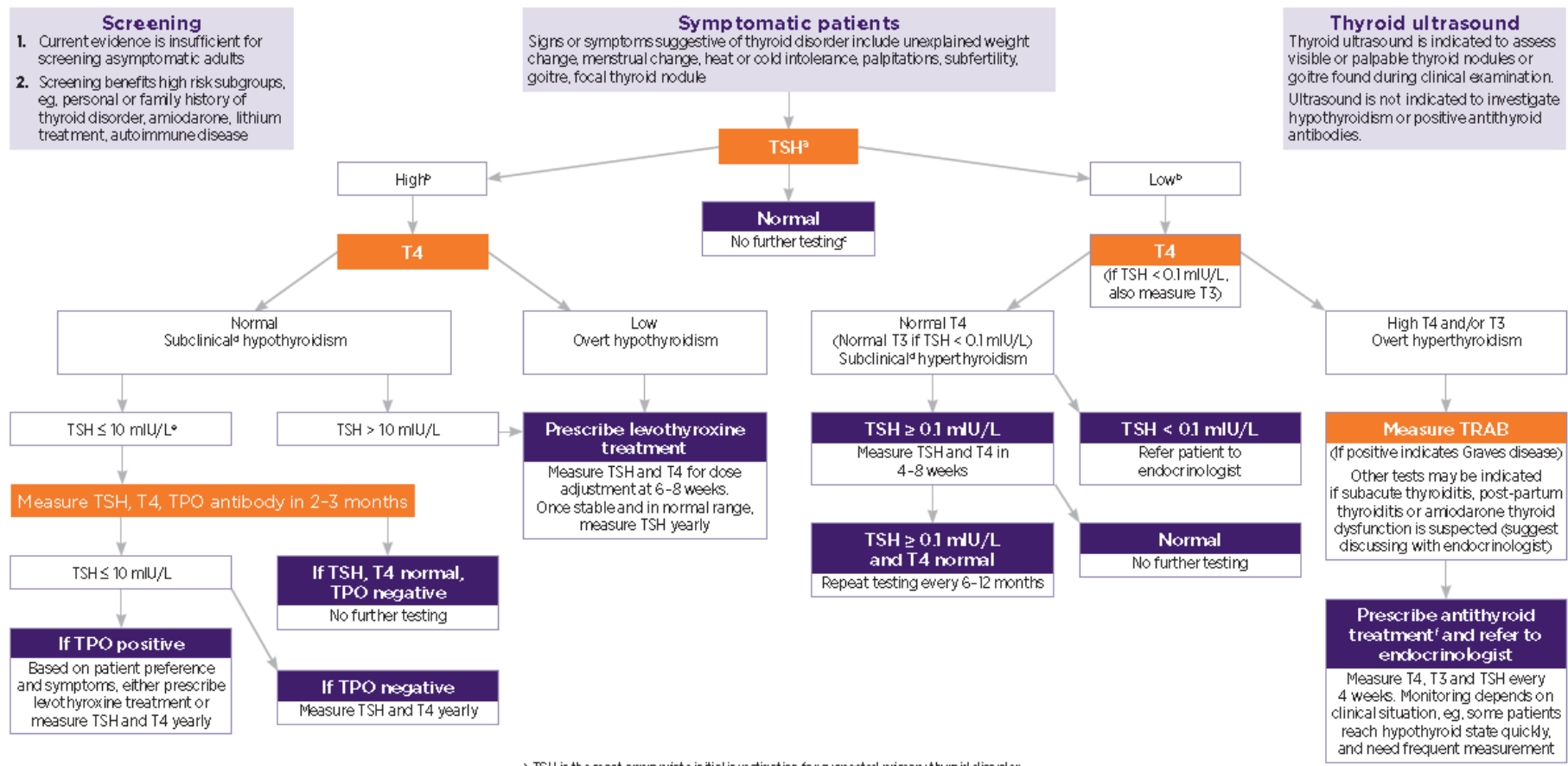
Clinical action plan	Patient group	Recommended laboratory assessments	Frequency of review
Yellow	<ul style="list-style-type: none"> Stage 1 (eGFR \geq 90 mL/min/1.73m²) or 2 (eGFR 60-89 mL/min/1.73m²) CKD with microalbuminuria (urine ACR of 2.5–25 mg/mmol for males or 3.5–35 mg/mmol for females) Stage 3a CKD (eGFR 45-59 mL/min/1.73m²) with normoalbuminuria (urine ACR < 2.5 mg/mmol for males and < 3.5 mg/mmol for females) 	<ul style="list-style-type: none"> Urine albumin-to-creatinine ratio (ACR) Estimated glomerular filtration rate (eGFR) Biochemical profile including urea, creatinine and electrolytes Fasting lipids HbA_{1c} if diabetic 	Every 12 months
Orange	<ul style="list-style-type: none"> Stage 3a CKD with microalbuminuria Stage 3b CKD (eGFR 30-44 mL/min/1.73m²) with normal or microalbuminuria 	As per yellow PLUS: <ul style="list-style-type: none"> Full blood count (FBC) Calcium and phosphate Parathyroid hormone 	Every 3–6 months
Red	<ul style="list-style-type: none"> Stage 4 (eGFR 15-29 mL/min/1.73m²) or 5 CKD (eGFR < 15 mL/min/1.73m² or on dialysis) irrespective of albuminuria Macroalbuminuria (urine ACR of > 25 mg/mmol for males or > 35 mg/mmol for females) irrespective of eGFR 	As per orange	Every 1–3 months

Source: Kidney Health Australia. Chronic Kidney Disease (CKD) Management in Primary Care. <https://kidney.org.au/health-professionals/prevent/chronic-kidney-disease-management-handbook>

Thyroid dysfunction

Thyroid dysfunction for this study includes hyperthyroidism (elevated thyroid hormone levels) and hypothyroidism (thyroid hormone deficiency). Figure 1 shows the algorithm for thyroid disorder testing in general practice developed by NPS MedicineWise.⁴ This algorithm was based on the 2017 Royal College of Pathologists of Australasia *Position statement: Thyroid function testing for adult diagnosis and monitoring*,⁵ with input from experts. The tests used in the evaluation and management of thyroid dysfunction include:⁵⁻⁷

- ▷ thyroid-stimulating hormone (TSH)
- ▷ free thyroxine (T4)
- ▷ free triiodothyronine (T3)
- ▷ thyroid peroxidase antibodies (TPOAbs)
- ▷ TSH receptor antibodies (TRAbs)
- ▷ thyroglobulin antibody (TgAb).



TSH = thyroid-stimulating hormone, T4 = free thyroxine, T3 = free triiodothyronine, TPO = thyroid peroxidase, TRAB = TSH receptor antibodies

Note: This algorithm does not apply in pregnancy. If results of thyroid tests do not match patient presentation, consider non-thyroid illness, recovery from intercurrent illness, interference by heterophile or other antibodies, or high dose biotin (with certain thyroid assays).

^a TSH is the most appropriate initial investigation for suspected primary thyroid disorder. Free T4 and/or free T3 are not usually requested in isolation.
^b If TSH is higher or lower than laboratory reference intervals, request free T4.
^c If you suspect pituitary disorder, request both TSH and free T4 on laboratory form initially, as it is essential to interpret TSH in the context of a free T4 measurement.
^d Subclinical thyroid disorder identified by testing requires careful clinical assessment of relevant symptoms, thyroid morphology and important comorbidities.
^e If patient is symptomatic, offer a 3-6-month trial of levothyroxine treatment without any antibody testing.
^f In subacute thyroiditis, antithyroid treatment is contraindicated.

Acknowledgements
 Developed based on 2017 Royal College of Pathologists of Australasia. Position statement: Thyroid function testing for adult diagnosis and monitoring, with input from experts: Associate Professor Shane Hamblin, Melbourne and Professor Rita Horvath, Sydney
 Endorsed by the Endocrine Society of Australia

FIGURE 1: ADULT THYROID DISORDER TESTING ALGORITHM
 Source: NPS MedicineWise. Adult thyroid disorder testing algorithm. https://www.nps.org.au/assets/NPS_MedicineWise_Thyroid_Testing_Algorithm_v3.pdf

Coeliac disease

Diagnosis of coeliac disease

Several investigations are conducted to confirm a diagnosis of coeliac disease (Figure 2).⁸⁻¹⁰

- ▷ Serology tests, including:
 - total immunoglobulin A (IgA)
 - transglutaminase-IgA (tTG-IgA)
 - tTG-immunoglobulin G (tTG-IgG)
 - deamidated gliadin peptide-IgG (DGP-IgG).

Note that patients should be consuming a gluten-containing diet at the time of testing and serology alone is not sufficient to diagnose coeliac disease.

- ▷ Histology – endoscopic duodenal biopsy. This is done following positive serological test results to confirm coeliac disease. If serology is negative, but there is a high clinical suspicion, further testing is recommended.
- ▷ Genotype testing for human leukocyte antigen (HLA) DQ2 /DQ8. The value of this test is to exclude coeliac disease. A positive result does not confirm diagnosis as approximately half of the Australian population have these genes.¹¹ This test is useful for evaluation of people with discrepant serology and histology, and for individuals where the diagnosis remains in question, such as people on a gluten-free diet with no prior tests.

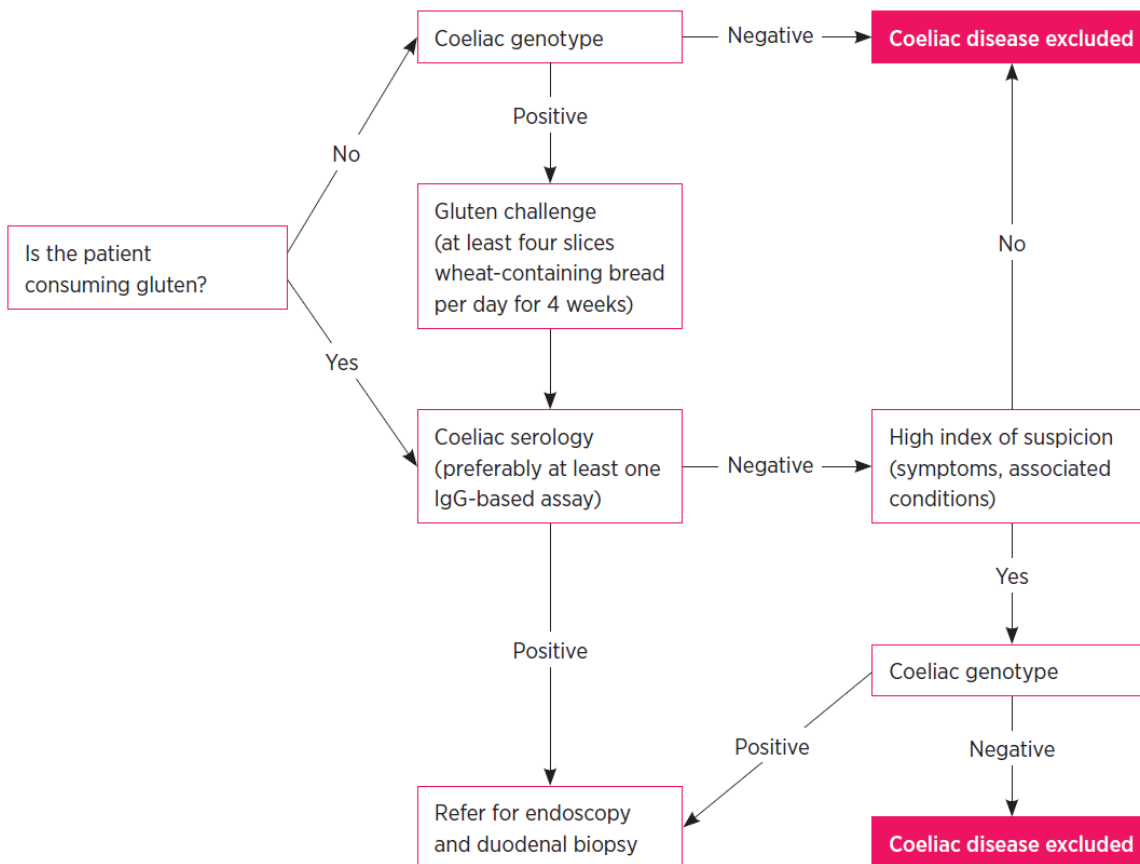


FIGURE 2: DIAGNOSIS OF COELIAC DISEASE

Source: Lewis D, Haridy J, Newnham ED. Testing for coeliac disease. Aust Prescr 2017;40:105-8. <https://www.nps.org.au/australian-prescriber/articles/testing-for-coeliac-disease>

Monitoring and follow-up of coeliac disease

Coeliac disease requires long-term follow-up to maintain health and to prevent occurrence of complications. Upon diagnosis, patients are assessed for associated conditions (eg, type 1 diabetes, thyroid disease, liver disease, nutrient deficiencies and bone density) if clinically relevant. Ongoing reviews are important for disease management, to monitor adherence to the gluten free diet and to check for any nutrient deficiencies. A repeat duodenal biopsy 12–24 months after diagnosis to confirm healing is recommended. However, ongoing biopsies are not required unless indicated by a specialist. Tests recommended for annual review of people with coeliac disease include:^{8,9,12}

- ▷ coeliac serology blood tests (tTG, DGP, total IgA)
- ▷ full blood count
- ▷ electrolytes eg, sodium and potassium
- ▷ liver function tests
- ▷ thyroid function tests
- ▷ fasting or random glucose
- ▷ tests for nutrient deficiencies eg, iron, calcium, phosphate, vitamin D, zinc, vitamin B12, folate, magnesium.

Australians with medically diagnosed coeliac disease are eligible for a Medicare rebate for a bone density scan every 2 years.¹²

Pregnancy-related medical tests

The Australian clinical practice guidelines on pregnancy care provide standardised guidance for all health professionals providing antenatal care in Australia.¹³ However, some obstetric units may have their own care set of tests. A range of clinical assessments are recommended during pregnancy, including:¹³⁻¹⁵

- ▷ full blood count
- ▷ ultrasound scan
- ▷ blood group and rhesus D (RhD) status
- ▷ iron test
- ▷ inherited blood conditions, such as thalassaemia and sickle cell disease
- ▷ certain infections, eg, asymptomatic bacteriuria, chlamydia, hepatitis B virus, HIV, syphilis
- ▷ gestational diabetes – oral glucose tolerant test (OGTT), glucose
- ▷ urine microscopy and culture
- ▷ screening for foetal conditions

The routine tests recommended during pregnancy are presented in Table 3.¹³

Table 3: SUMMARY OF ROUTINE TESTS RECOMMENDED DURING PREGNANCY

Condition	Test(s)	Follow-up/rationale
Anaemia	Haemoglobin concentration	Full blood count and consideration of possible nutrient deficiencies for women with low haemoglobin concentrations
Haemoglobin disorders eg, sickle cell and thalassaemia	Full blood count	Further investigations for women with abnormal red cell indices, family history or origin in a high-risk country
Gestational diabetes	Plasma glucose (fasting or following 75 g glucose loading)	Treatment of gestational diabetes reduces the risk of perinatal complications
HIV**	Enzyme immunoassay (EIA) and Western blot	Antiretroviral treatment in pregnancy reduces risk of transmission
Hepatitis B**	Blood test for HbsAg [†]	Vaccination of newborn reduces risk of infection
Hepatitis C**	Blood test for hepatitis antibody RNA if antibodies detected	Avoiding certain interventions among women who test positive reduces risk of mother-to-child transmission and direct-acting antiviral therapy used postpartum (or post breastfeeding) is highly curative protecting future pregnancies
Syphilis [†]	Treponemal assay confirmed with an alternative treponemal assay	Treatment benefits mother and prevents congenital syphilis
Rubella	Blood test for rubella antibody	Vaccination after birth protects future pregnancies. Inadvertent vaccination in early pregnancy is highly unlikely to harm the baby
Asymptomatic bacteriuria	Midstream urine culture	Treatment reduces risk of pyelonephritis
Group B streptococcus*	Self-collected vaginal-rectal swab culture	Identification of colonisation allows treatment during labour to reduce transmission to the baby

Source: Australian Government Department of Health. Clinical Practice Guidelines: Pregnancy Care. <https://www.health.gov.au/resources/pregnancy-care-guidelines>

EIA=enzyme immunoassay; HbsAg=hepatitis B surface antigen; HIV=human immunodeficiency virus.

Some care sets include varicella screening as well.

* According to organisational policy.

** Specialist care and psychosocial support are required for women with HIV, hepatitis B or hepatitis C.

[†] Psychosocial support, partner testing and contact tracing needed for women with sexually transmitted infections.

Table 4 shows other targeted tests that are recommended for pregnant women identified to be at increased risk.¹³

Table 4: SUMMARY OF TARGETED TESTS RECOMMENDED FOR WOMEN AT INCREASED RISK DURING PREGNANCY

Condition	Test recommended for:	Test(s)	Rationale/follow-up
Chlamydia*	Women younger than 30 years All pregnant women in areas of high prevalence	First pass urine Nucleic acid amplification test (NAAT)	Treatment may reduce the risk of preterm birth, premature rupture of the membranes and low birth weight
Gonorrhoea*	Women with known risk factors or living in areas where prevalence is high	Vaginal, urine or endocervical [†] specimens NAAT	Treatment may prevent neonatal infection
Trichomoniasis*	Women with symptoms	PCR testing of vaginal swabs	Treatment may prevent certain infections in the newborn but is associated with adverse effects
Toxoplasmosis	Women may request testing based on exposure to sources	Studies into tests are limited and inconclusive	Insufficient evidence on treatment. Advice on prevention may reduce the risk of infection
Cytomegalovirus	Women who have frequent contact with large numbers of very young children	Studies into tests are limited and inconclusive	Advice on prevention may reduce the risk of infection; seek expert advice if infection is identified

Condition	Test recommended for:	Test(s)	Rationale/follow-up
Hyperglycaemia	Women with risk factors for hyperglycaemia	Serology (cytomegalovirus-specific IgG HbA _{1c} ** or fasting blood glucose	Hyperglycaemia can be minimised during pregnancy to improve outcomes
Asymptomatic bacterial vaginosis	Women with a previous preterm birth	High vaginal swab Amsel's criteria Nugent's criteria	Early treatment (<20 weeks) may reduce risk of premature rupture of the membranes and low birth weight
Thyroid function	Women with symptoms or risk factors	Blood test for thyroid-stimulating hormone	Treatment improves maternal and newborn outcomes
Vitamin D status	Women considered to be at risk	Blood test for serum 25-OHD	Women at high risk of deficiency may benefit from supplementation
Human papilloma virus	Women who have not had a cervical screen in the recommended time period	Cervical screening test	Allows detection of precancerous cervical abnormalities

Source: Australian Government Department of Health. Clinical Practice Guidelines: Pregnancy Care. <https://www.health.gov.au/resources/pregnancy-care-guidelines>

* Psychosocial support, partner testing and contact tracing are required for women with sexually transmitted infections.

** HbA_{1c} is not recommended for testing for gestational diabetes in the second or third trimester, except in some circumstances, because it is less accurate in these stages of pregnancy.

† Endocervical swab is not usually recommended during pregnancy because of the associated bleeding.

25-OHD=25-hydroxyvitamin D; NAAT=nucleic acid amplification test; PCR=polymerase chain reaction; RNA=ribonucleic acid.

Tests performed during pregnancy can also be performed before pregnancy. These include:

- ▷ cervical screening test
- ▷ human chorionic gonadotropin (HCG), to confirm pregnancy
- ▷ thyroid function tests
- ▷ sexually transmitted disease such as HIV, chlamydia, syphilis, gonorrhoea, herpes
- ▷ genetic tests for haemoglobin disorders eg, sickle cell anaemia and thalassaemia
- ▷ serology – rubella and varicella.

Point-of-care tests

Point of care tests may be performed for monitoring and follow-up of some conditions. For example, monitoring of people with diabetes may be done via a glucose point-of-care finger prick test or glucose test strips. A dipstick test may be used to detect abnormalities in urine. Over-the-counter pregnancy test kits are also used for detection of early pregnancy.

Data for point-of-care tests and tests performed in the hospital or specialist settings are not available in MedicineInsight.

MedicineInsight program

MedicineInsight is a large-scale primary care data set of longitudinal de-identified electronic health records (EHR) in Australia. MedicineInsight was initially established by NPS MedicineWise in 2011, with core funding from the Australian Government Department of Health, to collect general practice data to support quality improvement in Australian primary care and post-market surveillance of medicines. The monthly collation of collected data can be analysed for the purposes of improving patient care, quality improvement and evaluation, performing population health analysis, research and developing health policy.

MedicineInsight utilises third-party data extraction tools which extract, de-identify, encrypt and securely transmit whole-of-practice data from the clinical information systems. Patient level data are de-identified 'at source' meaning patients' personal identifiers such as name, date of birth and address are not extracted by the tool (although year of birth and postcode are extracted, enabling the calculation of age and Socio-Economic Indexes for Areas [SEIFA]). However, each patient is assigned a unique number which allows all the records (clinical, prescription, referral etc) held in the database to be linked to the associated patient number. The process of collecting patient data achieves a data collection that meets the definition of non-identified data in the NHMRC National Statement on Ethical Conduct in Human Research. [chapter 3.2, p.27].

Further information is available online: <https://www.nps.org.au/medicine-insight>

Representativeness

As of March 2020, there were 5199 active GPs participating in the MedicineInsight program representing 14% of the national GP workforce. MedicineInsight has national coverage across all states and territories and remoteness areas. Practices in South Australia are underrepresented and practices in Tasmania are overrepresented, but otherwise the distribution of MedicineInsight practices in each state is similar to the distribution of all practices in each state or territory.

Compared to MBS data, patients in MedicineInsight are representative of the Australian patient population in terms of age and gender. Of the patients in the MedicineInsight cohort, 3.0% had been identified as Aboriginal or Torres Strait Islander people, similar to the 2.9% rate reported in MBS statistics for total GP non-referred attendances.¹⁶

Further information about MedicineInsight is available elsewhere^{16,17} and online:

<https://www.nps.org.au/medicine-insight>.

Ethics approval for MedicineInsight

In December 2017, NPS MedicineWise was granted ethics approval for the standard operations and uses of the MedicineInsight database by NPS MedicineWise. This program approval was given by the Royal Australian College of General Practitioners (RACGP) National Research and Evaluation Ethics Committee (NREEC 17-017).

The use of MedicineInsight data for the purposes of this report was approved on 10 February 2021 by the independent Data Governance Committee (2021–001).

2. AIM AND METHODS

Aim

The aim of this study is to describe the test requests recorded:

- ▷ over a 2-year period among all eligible MedicineInsight patients
- ▷ over a 2-year period among patients with the following chronic conditions:
 - type 2 diabetes
 - chronic kidney disease (CKD)
 - thyroid dysfunction (hypothyroidism and hyperthyroidism)
 - coeliac disease
- ▷ among patients newly diagnosed with coeliac disease, in the 366 days prior to and including the date of first record of coeliac disease in 2019
- ▷ 3 months prior to pregnancy and during pregnancy
- ▷ when the reason for test request includes reference to fatigue or tiredness.

These exploratory data will be used to inform the Diagnostic Imaging and Pathology Branch and the Quality Use of Medicines Branch of the Department of Health about potential medical tests that could be included in a 'care set' for the assessed conditions.

Research questions

The specific research questions are presented in Table 5.

Table 5: LIST OF STUDY OBJECTIVES AND RESEARCH QUESTIONS

Objectives	Questions
1. Explore the most commonly requested tests for all eligible MedicineInsight patients (baseline population)	a. What are the 25 most frequently requested tests (or panel of tests) for all patients over a 2-year period?
	b. On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
	c. What are the 25 most frequently requested tests (or panels of tests) where the reason for request is recorded?
	d. Among the test requests for the baseline population, what are the 25 most commonly requested tests where tiredness or fatigue is recorded as a reason for request?
2. Explore the tests requested for patients identified as having type 2 diabetes	a. What are the 25 most frequently requested tests (or panel of tests) for patients with type 2 diabetes over a 2-year period?
	b. On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
	c. What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to type 2 diabetes?
	d. What is the average Charlson Comorbidity Index score for patients with type 2 diabetes?
3. Explore the tests requested for patients identified as having chronic kidney disease (CKD)	a. What are the 25 most frequently requested tests (or panel of tests) for patients with CKD over a 2-year period?
	b. On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?

Objectives	Questions
	c. What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to CKD?
	d. What is the average Charlson Comorbidity Index score for patients with CKD?
4. Explore the tests requested for patients identified as having thyroid dysfunction	a. What are the 25 most frequently requested tests (or panel of tests) for patients with thyroid dysfunction over a 2-year period?
	b. On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
	c. What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to thyroid dysfunction?
	d. What is the average Charlson Comorbidity Index score for patients with thyroid dysfunction?
5a. Explore the tests requested for patients identified as having existing coeliac disease (diagnosed prior to 2018)	a. What are the 25 most frequently requested tests (or panel of tests) for patients with existing coeliac disease over a 2-year period?
	b. On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
	c. What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to coeliac disease?
	d. What is the average Charlson Comorbidity Index score for patients with existing coeliac disease?
5b. Explore the tests requested for patients identified as having newly diagnosed coeliac disease, in the 366 days prior to and including the date of first record of coeliac disease in 2019	a. What are the 25 most frequently requested tests (or panel of tests) for patients newly diagnosed with coeliac disease, in the 366 days prior to and including the date of first record of coeliac disease in 2019?
	b. On average, how many times are the top 25 tests (or panels of tests) requested in the year prior to diagnosis?
	c. What are the 15 most frequently requested tests (or panels of tests) where the recorded test reason is related to coeliac disease?
6. Explore the tests requested for patients whose date of confinement for a full-term birth (37 to 44 weeks of gestation) was in calendar year 2019	a. What are the 25 most frequently requested tests (or panel of tests), in the 3 months prior to and during pregnancy, for patients who had a full-term birth in 2019?
	b. On average, how many times are the top 25 tests (or panels of tests) requested prior to and during pregnancy?
	c. What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to pregnancy?
	d. What is the average Charlson Comorbidity Index score for pregnant women?

Study design and period

The descriptive analysis was conducted using general practice data from MedicinesInsight for a 2-year period from 1 January 2018 to 31 December 2019 for patients with specified chronic illnesses or pregnancy.

To ensure complete data, only pathology tests with a request date between 1 January 2018 and 31 December 2019 were included. Historical records up until the end of the relevant study period were included when identifying patient demographics, diagnoses and encounter history for patients with newly diagnosed coeliac disease.

Study cohort

General practice sites

De-identified patient data were obtained from 346 general practice sites, including 396 individual general practices, which met the standard data quality criteria in the MedicineInsight December 2020 download. A general practice site is used to describe one or more practices that share the same general practice database, either because they are operating within a common administrative system (eg, the same corporate entity) or in the same geographical area.

The standard data quality criteria applied included:

- ▷ the site had been established for at least 2 years, and
- ▷ had no significant interruptions of longer than 2 months in the 2 years prior to their practice data, and
- ▷ met the minimum threshold of clinical activity of at least 50 patients in the last 2 years.

Patient population

The general study population included patients of all ages who met the following inclusion criteria:

- ▷ visited a practice site that contributed data to MedicineInsight and meets specific data quality requirements
- ▷ had valid information for age (0–112 years as at 1 July 2019) and gender (male or female)
- ▷ regularly attending patients who had at least three clinical encounters during the study period (1 January 2018 to 31 December 2019).

There were a number of sub-populations depending on the study question. Each of these sub-populations had to have met the above criteria plus the relevant criteria below:

- have been diagnosed with type 2 diabetes, CKD, coeliac disease or thyroid dysfunction prior to 1 January 2018
- patients who had a full-term pregnancy (defined as 37 to 44 weeks of gestation) whose date of confinement was in calendar year 2019 (including a pre-conception period of 3 months and up until the birth fell within the study period)
- patients newly diagnosed with coeliac disease in calendar year 2019 and who had at least one clinical encounter in calendar year 2017 (to allow for a 12-month washout period to increase the likelihood that the diagnosis is new).

Definitions

Clinical encounters

Clinical encounters, or any professional exchange between a patient and a healthcare professional, were defined as all encounters at the practice site with a GP or a nurse that were: a) not identified as administrator entries nor encounters that have been transferred/imported from another practice and b)

were not identified by predefined ‘administration-type’ terms found in the ‘reason for encounter’ field such as ‘administrative reasons’, ‘forms’, and ‘recall’*.

Conditions

MedicineInsight ‘condition flags’ were used to identify patients with the specified conditions, type 2 diabetes, CKD, thyroid dysfunction and coeliac disease. The flags identified patients using an algorithm that looks at relevant coded (Docle, Pyefinch) or free text entries in one of the three diagnosis fields – diagnosis, reason for encounter or reason for prescription. For all conditions, except newly diagnosed coeliac disease, the flags included diagnosis entries recorded at any time from the patient’s earliest record up to 31 December 2017 (ie, ever recorded in the medical history). For newly diagnosed coeliac disease, the flag included diagnosis entries recorded between January 2019 and December 2019. The terms used to identify each of the condition flags are shown in Table 6.

Records identified by a free text string alone are not automatically flagged. Instead, a clinical coder reviews the text string to determine whether it refers to the condition or is present in another context (eg, a search for ‘cancer’ may identify ‘partner died from cancer’). Each record is flagged accordingly. Records indicating ‘suspected’, ‘query’ or ‘?’ records of the condition are not flagged as the condition, unless otherwise specified.

Table 6: CLINICAL DEFINITIONS USED TO IDENTIFY SPECIFIED CONDITIONS

Condition/event	Included terms
Type 2/unspecified diabetes	Relevant terms included: diabetes, diabetes (controlled or cortisone induced or unstable), diabetes mellitus, diabetes mellitus (NIDDM, or type ii or type 2 or type 3c), latent autoimmune diabetes of adults, NIDDM, non-insulin dependent diabetes mellitus, pancreatogenic diabetes, t2dm, t11, tii, type two, unstable diabetes
Chronic kidney disease	Relevant terms included: anaemia - chronic renal failure, CAPD, catheterisation of peritoneum, chronic kidney disease or CKD (all stages), chronic renal disease (all stages), chronic renal failure, chronic renal failure – hyperparathyroidism, chronic renal insufficiency, continuous ambulatory peritoneal dialysis, CRF, dialysis, haemodialysis, hemodialysis, peritoneal catheterisation for dialysis, peritoneal dialysis renal dialysis or surgery -abdomen - dialysis - catheterisation
Thyroid dysfunction	Relevant terms included: Graves' disease, hyperthyroid, hyperthyroidism, thyrotoxicosis, hyperthyroid crisis, thyrotoxic storm, hyperthyroidism (borderline or subclinical), hypothyroid, hypothyroidism, hypothyroidism (borderline or Hashimoto's or primary or secondary or subclinical), coma (hypothyroid or myxedema or myxedematous or myxoedemic), myxoedema, thyroid deficiency, underactive thyroid
Coeliac disease	Relevant terms included: coeliac disease, gluten enteropathy, intractable coeliac sprue, refractory sprue, (celiac or ceoliac or coeliac)

The condition groups are not mutually exclusive. Patients with type 2 diabetes may also have CKD or one of the other conditions. This means patients may be included in more than one of the groups.

Patients with the specified conditions are also likely to have other comorbidities and health concerns.

We were not able to identify patients who have exclusively the conditions of interest as not every

* Please note that in this instance, this term denotes that the reason for contact was to ask the patient to return to the practice, and it does not refer to the encounter itself.

single condition has been coded in MedicineInsight. Therefore, it is possible that some tests unrelated to the condition of interest were identified. To assist with interpretation and as **sensitivity analyses**, we:

- ▷ provided information on the average Charlson Comorbidity Index (CCI) score* for patients within each condition group.
- ▷ restricted analyses to the approximately half of test requests with entries in the 'TEST_REASON' field relevant to the specified condition and explored these tests.

Identifying patients who were pregnant

The newly created MedicineInsight pregnancy dataset was used to identify pregnant women. This study included patients who had a full-term birth (defined as 37 to 44 weeks of gestation) recorded between 1 January 2019 and 31 December 2019. This was to ensure that the full period of pregnancy and the 3 months prior were captured in the study period.

Test requests

There are three potential sources of information about pathology tests within the GP clinical information system (CIS):

- ▷ tests requested – these are recorded by the GP using free text or prepopulated menus. However, no information about test results (including collection dates) is recorded;
- ▷ test result summaries (ie, test result headers) – this includes general information about the test results received back from pathology laboratories. It includes the request date and the collection date, but not the individual (atomised) results; and
- ▷ the atomised test result details – each component of a pathology test result, including the result date, is recorded separately (atomised) in this table.

This study utilised **tests requested** (REQUESTED_TESTS) only. The test result summaries (RESULT_NAME) were not used because in feasibility analyses the most common entries were broad descriptors of the general type of test (eg, biochemistry or haematology) – not specific tests (eg, full blood count). The atomised test result detail was not used because the study focused on the types and frequencies of tests ordered, not the results of these tests. In addition, the way some test results are transmitted from pathology laboratories to practices limits the test result summaries and the atomised test results to biochemistry and haematology tests. Other types of tests – microbiological, serological, etc – may be missed.

Classifying test requests

Only tests requested between 1 January 2018 and 31 December 2019 were included in this study. It was necessary to re-classify entries in the 'REQUESTED_TEST' field for this analysis. This is because the 'REQUESTED_TESTS' field often has more than one medical test listed on the same row and

* The CCI is a method of categorising comorbidities of patients based on the International Classification of Diseases (ICD) diagnosis codes found in administrative data, such as general practice data. Each of the 17 different comorbidity classifications are scored on a scale of 1 to 6, based on the adjusted risk of mortality or resource use, and all these scores are added together to give a single comorbidity score for a patient. A score of zero indicates that no comorbidities were found. The higher the score, the greater the burden of comorbidities within that patient.

data are mostly entered as free text. In addition, GPs use variations on a test name when requesting or reporting on a test. For example, a liver function test may be written as LFT.

As there is no standardised classification system for tests in MedicineInsight, a pragmatic approach was used to classify the test requests into relevant groups. A custom system was developed to classify the free text of the most common test requests in the study period, for the patients with each condition of interest, and for the baseline population. Data for test requests, often containing requests for multiple tests, were arranged from the most to the least common. Using SAS algorithms in an iterative process including quality checks, 58 test-request flags were defined. The test-request flag definitions were based on common groupings of request (eg, blood test request for electrolytes, urea, creatinine: the 'EUC' flag) or of individual tests (eg, HbA_{1c}) where appropriate. Requests for isolated tests that were already covered by a common relevant group flag were assigned to that flag (eg, blood test request for 'creatinine' was assigned to the 'EUC' flag). Test requests that had non-specific entries such as 'serology' or 'histology' were grouped broadly as recorded. Although most test-request flags are mutually exclusive, occasionally a single request could be assigned to 2 flags (eg, a request for 'coeliac serology' would be assigned to the flags for 'coeliac test' and for 'serology'). Only about 3% of all the test requests were not classified, mainly reproductive health, microbiology and allergy tests. Detailed information about the test request groups are presented in Appendix 1.

For statistically more robust results, only the 25 most frequent test-request flags, also referred to as 'test/ panel of tests', for each condition recorded in the 2-year period are presented. For patients with newly diagnosed coeliac disease, the most frequent test/panel of tests recorded in the 366 days prior to and including the date of first record of coeliac disease in 2019 are presented. For pregnant women, we report the most frequent test/panel of tests recorded in the 3 months prior to pregnancy and during full-term pregnancy (defined as 37 to 44 weeks of gestation) recorded in 2019.

For the **sensitivity analyses**, where the analyses were limited to test requests where the test reason is relevant to the specified condition (type 2 diabetes, CKD, thyroid dysfunction, coeliac disease, pregnancy), we also presented the top 25 most frequent tests/panels of tests. For example, for type 2 diabetes, test requests where the reason for the test was recorded as type 2 diabetes (or other relevant terms) were identified and the top 25 tests among these are presented.

Fatigue or tiredness is a common presentation in general practice and more than two-thirds of patients presented with this problem in the 2015–16 Bettering the Evaluation and Care of Health (BEACH) study.¹⁸ As fatigue and tiredness are symptoms, not diagnoses, a different approach was used to identify test requests associated with these symptoms. We identified test requests for patients in the baseline population where 'fatigue' or 'tiredness' were recorded in the 'TEST_REASON' field. Although almost half of the test requests do not have a reason for request recorded, this is a reasonable approach to identify tests that are being ordered for the specific purpose of investigating these symptoms.

Data analysis

Analysis of the data was conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Measures included are descriptive statistics, frequencies, proportions and means, as appropriate. To indicate the reliability of the estimates of proportions, 95% confidence intervals (CI) were included as

needed. Non-overlap of 95% CIs (adjusted for clustering by practice site) determine if there are significant differences between groups when appropriate.

If a particular result was only reported in 1–4 patients, this result has been reported as < 5 in order to preserve the privacy of individuals (with the exception of missing variables).

3. BASELINE STUDY POPULATION

- ▷ The baseline population comprised 1,703,338 regular patients.
- ▷ 6,067,329 test requests (of any kind) were recorded for these patients in the 2-year study period, an average of 3.6 test requests per patient.
- ▷ Of all the test requests, 31.6% included a request for full blood count (FBC), 30.5% for electrolytes, urea and creatinine (EUC), 28.7% for liver function tests (LFT), 18.1% for thyroid function tests (TFT) and 16.9% for lipids.
- ▷ On average, 1.1 FBC tests were requested per patient in the 2-year period, 1.1 EUC, 1.0 LFT, 0.6 TFT and lipids, each.
- ▷ Among the 3,270,695 test requests with a recorded reason for test (53.9% of all test requests), 28.5% were for FBC, 27.4% EUC and 25.8% LFT.
- ▷ Of the 78,197 test requests (for 65,733 patients in the baseline population) where fatigue or tiredness was recorded as the test reason, 84.9% included a request for FBC, 76.7% for EUC, 74.5% for LFT, 73.1% for TFT and 71.7% for iron tests (including iron, ferritin, transferrin, total iron binding capacity).

Study questions

- ▷ What are the 25 most frequently requested tests (or panel of tests) for all patients over a 2-year period?
- ▷ On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
- ▷ What are the 25 most frequently requested tests (or panels of tests) where the reason for request is recorded?
- ▷ What are the 25 most commonly requested tests (or panels of tests) among the baseline population where tiredness or fatigue is recorded as a reason for request?

Baseline study population and sub-populations

The baseline population comprised 1,703,338 regular patients. Of these:

- ▷ 90,252 patients (5.3%) were identified as having type 2 diabetes prior to January 2018
- ▷ 17,635 patients (1.0%) had a record of CKD
- ▷ 67,078 patients (3.9%) had thyroid dysfunction
- ▷ 6,939 patients (0.4%) had existing coeliac disease and 582 patients (0.03%) were newly diagnosed with coeliac disease in 2019
- ▷ and 11,933 patients (0.7%) had a full-term delivery recorded in 2019 (Figure 3).

The sociodemographic characteristics of the baseline population and the sub-populations are presented in Appendix 2.

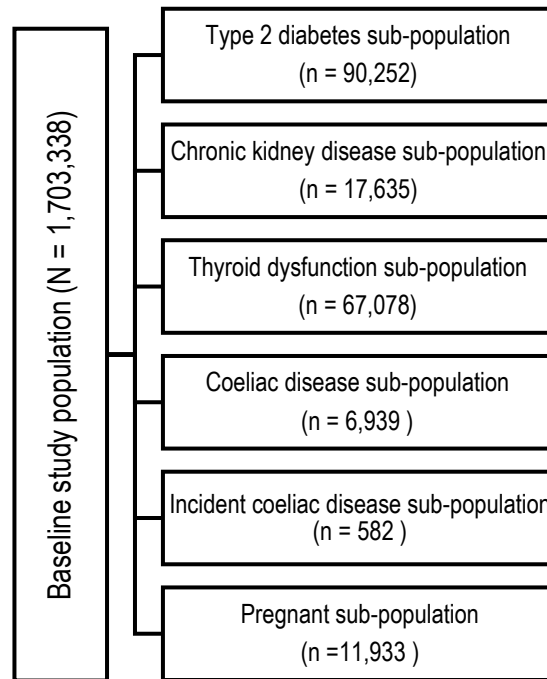


FIGURE 3. BASELINE STUDY POPULATION AND SUB-POPULATIONS

Sub-populations are not mutually exclusive. A patient with both type 2 diabetes and chronic kidney disease would be included in both groups.

Test requests for baseline population

For better interpretation and to understand the test requests for the specified conditions, we have reported on the data for the baseline population. This population includes all regularly attending patients, regardless of whether they have one of the selected conditions or not. There were 6,067,329 test requests recorded for the 1.7 million patients in the baseline population in the 2-year period, an average of 3.6 tests per patient.

Commonly recorded tests and average number of tests per patient

Table 7 shows the top 25 frequently requested tests/panel of tests among patients in the baseline population in the 2-year study from January 2018 to December 2019. Of the 6,067,329 test requests, 31.6% included tests for FBC, 30.5% for EUC, 28.7% for LFT, 18.1% for TFT and 16.9% for lipids (including total cholesterol, LDL, HDL and triglyceride).

On average, 1.13 FBC tests were requested per patient in the baseline population in the 2-year period, 1.09 EUC, 1.02 LFT, 0.64 TFT, and 0.60 tests for lipids (Table 7).

Table 7: COMMONLY RECORDED TESTS AMONG TEST REQUESTS FOR PATIENTS IN THE BASELINE POPULATION AND AVERAGE NUMBER OF TESTS PER PATIENT, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 6,067,329 test requests**)		Average number of tests per patient (95% CI) (N = 1,703,338 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Full blood count	1,919,002	31.63 (31.14–32.11)	1.13 (1.08–1.17)
2	Electrolytes, urea and creatinine	1,849,062	30.48 (29.88–31.07)	1.09 (1.04–1.13)
3	Liver function tests	1,742,496	28.72 (28.07–29.37)	1.02 (0.98–1.07)
4	Thyroid function tests	1,095,590	18.06 (17.48–18.63)	0.64 (0.62–0.67)
5	Lipids	1,022,384	16.85 (16.31–17.39)	0.60 (0.57–0.63)
6	Iron	947,663	15.62 (14.94–16.30)	0.56 (0.53–0.59)
7	Ultrasound	854,354	14.08 (13.58–14.58)	0.50 (0.47–0.53)
8	Glucose	812,274	13.39 (12.44–14.34)	0.48 (0.44–0.51)
9	ESR and CRP	674,087	11.11 (10.58–11.65)	0.40 (0.37–0.42)
10	HbA _{1c}	603,171	9.94 (9.42–10.46)	0.35 (0.33–0.38)
11	X-ray	593,656	9.78 (9.50–10.07)	0.35 (0.33–0.37)
12	Non-urine MCS	528,370	8.71 (8.26–9.16)	0.31 (0.29–0.33)
13	Vitamin B12 and folate	513,044	8.46 (7.84–9.07)	0.30 (0.28–0.32)
14	Urine MCS	494,825	8.16 (7.84–8.47)	0.29 (0.28–0.30)
15	Vitamin D	380,341	6.27 (5.68–6.85)	0.22 (0.20–0.24)
16	Calcium, magnesium and phosphate	255,509	4.21 (3.76–4.66)	0.15 (0.13–0.17)
17	Histology	247,230	4.07 (3.58–4.57)	0.15 (0.13–0.16)
18	Urine ACR or albumin	237,783	3.92 (3.62–4.22)	0.14 (0.13–0.15)
19	Computed tomography	236,746	3.90 (3.74–4.06)	0.14 (0.13–0.15)
20	Serology	226,323	3.73 (3.43–4.03)	0.13 (0.12–0.14)
21	Cervical	210,247	3.47 (3.31–3.62)	0.12 (0.12–0.13)
22	Prostate-specific antigen	195,012	3.21 (3.03–3.40)	0.11 (0.11–0.12)
23	Urate	98,569	1.62 (1.28–1.97)	0.06 (0.05–0.07)
24	MRI	95,981	1.58 (1.50–1.66)	0.06 (0.05–0.06)
25	HCG (blood)	76,090	1.25 (1.14–1.37)	0.04 (0.04–0.05)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different tests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 387,227 patients (22.7%) with no test requests in the 2-year study period.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; HCG, human chorionic gonadotropin; MCS, microscopy, culture and sensitivity; MRI, magnetic resonance imaging.

Commonly requested tests among those with a recorded reason for test

Of the 6,067,329 test requests for the baseline population, 3,270,695 tests (53.9%) had a recorded reason for the test,* attributed to 835,840 patients. Among the test requests with the reason for test available, 28.5% were for FBC, 27.4% EUC, 25.8% LFT, 16.9% ultrasound scan and 16.4% for TFT (Table 8). Although almost half of the test requests do not have a reason for request recorded, these findings are consistent with those from the analysis of all the test requests as shown in Table 7.

* This includes any entry recorded in the 'TEST_REASON' field.

Table 8: COMMONLY REQUESTED TESTS AMONG TESTS WITH A RECORDED REASON IN THE BASELINE POPULATION, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/ panel of tests*	Tests with a recorded reason (N = 3,270,695 test requests**)	
		Number of test	% of all tests with a recorded reason (95% CI)
1	Full blood count	932,393	28.51 (27.82–29.19)
2	Electrolytes, urea and creatinine	895,558	27.38 (26.62–28.14)
3	Liver function tests	844,343	25.82 (25.02–26.61)
4	Ultrasound	551,813	16.87 (16.13–17.61)
5	Thyroid function tests	537,439	16.43 (15.77–17.10)
6	Lipids	481,940	14.74 (14.07–15.40)
7	Iron	459,270	14.04 (13.29–14.79)
8	Glucose	393,796	12.04 (10.89–13.19)
9	X-ray	387,821	11.86 (11.42–12.29)
10	ESR and CRP	317,365	9.70 (9.16–10.24)
11	HbA _{1c}	289,624	8.86 (8.20–9.51)
12	Non-urine MCS	264,529	8.09 (7.67–8.51)
13	Vitamin B12 and folate	247,526	7.57 (6.89–8.24)
14	Urine MCS	240,778	7.36 (7.04–7.68)
15	Vitamin D	190,886	5.84 (5.18–6.49)
16	Computed tomography	154,345	4.72 (4.48–4.96)
17	Calcium, magnesium and phosphate	129,023	3.94 (3.45–4.44)
18	Histology	128,786	3.94 (3.38–4.49)
19	Urine ACR or albumin	113,516	3.47 (3.12–3.82)
20	Cervical	112,146	3.43 (3.21–3.65)
21	Serology	106,071	3.24 (2.97–3.52)
22	Prostate-specific antigen	89,881	2.75 (2.53–2.96)
23	MRI	63,533	1.94 (1.83–2.06)
24	Urate	50,980	1.56 (1.14–1.97)
25	Densitometry	40,117	1.23 (1.11–1.34)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity; MRI, magnetic resonance imaging.

Charlson Comorbidity Index score for baseline population

The mean CCI score for patients in the baseline population was 0.5 and the median was nil, which indicates a low comorbidity burden (Table 9).

Table 9: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS IN THE BASELINE POPULATION

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	1,703,338	0.54 (0.52–0.57)	0.00 (0.00–0.35)

Test requests where fatigue or tiredness was recorded as a reason for the test

Of the 3,270,695 test requests in the 2-year period with a reason for the test available, fatigue or tiredness was recorded for 78,197 test requests (for 65,733 patients).

The Royal College of Pathologists of Australasia (RCPA) recommends a number of investigations in determining the underlying cause of fatigue, including FBC, LFT, EUC, thyroid stimulating hormone (part of TFT) and C-reactive protein.¹⁹ In this study, among test requests where fatigue or tiredness was recorded as the test reason, 84.9% included a request for FBC, 76.7% for EUC, 74.5% for LFT, 73.1% for TFT and 71.7% for iron tests (including iron, ferritin, transferrin, TIBC) (Table 10).

Table 10: COMMONLY REQUESTED TESTS AMONG TEST REQUESTS FOR THE BASELINE POPULATION WHERE FATIGUE OR TIREDNESS WAS RECORDED AS THE REASON, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Tests with fatigue/tiredness as reason for test request (N = 78,197 test requests**)	
		Number of tests with fatigue/tiredness as the reason for test	% of all tests with fatigue/tiredness as reason for test
1	Full blood count	66,432	84.95 (83.97–85.94)
2	Electrolytes, urea and creatinine	60,010	76.74 (75.27–78.21)
3	Liver function tests	58,257	74.50 (72.65–76.35)
4	Thyroid function tests	57,124	73.05 (71.51–74.59)
5	Iron	56,092	71.73 (69.64–73.82)
6	Vitamin B12 and folate	35,689	45.64 (42.84–48.44)
7	ESR and CRP	28,507	36.46 (34.49–38.42)
8	Glucose	26,046	33.31 (29.32–37.30)
9	Lipids	23,418	29.95 (26.99–32.91)
10	Vitamin D	19,025	24.33 (21.23–27.43)
11	HbA _{1c}	11,448	14.64 (12.68–16.60)
12	Calcium, magnesium and phosphate	9,220	11.79 (10.27–13.31)
13	Serology	6,776	8.67 (7.76–9.57)
14	Urine MCS	3,994	5.11 (4.49–5.72)
15	Coeliac test	3,043	3.89 (3.38–4.41)
16	Urate	2,632	3.37 (0.74–5.99)
17	Creatinine kinase and troponin	2,177	2.78 (0.94–4.63)
18	Prostate-specific antigen	2,005	2.56 (2.04–3.08)
19	Non-urine MCS	1,989	2.54 (2.16–2.92)
20	Testosterone	1,953	2.50 (2.10–2.90)
21	Urine ACR or albumin	1,578	2.02 (1.54–2.50)
22	X-ray	1,308	1.67 (1.48–1.87)
23	HCG (blood)	1,194	1.53 (1.32–1.73)
24	Ultrasound	1,174	1.50 (1.31–1.70)
25	Progesterone	1,009	1.29 (1.00–1.58)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; HCG, human chorionic gonadotropin; MCS, microscopy, culture and sensitivity.

4. TYPE 2 DIABETES

- ▶ Among the 90,252 patients with type 2 diabetes, of the 631,205 test requests, the most frequently recorded in the test request field during the 2-year period were EUC (42.7% of test requests had at least 1 EUC recorded), HbA_{1c} (38.3%), LFT (35.0%), FBC (35.1%) and lipids (25.6%).
- ▶ On average, during the 2-year period for a patient with type 2 diabetes, about 3.0 EUC, 2.7 HbA_{1c}, 2.5 LFT, 2.5 FBC and 1.8 lipid test requests were recorded.
- ▶ The mean CCI score of 2.4 for patients with type 2 diabetes indicates a higher comorbidity burden than the baseline population (0.5), suggesting that some tests may have been requested for co-existing conditions other than type 2 diabetes.
- ▶ In a sensitivity analysis, we restricted the analysis to test requests where the test reason related to type 2 diabetes (n=113,183). Of these test requests, 85.8% included a request for HbA_{1c}, 72.0% for EUC, 62.0% for LFT, 55.5% for FBC and 52.8% for lipids.

Study questions

- ▶ What are the 25 most frequently requested tests (or panel of tests) for patients with type 2 diabetes over a 2-year period?
- ▶ On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
- ▶ What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to type 2 diabetes?
- ▶ What is the average Charlson Comorbidity Index (CCI) score for patients with type 2 diabetes?

Test requests for patients with type 2 diabetes

There were 631,205 test requests (of any kind) recorded for 90,252 patients with type 2 diabetes in the 2-year study period, on average about 7.0 test requests per patient.

Commonly recorded tests and average number of tests per patient

Table 11 shows the top 25 frequently requested tests in the 2-year period among patients identified as having type 2 diabetes prior to January 2018. The tests (or panel of tests) that were most frequently recorded in the test request field were EUC (42.7% of test requests had at least 1 EUC recorded), HbA_{1c} (38.3%), LFT (35.0%), FBC (35.1%) and lipids (25.6%). Most of these tests are consistent with tests recommended for management of type 2 diabetes by the RACGP¹ and RCPA.²⁰ However, as patients with type 2 diabetes may have other comorbidities, as indicated by the comorbidity index score (mean: 2.4; Table 12), some of the tests may have been requested for other co-existing conditions and not necessarily for diabetes.

On average, for a patient with type 2 diabetes during the 2-year period, about 3.0 EUC, 2.7 HbA_{1c}, 2.5 LFT, 2.5 FBC and 1.8 lipid test requests were recorded (Table 11).

Table 11: COMMONLY RECORDED TEST REQUESTS FOR PATIENTS WITH TYPE 2 DIABETES AND AVERAGE NUMBER OF TESTS PER PATIENT, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 631,205 test requests**)		Average number of tests per patient (95% CI) (N = 90,252 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Electrolytes, urea and creatinine	269,473	42.69 (41.56–43.82)	2.99 (2.84–3.13)
2	HbA _{1c}	242,022	38.34 (37.31–39.38)	2.68 (2.56–2.80)
3	Liver function tests	229,133	36.30 (34.95–37.65)	2.54 (2.41–2.67)
4	Full blood count	221,391	35.07 (33.90–36.25)	2.45 (2.34–2.57)
5	Lipids	161,412	25.57 (24.38–26.77)	1.79 (1.69–1.89)
6	Urine ACR or albumin	110,937	17.58 (16.42–18.73)	1.23 (1.14–1.32)
7	Glucose	101,237	16.04 (14.30–17.78)	1.12 (1.00–1.25)
8	Thyroid function tests	91,582	14.51 (13.72–15.29)	1.01 (0.96–1.07)
9	Iron	72,707	11.52 (10.86–12.18)	0.81 (0.75–0.86)
10	ESR and CRP	63,897	10.12 (9.36–10.88)	0.71 (0.65–0.77)
11	Ultrasound	62,963	9.98 (9.59–10.36)	0.70 (0.66–0.73)
12	X-ray	53,901	8.54 (8.28–8.80)	0.60 (0.57–0.62)
13	Vitamin B12 and folate	49,536	7.85 (7.17–8.52)	0.55 (0.50–0.60)
14	Urine MCS	47,236	7.48 (7.04–7.93)	0.52 (0.49–0.56)
15	Vitamin D	31,969	5.06 (4.49–5.64)	0.35 (0.31–0.39)
16	Calcium, magnesium and phosphate	28,792	4.56 (3.96–5.16)	0.32 (0.28–0.36)
17	Non-urine MCS	27,659	4.38 (4.18–4.59)	0.31 (0.29–0.32)
18	Computed tomography	26,449	4.19 (4.03–4.35)	0.29 (0.28–0.31)
19	Histology	25,008	3.96 (3.56–4.36)	0.28 (0.25–0.31)
20	Prostate-specific antigen	24,903	3.95 (3.68–4.21)	0.28 (0.26–0.30)
21	Diabetes screen	12,868	2.04 (1.15–2.93)	0.14 (0.08–0.21)
22	Urate	12,190	1.93 (1.51–2.35)	0.14 (0.11–0.16)
23	Creatinine kinase and troponin	10,606	1.68 (1.25–2.11)	0.12 (0.09–0.15)
24	Coagulation	7,399	1.17 (1.02–1.32)	0.08 (0.07–0.09)
25	Faecal occult blood	7,350	1.16 (1.07–1.26)	0.08 (0.07–0.09)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different tests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 8,664 patients (9.6%) with no test requests of any kind in the 2-year study period.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

Charlson Comorbidity Index score for patients with type 2 diabetes

On average, patients who were identified as having type 2 diabetes prior to 1 January 2018, had a higher comorbidity burden (2.4) compared to the baseline population (0.5) (Table 12). This makes it more likely that some tests may have been requested for co-existing conditions and not necessarily for diabetes.

Table 12: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS WITH TYPE 2 DIABETES

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	90,252	2.39 (2.35–2.44)	1.46 (0.66–2.66)

Commonly requested tests where the test reason is related to type 2 diabetes

There were 113,183 test requests (for 37,320 patients with diabetes) where the reason for the test was relevant to type 2 diabetes. Of these test requests, 85.8% included a request for HbA_{1c} while 72.0% included a request for EUC, 62.0% for LFT, 55.5% for FBC and 52.8% for lipids (Table 13). While findings from this sensitivity analysis (Table 13) may provide a better indication of the tests requested for patients with type 2 diabetes compared to those for the primary analysis (Table 11), these results should be interpreted with caution as almost half of the test requests do not have a reason for request recorded. However, the top 5 frequently recorded tests for the sensitivity analysis are consistent with those for the primary analysis, with slight changes in the frequency order.

Table 13: COMMONLY REQUESTED TESTS FOR PATIENTS WITH TYPE 2 DIABETES WHERE THE TEST REASON IS RELATED TO TYPE 2 DIABETES, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Tests with the recorded reason related to type 2 diabetes (N = 113,183 test requests**)	
		Number of tests with reason related to diabetes	% of all tests with reason related to diabetes (95% CI)
1	HbA _{1c}	97,094	85.79 (84.26–87.31)
2	Electrolytes, urea and creatinine	81,465	71.98 (69.20–74.75)
3	Liver function tests	70,162	61.99 (58.55–65.43)
4	Full blood count	62,862	55.54 (51.61–59.47)
5	Lipids	59,766	52.80 (48.91–56.70)
6	Urine ACR or albumin	45,597	40.29 (37.58–42.99)
7	Glucose	37,437	33.08 (27.69–38.46)
8	Thyroid function tests	25,019	22.10 (19.77–24.44)
9	Iron	17,305	15.29 (13.53–17.05)
10	Vitamin B12 and folate	13,752	12.15 (10.29–14.01)
11	ESR and CRP	11,183	9.88 (8.13–11.63)
12	Vitamin D	10,234	9.04 (7.25–10.83)
13	Calcium, magnesium and phosphate	7,585	6.70 (4.90–8.51)
14	Prostate-specific antigen	6,862	6.06 (5.36–6.76)
15	Diabetes screen	5,914	5.23 (2.49–7.96)
16	Urine MCS	4,395	3.88 (2.85–4.92)
17	Creatinine kinase and troponin	4,034	3.56 (1.73–5.40)
18	Urate	3,496	3.09 (2.02–4.16)
19	Ultrasound	1,774	1.57 (1.36–1.78)
20	Multiple biochemical analysis	1,691	1.49 (0.36–2.63)
21	Electrocardiogram	997	0.88 (0.41–1.35)
22	Non-urine MCS	941	0.83 (0.67–0.99)
23	X-ray	747	0.66 (0.52–0.80)
24	Computed tomography	688	0.61 (0.50–0.71)
25	Parathyroid hormone	648	0.57 (0.27–0.87)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

Our results show that although the recorded reason for the test request was relevant to type 2 diabetes, a number of the tests are not related to type 2 diabetes monitoring. Given that a test request can have multiple different tests listed, it is possible that type 2 diabetes could have been the main reason for the GP visit and was recorded as the reason for the test request although the request included tests for other different conditions or investigations not related to type 2 diabetes.

5. CHRONIC KIDNEY DISEASE

- ▷ Of the 131,061 tests that were recorded for the 17,635 patients with CKD (any stage) during the 2-year period, the most frequently recorded tests were EUC (42.3% had at least 1 EUC recorded), FBC (34.3%), LFT (31.9%), HbA_{1c} (15.8%) and lipids (15.5%).
- ▷ The average number of recorded test requests in the 2-year period for a patient with CKD was 3.1 for EUC, 2.6 FBC, 2.4 LFT, 1.2 HbA_{1c} and 1.2 for lipid tests.
- ▷ Patients with CKD had on average a higher comorbidity burden (4.0) than the baseline population (0.5), an indication that some tests may have been requested for co-existing conditions other than CKD.
- ▷ Among the 8,006 test requests for 3,538 patients with CKD where the test reason related to CKD, 74.5% included a request for EUC, 51.5% FBC, 47.8% LFT, 19.2% urine albumin creatinine ratio (ACR) and 19.2% iron tests.

Study questions

- ▷ What are the 25 most frequently requested tests (or panel of tests) for patients with CKD over a 2-year period?
- ▷ On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
- ▷ What are the 25 most frequently requested tests (or panels of tests) where the test reason is related to CKD?
- ▷ What is the average Charlson Comorbidity Index score for patients with CKD?

Test requests for patients with chronic kidney disease

There were 131,061 test requests (of any kind) recorded for 17,635 patients with CKD in the 2-year period which, on average, is equivalent to 7.4 tests per patient.

Commonly recorded tests and average number of tests per patient

For people with mild CKD, Kidney Health Australia guidelines recommend eGFR, urine ACR, biochemical profile including UEC, lipids, and HbA_{1c} (for patient with diabetes) testing at least annually.³ As the condition progresses, additional tests and increased testing frequency are performed.

Among all the test requests for patients with CKD (any stage) in the 2-year period, 42.3% included a request for EUC, 34.3% FBC, 31.9% LFT, 15.8% HbA_{1c} and 15.5% for lipids (Table 14). As the mean CCI score of 4.0 for patients with CKD suggests a high comorbidity burden (Table 15), it is likely that some of the tests may have been requested for other co-existing conditions and not necessarily for CKD.

The average number of recorded test requests in the 2-year period for a patient with CKD was 3.1 for EUC, 2.6 FBC, 2.4 LFT, 1.2 HbA_{1c} and 1.2 for lipids (Table 14).

Table 14: COMMONLY RECORDED TEST REQUESTS FOR PATIENTS WITH CKD AND AVERAGE NUMBER OF TESTS PER PATIENT, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 131,061 test requests**)		Average number of tests per patient (95% CI) (N = 17,635 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Electrolytes, urea and creatinine	55,418	42.28 (41.13–43.44)	3.14 (2.96–3.33)
2	Full blood count	44,947	34.29 (33.23–35.36)	2.55 (2.40–2.70)
3	Liver function tests	41,814	31.90 (30.19–33.62)	2.37 (2.20–2.55)
4	HbA _{1c}	20,698	15.79 (14.93–16.66)	1.17 (1.10–1.25)
5	Lipids	20,340	15.52 (14.54–16.49)	1.15 (1.07–1.24)
6	Thyroid function tests	17,591	13.42 (12.39–14.45)	1.00 (0.92–1.08)
7	Iron	15,983	12.20 (11.47–12.92)	0.91 (0.84–0.97)
8	Glucose	15,474	11.81 (10.43–13.18)	0.88 (0.77–0.98)
9	ESR and CRP	14,748	11.25 (10.34–12.17)	0.84 (0.75–0.92)
10	Urine ACR or albumin	13,339	10.18 (9.15–11.20)	0.76 (0.68–0.83)
11	Urine MCS	12,335	9.41 (8.78–10.04)	0.70 (0.65–0.75)
12	Ultrasound	12,280	9.37 (8.82–9.92)	0.70 (0.64–0.75)
13	X-ray	11,984	9.14 (8.88–9.41)	0.68 (0.64–0.72)
14	Vitamin B12 and folate	9,286	7.09 (6.39–7.78)	0.53 (0.47–0.58)
15	Calcium, magnesium and phosphate	9,220	7.03 (6.24–7.83)	0.52 (0.46–0.59)
16	Vitamin D	7,157	5.46 (4.85–6.07)	0.41 (0.36–0.45)
17	Histology	6,966	5.32 (4.65–5.98)	0.40 (0.34–0.45)
18	Non-urine MCS	6,227	4.75 (4.42–5.08)	0.35 (0.32–0.38)
19	Computed tomography	5,748	4.39 (4.17–4.60)	0.33 (0.30–0.35)
20	Prostate-specific antigen	4,101	3.13 (2.84–3.41)	0.23 (0.21–0.25)
21	Coagulation	3,195	2.44 (2.04–2.84)	0.18 (0.15–0.21)
22	Urate	3,149	2.40 (1.94–2.87)	0.18 (0.14–0.21)
23	Densitometry	2,176	1.66 (1.50–1.82)	0.12 (0.11–0.14)
24	Parathyroid hormone	1,923	1.47 (1.19–1.74)	0.11 (0.09–0.13)
25	Creatinine kinase and troponin	1,581	1.21 (0.98–1.43)	0.09 (0.07–0.11)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different tests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 1,886 patients (10.7%) with no test requests of any kind in the 2-year study.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

Charlson Comorbidity Index score for patients with CKD

The mean CCI score for patients who had a record of CKD (4.0) prior to 1 January 2018 was higher than the baseline population (0.5) (Table 15), which reflects a higher comorbidity burden for patients with CKD than the baseline population.

Table 15: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS WITH CKD

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	17,635	3.99 (3.93–4.04)	3.17 (2.17–4.41)

Commonly requested tests where the test reason is related to CKD

There were 8,006 test requests for 3,538 patients with CKD where the test reason related to CKD.

Among these test requests, the most frequently recorded tests were EUC (74.5% had at least 1 EUC recorded), followed by FBC (51.5%), LFT (47.8%), urine ACR (19.2%) and iron (19.2%) (Table 16).

While the frequently recorded tests in this sensitivity analysis (Table 16) are mostly consistent with those for the primary analysis (Table 14), it is important to note that almost half of the test requests do not have a reason for request recorded.

Table 16: COMMONLY REQUESTED TESTS FOR PATIENTS WITH CKD WHERE THE TEST REASON IS RELATED TO CKD, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Tests with the recorded reason related to CKD (N = 8,006 test requests**)	
		Number of tests with reason related to CKD	% of all tests with reason related to CKD (95% CI)
1	Electrolytes, urea and creatinine	5,968	74.54 (72.49–76.60)
2	Full blood count	4,121	51.47 (48.76–54.19)
3	Liver function tests	3,829	47.83 (43.42–52.23)
4	Urine ACR or albumin	1,537	19.20 (16.98–21.41)
5	Iron	1,366	17.06 (15.27–18.85)
6	Lipids	1,344	16.79 (14.70–18.87)
7	Calcium, magnesium and phosphate	1,198	14.96 (12.17–17.76)
8	HbA _{1c}	1,175	14.68 (13.00–16.36)
9	Thyroid function tests	1,111	13.88 (12.26–15.50)
10	Glucose	1,079	13.48 (10.71–16.24)
11	ESR and CRP	934	11.67 (9.96–13.37)
12	Ultrasound	665	8.31 (7.39–9.22)
13	Vitamin D	638	7.97 (6.26–9.68)
14	Urine MCS	620	7.74 (6.57–8.92)
15	Vitamin B12 and folate	613	7.66 (6.09–9.23)
16	Parathyroid hormone	451	5.63 (4.00–7.27)
17	Urate	399	4.98 (3.59–6.37)
18	Computed tomography	291	3.63 (3.09–4.18)
19	Prostate-specific antigen	232	2.90 (2.29–3.50)
20	Coagulation	148	1.85 (1.31–2.39)
21	X-ray	141	1.76 (1.27–2.25)
22	Densitometry	114	1.42 (1.09–1.75)
23	Multiple biochemical analysis	105	1.31 (0.08–2.54)
24	Creatinine kinase and troponin	87	1.09 (0.67–1.50)
25	Non-urine MCS	49	0.61 (0.42–0.80)

*Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

6. THYROID DYSFUNCTION

- ▷ Of the 442,107 tests for 67,078 patients with thyroid dysfunction during the 2-year period, the most frequently recorded test request fields were TFT (33.4% had at least 1 TFT recorded), EUC (31.5%), FBC (31.5%), LFT (28.8%) and lipids (16.7%).
- ▷ During the 2-year period, patients with thyroid dysfunction had on average 2.2 test requests for TFT, 2.1 EUC, 2.1 FBC and 1.9 LFT.
- ▷ The mean CCI score for patients who had a record of thyroid dysfunction was 1.1 while that for the baseline population was 0.5, which suggests that some of the tests may have been requested for co-existing conditions other than thyroid dysfunction.
- ▷ Of the 52,818 test requests for 23,170 patients with thyroid dysfunction where the test reason was relevant to thyroid dysfunction, the majority included a request for TFT (92.2%), followed by FBC (49.5%), EUC (48.5%), LFT (46.0%) and lipids (28.9%).

Study questions

- ▷ What are the 25 most frequently requested tests (or panel of tests) for patients with thyroid dysfunction over a 2-year period?
- ▷ On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
- ▷ What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to thyroid dysfunction?
- ▷ What is the average Charlson Comorbidity Index score for patients with thyroid dysfunction?

Test requests for patients with thyroid dysfunction

Over the 2-year period, 442,107 test requests (of any kind) were recorded for 67,078 patients with thyroid dysfunction, an average of 6.6 test requests per patient.

Commonly recorded tests and average number of tests per patient

Consistent with the guidelines,⁵⁻⁷ TFT (33.4% of test requests had at least 1 TFT recorded), which includes TSH, T3 and T4, was the test /panel of tests most recorded for patients with thyroid dysfunction (Table 17). Other tests frequently recorded in the test request field were EUC (31.5%), FBC (31.5%), LFT (28.8%) and lipids (16.7%). As the mean comorbidity index score suggests (Table 18), some tests may have been requested for co-existing conditions other than thyroid dysfunction.

During the 2-year period, patients with thyroid dysfunction had, on average, a record of 2.2 test requests for TFT, 2.1 EUC, 2.1 FBC and 1.9 LFT (Table 17).

Table 17: COMMONLY RECORDED TEST REQUESTS FOR PATIENTS WITH THYROID DYSFUNCTION AND AVERAGE NUMBER OF TESTS PER PATIENT, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 442,107 test requests**)		Average number of tests per patient (95% CI) (N = 67,078 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Thyroid function tests	147,530	33.37 (32.77–33.97)	2.20 (2.13–2.27)
2	Electrolytes, urea and creatinine	139,423	31.54 (30.80–32.28)	2.08 (2.00–2.16)
3	Full blood count	139,406	31.53 (30.90–32.17)	2.08 (2.01–2.15)
4	Liver function tests	127,195	28.77 (27.89–29.65)	1.90 (1.81–1.98)
5	Lipids	74,021	16.74 (16.14–17.35)	1.10 (1.05–1.15)
6	Iron	64,715	14.64 (13.96–15.31)	0.96 (0.91–1.02)
7	Glucose	55,597	12.58 (11.60–13.55)	0.83 (0.76–0.89)
8	Ultrasound	54,926	12.42 (11.98–12.86)	0.82 (0.78–0.86)
9	ESR and CRP	47,661	10.78 (10.19–11.37)	0.71 (0.67–0.76)
10	HbA _{1c}	44,659	10.10 (9.58–10.63)	0.67 (0.63–0.70)
11	X-ray	39,448	8.92 (8.67–9.17)	0.59 (0.56–0.61)
12	Vitamin B12 and folate	36,473	8.25 (7.69–8.81)	0.54 (0.50–0.59)
13	Urine MCS	32,168	7.28 (6.99–7.57)	0.48 (0.46–0.50)
14	Vitamin D	29,495	6.67 (6.11–7.23)	0.44 (0.40–0.48)
15	Non-urine MCS	22,511	5.09 (4.87–5.31)	0.34 (0.32–0.35)
16	Calcium, magnesium and phosphate	21,327	4.82 (4.30–5.35)	0.32 (0.28–0.35)
17	Urine ACR or albumin	17,918	4.05 (3.72–4.39)	0.27 (0.24–0.29)
18	Computed tomography	17,562	3.97 (3.81–4.14)	0.26 (0.25–0.28)
19	Cervical	15,090	3.41 (3.24–3.59)	0.22 (0.21–0.24)
20	Histology	14,550	3.29 (2.99–3.59)	0.22 (0.19–0.24)
21	Serology	8,430	1.91 (1.76–2.06)	0.13 (0.12–0.14)
22	Densitometry	6,919	1.57 (1.46–1.67)	0.10 (0.10–0.11)
23	Urate	6,122	1.38 (1.02–1.75)	0.09 (0.07–0.12)
24	Prostate-specific antigen	5,889	1.33 (1.24–1.42)	0.09 (0.08–0.09)
25	MRI	5,067	1.15 (1.08–1.21)	0.08 (0.07–0.08)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different tests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 5,630 patients (8.4%) with no test requests of any kind in the 2-year study period

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity; MRI, magnetic resonance imaging.

Charlson Comorbidity Index score for patients with thyroid dysfunction

The mean CCI score for patients who had a record of thyroid dysfunction prior to 1 January 2018 was 1.1 while that for the baseline population was 0.5 (Table 18), which indicates a higher comorbidity burden for patients with thyroid dysfunction than the baseline population.

Table 18: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS WITH THYROID DYSFUNCTION

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	67,078	1.05 (1.02–1.09)	0.09 (0.00–1.06)

Commonly requested tests where the test reason is related to thyroid dysfunction

There were 52,818 test requests recorded for 23,170 patients with thyroid dysfunction with the reason for test relevant to thyroid dysfunction. As expected, most of the test requests where the reason was relevant to thyroid dysfunction included TFT (92.2% had at least 1 TFT recorded) (Table 19). As already mentioned, almost half of the test requests do not have a reason for test recorded. The top 7 frequently recorded tests/ panel of tests in this sensitivity analysis (Table 19) are similar to those of the primary analysis (Table 17).

Table 19: COMMONLY REQUESTED TESTS FOR PATIENTS WITH THYROID DYSFUNCTION WHERE THE TEST REASON IS RELATED TO THYROID DYSFUNCTION, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Tests with the recorded reason related to thyroid dysfunction (N = 52,818 test requests**)	
		Number of tests with reason related to thyroid dysfunction	% of all tests with reason related to thyroid dysfunction (95% CI)
1	Thyroid function tests	48,670	92.15 (91.46–92.83)
2	Full blood count	26,160	49.53 (47.50–51.55)
3	Electrolytes, urea and creatinine	25,640	48.54 (46.53–50.56)
4	Liver function tests	24,275	45.96 (43.66–48.26)
5	Lipids	15,275	28.92 (27.40–30.44)
6	Iron	12,214	23.12 (21.37–24.88)
7	Glucose	11,126	21.06 (18.64–23.49)
8	Vitamin B12 and folate	6,913	13.09 (11.71–14.46)
9	HbA _{1c}	6,669	12.63 (11.56–13.69)
10	ESR and CRP	6,133	11.61 (10.50–12.72)
11	Vitamin D	5,970	11.30 (9.96–12.64)
12	Calcium, magnesium and phosphate	3,836	7.26 (5.97–8.55)
13	Urine ACR or albumin	2,047	3.88 (3.30–4.46)
14	Ultrasound	1,892	3.58 (3.19–3.98)
15	Urate	996	1.89 (1.17–2.61)
16	Prostate-specific antigen	886	1.68 (1.46–1.89)
17	Urine MCS	824	1.56 (1.17–1.95)
18	Serology	776	1.47 (1.24–1.70)
19	Creatinine kinase and troponin	756	1.43 (1.05–1.82)
20	Parathyroid hormone	634	1.20 (0.96–1.45)
21	Densitometry	504	0.95 (0.82–1.09)
22	Multiple biochemical analysis	425	0.80 (0.22–1.39)
23	Coeliac test	413	0.78 (0.60–0.96)
24	Progesterone	357	0.68 (0.33–1.02)
25	Testosterone	311	0.59 (0.30–0.88)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

7. COELIAC DISEASE

- ▶ Among 6,939 patients with existing coeliac disease during the 2-year period, of the 37,410 tests the most frequently recorded test requests were for FBC (32.2% had at least 1 FBC recorded), EUC (29.7%), LFT (28.3%), TFT (20.6%) and iron (19.7%)
- ▶ The mean number of test requests per patient with existing coeliac disease over the 2-year period was 1.7 for FBC, 1.6 EUC, 1.5 LFT, 1.1 TFT and 1.1 for iron tests.
- ▶ The mean CCI score for patients with existing coeliac disease (0.7) was slightly higher than that for the baseline population (0.5).
- ▶ Of the 1,978 test requests for 1,215 patients with existing coeliac disease where the test reason related to coeliac disease, the most frequently recorded test requests included FBC (66.3%), followed by iron (59.9%), LFT (56.4%), EUC (54.3%) and vitamin B12 or folate (47.5%).
- ▶ Among 582 patients newly diagnosed with coeliac disease, of the 1,952 test requests, the most frequent test requests in the 366 days prior to and including the date of first record of coeliac disease were FBC (37.4% had at least 1 FBC recorded), EUC (30.6%), iron (30.1%), LFT (30.1%) and TFT (22.3%).
- ▶ The mean number of test requests for patients with newly diagnosed coeliac disease, in the year prior to and including the date of first record of diagnosis, was 1.3 for FBC, 1.0 EUC, 1.0 iron, 1.0 LFT and 0.8 for TFT.
- ▶ Of the 128 test requests for 103 patients with newly diagnosed coeliac disease where the test reason related to coeliac disease, the most frequently recorded tests included iron (55.5%), FBC (52.3%) and coeliac tests (51.6%).

Study questions

- ▶ What are the 25 most frequently requested tests (or panel of tests) for patients with existing coeliac disease (diagnosed prior to January 2018) over a 2-year period?
- ▶ On average, how many times are the top 25 tests (or panels of tests) requested over a 2-year period?
- ▶ What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to coeliac disease?
- ▶ What is the average Charlson Comorbidity Index score for patients with existing coeliac disease?
- ▶ What are the 25 most frequently requested tests (or panel of tests) for patients newly diagnosed with coeliac disease, in the 366 days prior to and including the date of first record of coeliac disease in 2019?
- ▶ On average, how many times are the top 25 tests (or panels of tests) requested in the year prior to diagnosis?
- ▶ Among newly diagnosed patients, what are the 15 most frequently requested tests (or panels of tests) where the recorded test reason is related to coeliac disease?

Test requests for patients with existing coeliac disease

There were 37,410 test requests (of any kind) recorded for 6,939 patients with existing coeliac disease (diagnosed prior to January 2018) in the 2-year period, an average of 5.4 tests per patient.

Commonly recorded tests and average number of tests per patient

Several tests are recommended for annual review of people with coeliac disease including coeliac serology tests, FBC, EUC, TFT, LFT, and tests for nutrient deficiencies such as iron, calcium, phosphate, vitamin D, zinc, vitamin B12, folate and magnesium.^{8,9,12}

Our findings indicate that among patients with existing coeliac disease, the tests/panel of tests that were most frequently recorded in the test request field during the 2-year period were FBC (32.2% had at least 1 FBC recorded), EUC (29.7%), LFT (28.3%), TFT (20.6%) and iron (19.7%) (Table 20).

Although the mean CCI score for a patient with existing coeliac disease (Table 21) was slightly higher than that for the baseline population, it is possible that some tests may have been requested for co-existing conditions other than coeliac disease.

Table 20: COMMONLY RECORDED TEST REQUESTS FOR PATIENTS WITH EXISTING COELIAC DISEASE AND AVERAGE NUMBER OF TESTS PER PATIENT, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 37,410 test requests**)		Average number of tests per patient (95% CI) (N = 6,939 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Full blood count	12,035	32.17 (31.34–33.01)	1.73 (1.65–1.81)
2	Electrolytes, urea and creatinine	11,125	29.74 (28.76–30.72)	1.60 (1.52–1.69)
3	Liver function tests	10,580	28.28 (27.27–29.29)	1.52 (1.44–1.61)
4	Thyroid function tests	7,687	20.55 (19.79–21.31)	1.11 (1.05–1.17)
5	Iron	7,355	19.66 (18.79–20.53)	1.06 (1.00–1.12)
6	Ultrasound	5,099	13.63 (12.99–14.27)	0.73 (0.69–0.78)
7	Lipids	5,095	13.62 (12.95–14.29)	0.73 (0.69–0.78)
8	Vitamin B12 and folate	4,613	12.33 (11.63–13.04)	0.66 (0.62–0.71)
9	ESR and CRP	4,587	12.26 (11.54–12.98)	0.66 (0.61–0.71)
10	Glucose	4,305	11.51 (10.51–12.51)	0.62 (0.56–0.68)
11	X-ray	3,523	9.42 (9.01–9.83)	0.51 (0.48–0.54)
12	Vitamin D	3,011	8.05 (7.40–8.69)	0.43 (0.40–0.47)
13	Non-urine MCS	2,818	7.53 (7.06–8.01)	0.41 (0.38–0.44)
14	HbA _{1c}	2,794	7.47 (6.82–8.12)	0.40 (0.36–0.44)
15	Urine MCS	2,733	7.31 (6.84–7.77)	0.39 (0.37–0.42)
16	Calcium, magnesium and phosphate	2,066	5.52 (4.92–6.13)	0.30 (0.26–0.33)
17	Serology	1,992	5.32 (4.65–6.00)	0.29 (0.25–0.32)
18	Coeliac test	1,839	4.92 (4.27–5.56)	0.27 (0.23–0.30)
19	Cervical	1,622	4.34 (4.04–4.63)	0.23 (0.22–0.25)
20	Computed tomography	1,358	3.63 (3.36–3.90)	0.20 (0.18–0.21)
21	Histology	1,217	3.25 (2.89–3.61)	0.18 (0.15–0.20)
22	Urine ACR or albumin	981	2.62 (2.32–2.92)	0.14 (0.12–0.16)
23	Densitometry	919	2.46 (2.23–2.68)	0.13 (0.12–0.15)
24	MRI	633	1.69 (1.52–1.86)	0.09 (0.08–0.10)
25	Prostate-specific antigen	617	1.65 (1.44–1.86)	0.09 (0.08–0.10)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 803 patients (11.6%) with no test requests of any kind in the 2-year study period.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity; MRI, magnetic resonance imaging.

The mean number of test requests per patient with existing coeliac disease over the 2-year period was 1.7 for FBC, 1.6 EUC, 1.5 LFT, 1.1 TFT and 1.1 iron tests (Table 20).

Charlson Comorbidity Index score for patients with existing coeliac disease

The mean CCI score, a measure of the comorbidity burden, for a patient with existing coeliac disease (0.7) was slightly higher than that for the baseline population (0.5) (Table 21).

Table 21: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS WITH COELIAC DISEASE

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	6,939	0.73 (0.69–0.77)	0.00 (0.00–0.68)

Commonly requested tests where the test reason is related to coeliac disease

There were 1,978 test requests (for 1,215 patients with existing coeliac disease) where the reason for the test related to coeliac disease. The top five commonly recorded tests/panel of tests where the reason for the test request related to coeliac disease included FBC (66.3% of test requests had at least 1 FBC recorded), iron (59.9%), LFT (56.4%), EUC (54.3%) and vitamin B12 or folate (47.5%) (Table 22). These findings should be interpreted with caution because almost half of the test requests do not have a reason for test recorded.

Table 22: COMMONLY REQUESTED TESTS FOR PATIENTS WITH EXISTING COELIAC DISEASE WHERE THE TEST REASON IS RELATED TO COELIAC DISEASE, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test (or panel of tests)*	Tests with the recorded reason related to coeliac disease (N = 1,978 test requests**)	
		Number of tests with the reason related to coeliac disease	% of all tests with reason related to coeliac disease (95% CI)
1	Full blood count	1,311	66.28 (63.42–69.14)
2	Iron	1,184	59.86 (56.42–63.30)
3	Liver function tests	1,115	56.37 (53.42–59.32)
4	Electrolytes, urea and creatinine	1,073	54.25 (50.52–57.97)
5	Vitamin B12 and folate	940	47.52 (43.93–51.11)
6	Thyroid function tests	898	45.40 (42.17–48.63)
7	Coeliac test	767	38.78 (34.50–43.06)
8	Vitamin D	596	30.13 (26.33–33.93)
9	Glucose	480	24.27 (20.65–27.89)
10	Lipids	465	23.51 (20.81–26.21)
11	Serology	462	23.36 (17.51–29.20)
12	ESR and CRP	437	22.09 (19.16–25.02)
13	Calcium, magnesium and phosphate	297	15.02 (11.65–18.38)
14	Densitometry	265	13.40 (11.70–15.09)
15	HbA _{1c}	210	10.62 (7.89–13.34)
16	Urine ACR or albumin	53	2.68 (1.55–3.81)
17	Ultrasound	41	2.07 (1.34–2.80)
18	Urine MCS	40	2.02 (0.97–3.07)

Descending frequency order	Test (or panel of tests)*	Tests with the recorded reason related to coeliac disease (N = 1,978 test requests**)	
		Number of tests with the reason related to coeliac disease	% of all tests with reason related to coeliac disease (95% CI)
19	Non-urine MCS	38	1.92 (1.22–2.62)
20	Prostate-specific antigen	38	1.92 (1.24–2.61)
21	Parathyroid hormone	32	1.62 (0.94–2.29)
22	Urate	32	1.62 (0.61–2.63)
23	Lipase	27	1.37 (0.86–1.87)
24	Creatinine kinase and troponin	23	1.16 (0.53–1.79)
25	Computed tomography	23	1.16 (0.60–1.73)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA1c, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA1c, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

Test requests for patients newly diagnosed with coeliac disease in 2019

For the 582 patients newly diagnosed with coeliac disease, 1,952 test requests (of any kind) were recorded in the 366 days prior to and including the date of first recorded coeliac disease diagnosis in 2019. This equates to an average of 3.4 tests per patient.

Commonly recorded tests and average number of tests per patient

Several investigations are conducted to confirm a diagnosis of coeliac disease such as coeliac serological tests, genotype test (HLA DQ2 /DQ8) and histology (small bowel biopsy).⁸⁻¹⁰

Table 23 shows the top 25 frequently requested tests/panel of tests for patients newly diagnosed with coeliac disease, recorded in the 366 days prior to and including the date of first record of coeliac disease. The tests that were commonly recorded in the test request field were FBC (37.4% had at least 1 FBC recorded), EUC (30.6%), iron (30.1%), LFT (30.1%) and TFT (22.3%).

The mean number of test requests for patients newly diagnosed with coeliac disease, recorded in the 366 days prior to and including the date of first record of diagnosis, was 1.3 for FBC, 1.0 EUC, 1.0 iron, 1.0 LFT and 0.8 for TFT (Table 23).

Table 23: COMMONLY RECORDED TEST REQUESTS IN THE 366 DAYS PRIOR TO AND INCLUDING THE DAY OF BEING NEWLY DIAGNOSED WITH COELIAC DISEASE IN 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 1,952 test requests**)		Average number of tests per patient in the 366 days up to and including the date of first recorded coeliac disease diagnosis in 2019 (95% CI) (N = 582 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Full blood count	730	37.40 (35.27–39.53)	1.25 (1.16–1.35)
2	Electrolytes, urea and creatinine	597	30.58 (28.27–32.90)	1.03 (0.94–1.12)
3	Iron	587	30.07 (27.50–32.64)	1.01 (0.92–1.10)
4	Liver function tests	587	30.07 (27.75–32.39)	1.01 (0.92–1.10)
5	Thyroid function tests	436	22.34 (20.34–24.33)	0.75 (0.66–0.84)

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 1,952 test requests**)		Average number of tests per patient in the 366 days up to and including the date of first recorded coeliac disease diagnosis in 2019 (95% CI) (N = 582 patients†)
		Number of tests	% of all test requests (95% CI)	
6	ESR and CRP	307	15.73 (13.83–17.62)	0.53 (0.46–0.59)
7	Vitamin B12 and folate	295	15.11 (13.24–16.98)	0.51 (0.43–0.58)
8	Coeliac test	291	14.91 (12.78–17.04)	0.50 (0.43–0.57)
9	Ultrasound	235	12.04 (10.30–13.78)	0.40 (0.33–0.48)
10	Glucose	226	11.58 (9.92–13.24)	0.39 (0.32–0.45)
11	Serology	225	11.53 (9.39–13.67)	0.39 (0.31–0.46)
12	Lipids	203	10.40 (8.87–11.93)	0.35 (0.29–0.41)
13	Non-urine MCS	180	9.22 (7.68–10.76)	0.31 (0.25–0.36)
14	Vitamin D	174	8.91 (7.41–10.42)	0.30 (0.25–0.35)
15	X-ray	151	7.74 (6.39–9.08)	0.26 (0.21–0.31)
16	Urine MCS	145	7.43 (5.97–8.88)	0.25 (0.19–0.31)
17	HbA _{1c}	110	5.64 (4.54–6.73)	0.19 (0.15–0.23)
18	Calcium, magnesium and phosphate	108	5.53 (4.05–7.01)	0.19 (0.13–0.24)
19	Cervical	70	3.59 (2.80–4.37)	0.12 (0.09–0.15)
20	Helicobacter pylori	43	2.20 (1.51–2.90)	0.07 (0.05–0.10)
21	Densitometry	41	2.10 (1.44–2.77)	0.07 (0.05–0.09)
22	Histology	40	2.05 (1.25–2.85)	0.07 (0.04–0.10)
23	Computed tomography	37	1.90 (1.27–2.52)	0.06 (0.04–0.08)
24	Urine ACR or albumin	35	1.79 (1.04–2.55)	0.06 (0.03–0.09)
25	Faecal occult blood	32	1.64 (1.03–2.25)	0.05 (0.03–0.08)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 82 (14.1%) patients with newly diagnosed coeliac disease who had no test-request of any type in the 366 days prior to and including the date of first recorded coeliac diagnosis in 2019.

ACR, albumin creatinine ratio; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; MCS, microscopy, culture and sensitivity.

Commonly requested tests for patients newly diagnosed with coeliac disease where the test reason is related to coeliac disease

There were only 128 test requests for 103 patients with newly diagnosed coeliac disease where the reason for the test related to coeliac disease. Because of the small number of test requests, and for statistical robustness of the results, we present the top 15 commonly recorded tests/panel of tests where the reason for the test request related to coeliac disease (Table 24). Of these test requests, the most frequently recorded tests included iron (55.5%), FBC (52.3%) and coeliac tests (51.6%).

However, these findings should be interpreted with caution because almost half of the test requests do not have a reason for test recorded.

Table 24: COMMONLY REQUESTED TESTS FOR PATIENTS NEWLY DIAGNOSED WITH COELIAC DISEASE WHERE THE TEST IS RELATED TO COELIAC DISEASE

Descending frequency order	Test/panel of tests*	Tests with the recorded reason related to coeliac disease (N = 128 test requests**)	
		Number of tests with the reason related to coeliac disease	% of all tests with reason related to coeliac disease (95% CI)
1	Iron	71	55.47 (46.22–64.72)
2	Full blood count	67	52.34 (43.58–61.11)
3	Coeliac test	66	51.56 (43.16–59.97)
4	Electrolytes, urea and creatinine	56	43.75 (34.67–52.83)
5	Liver function tests	55	42.97 (33.31–52.63)
6	Vitamin B12 and folate	49	38.28 (29.58–46.99)
7	Serology	40	31.25 (22.33–40.17)
8	Thyroid function tests	32	25.00 (17.13–32.87)
9	Vitamin D	25	19.53 (12.67–26.40)
10	ESR and CRP	22	17.19 (9.96–24.41)
11	Densitometry	14	10.94 (5.93–15.95)
12	Glucose	14	10.94 (5.73–16.14)
13	Calcium, magnesium and phosphate	13	10.16 (2.89–17.43)
14	Lipids	12	9.38 (4.46–14.29)
15	HbA _{1c}	5	3.91 (0.47–7.34)

*Tests are not necessarily mutually exclusive (eg, coeliac serology could be assigned to coeliac test and serology groups). Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.
CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin.

8. PREGNANCY

- ▶ The commonly recorded test/panel of test requests in the 3 months prior to and during pregnancy* for 11,933 patients who had a full-term birth included ultrasound scan (32.5% had at least 1 ultrasound recorded), FBC (27.5%), iron (18.1%), urine microscopy, culture and sensitivity (MCS) (14.9%), TFT (12.9%).
- ▶ The mean number of test requests recorded in the 3 months prior to and during pregnancy for patients who had a full-term birth in 2019 was 1.9 for ultrasound scan, 1.6 FBC, 1.1 iron, 0.9 urine MCS and 0.8 for TFT.
- ▶ Among the 27,916 test requests for 6,743 patients who had a full-term birth in 2019 where the test reason was related to pregnancy, the most frequently recorded tests were ultrasound scan (43.7% had at least 1 ultrasound recorded), FBC (25.8%), iron (17.0%), first trimester scan (12.5%) and urine MCS (11.6%).
- ▶ Patients who had a full-term delivery in 2019 (0.2) had a lower comorbidity burden than the baseline population (0.5).

Study questions

- ▶ What are the 25 most frequently requested tests (or panel of tests), in the 3 months prior to and during pregnancy, for patients who had a full-term birth in 2019?
- ▶ On average, how many times are the top 25 tests (or panels of tests) requested prior to and during pregnancy?
- ▶ What are the 25 most frequently requested tests (or panels of tests) where the recorded test reason is related to pregnancy?
- ▶ What is the average Charlson Comorbidity Index score for pregnant women?

Test requests for patients who had a full-term birth in 2019

For the 11,933 patients who had a full-term birth (37 to 44 weeks of gestation) in 2019, 70,934 test requests (of any kind) were recorded in the 3 months prior to and during pregnancy. This on average equates to 5.9 tests per person in the year prior to birth.

Commonly recorded tests and average number of tests per person

The commonly recorded test requests in the 3 months prior to and during pregnancy for patients who had a full-term birth in 2019 included ultrasound scan (32.5% had at least 1 ultrasound recorded), FBC (27.5%), iron (18.1%), urine microscopy, culture and sensitivity (MCS) (14.9%), TFT (12.9%) (Table 25). The majority of the recorded test requests are consistent with the national clinical practice guidelines for pregnancy care.¹³

The mean number of test requests for patients who had a full-term birth in 2019, in the 3 months prior to pregnancy and during pregnancy, was 1.9 for ultrasound scan, 1.6 FBC, 1.1 iron, 0.9 urine MCS and 0.8 for TFT (Table 25).

* More precisely, this period is the 366 days up to and including the date of confinement for patients who had a full-term birth (37 to 44 weeks of gestation).

Table 25: COMMONLY RECORDED TEST REQUESTS IN THE 3 MONTHS PRIOR TO AND DURING PREGNANCY FOR PATIENTS WHO HAD A FULL-TERM BIRTH IN 2019

Descending frequency order	Test/panel of tests*	Frequency of recorded test requests (N = 70,934 test requests**)		Average number of tests per patient in the 366 days up to and including the date of confinement in 2019 (N = 11,933 patients†)
		Number of tests	% of all test requests (95% CI)	
1	Ultrasound	23,045	32.49 (30.78–34.19)	1.93 (1.79–2.07)
2	Full blood count	19,508	27.50 (26.11–28.89)	1.63 (1.50–1.77)
3	Iron	12,858	18.13 (16.59–19.66)	1.08 (0.95–1.20)
4	Urine MCS	10,542	14.86 (13.93–15.79)	0.88 (0.83–0.94)
5	Thyroid function tests	9,153	12.90 (11.99–13.81)	0.77 (0.70–0.83)
6	First trimester scan	7,994	11.27 (10.36–12.18)	0.67 (0.61–0.73)
7	Glucose	7,755	10.93 (10.04–11.83)	0.65 (0.58–0.72)
8	Electrolytes, urea and creatinine	7,737	10.91 (9.96–11.85)	0.65 (0.59–0.71)
9	Serology	7,622	10.75 (9.77–11.72)	0.64 (0.58–0.69)
10	Liver function tests	7,486	10.55 (9.58–11.52)	0.63 (0.57–0.69)
11	Blood group	7,163	10.10 (9.06–11.14)	0.60 (0.54–0.66)
12	HCG (blood)	7,093	10.00 (9.05–10.95)	0.59 (0.55–0.64)
13	Non-urine MCS	4,508	6.36 (5.67–7.04)	0.38 (0.33–0.43)
14	Vitamin D	4,423	6.24 (5.01–7.46)	0.37 (0.29–0.45)
15	Vitamin B12 and folate	2,702	3.81 (3.18–4.44)	0.23 (0.19–0.27)
16	Morphology scan	2,371	3.34 (2.44–4.25)	0.20 (0.14–0.26)
17	ESR and CRP	1,690	2.38 (2.08–2.69)	0.14 (0.12–0.16)
18	Maternal screen	1,595	2.25 (1.64–2.85)	0.13 (0.10–0.17)
19	Cervical	1,202	1.69 (1.48–1.90)	0.10 (0.09–0.11)
20	HbA _{1c}	920	1.30 (1.12–1.48)	0.08 (0.07–0.09)
21	Lipids	688	0.97 (0.78–1.16)	0.06 (0.05–0.07)
22	Progesterone	627	0.88 (0.70–1.07)	0.05 (0.04–0.06)
23	Low vaginal swab	610	0.86 (0.39–1.33)	0.05 (0.02–0.08)
24	NIPT	540	0.76 (0.55–0.98)	0.05 (0.03–0.06)
25	Urate	515	0.73 (0.44–1.02)	0.04 (0.02–0.06)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different tests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

†Includes 1,072 (9.0%) patients who had no test-request of any type in the 366 days up to and including the date of confinement in 2019.

CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; HCG, human chorionic gonadotropin; MCS, microscopy, culture and sensitivity; NIPT, non-invasive prenatal test.

Charlson Comorbidity Index score for patients who had a full-term birth

Compared with the baseline population (0.5), patients who had a full-term delivery in 2019 (0.2) had a lower comorbidity burden (Table 26).

Table 26: CHARLSON COMORBIDITY INDEX SCORE FOR PATIENTS WHO HAD A FULL-TERM BIRTH IN 2019

	N	Mean (95% CI)	Median (Q1, Q3)
Charlson Comorbidity Index score	11,933	0.19 (0.18–0.20)	0.00 (0.00–0.00)

Commonly requested tests where the test reason relates to pregnancy

There were 27,916 test requests for 6,743 patients with a full-term birth in 2019 where the reason for the test was relevant to pregnancy. Of these test requests, the tests most frequently included in the test requests were ultrasound scan (43.7%), FBC (25.8%), iron (17.0%), first trimester scan* (12.5%) and urine MCS (11.6%) (Table 27). These findings may provide a better indication of the tests requested for during pregnancy. However, the findings should be interpreted with caution as almost half of the test requests do not have a reason for request recorded.

Table 27: COMMONLY REQUESTED TESTS FOR PATIENTS WHO HAD A FULL-TERM BIRTH IN 2019 WHERE THE TEST REASON IS RELATED TO PREGNANCY, 1 JANUARY 2018–31 DECEMBER 2019

Descending frequency order	Test/panel of tests*	Tests with reason related to pregnancy (N = 27,916 test requests**)	
		Number of tests with the reason related to pregnancy	% of all tests with reason related to pregnancy
1	Ultrasound	12,189	43.66 (40.06–47.26)
2	Full blood count	7,194	25.77 (23.45–28.09)
3	Iron	4,741	16.98 (14.30–19.67)
4	First trimester scan	3,502	12.54 (11.13–13.96)
5	Urine MCS	3,241	11.61 (10.31–12.91)
6	Thyroid function tests	3,233	11.58 (10.20–12.96)
7	Glucose	3,084	11.05 (9.75–12.35)
8	Serology	3,014	10.80 (9.51–12.08)
9	Blood group	2,816	10.09 (8.69–11.48)
10	HCG (blood)	2,535	9.08 (7.76–10.41)
11	Electrolytes, urea and creatinine	2,483	8.89 (7.69–10.10)
12	Liver function tests	2,398	8.59 (7.38–9.80)
13	Vitamin D	1,678	6.01 (4.67–7.35)
14	Non-urine MCS	1,117	4.00 (2.99–5.02)
15	Morphology scan	996	3.57 (2.82–4.32)
16	Vitamin B12 and folate	933	3.34 (2.49–4.19)
17	Maternal screen	809	2.90 (1.91–3.89)
18	ESR and CRP	371	1.33 (1.07–1.59)
19	HbA _{1c}	294	1.05 (0.80–1.30)
20	Cervical	221	0.79 (0.58–1.01)
21	Urate	193	0.69 (0.28–1.10)
22	NIPT	178	0.64 (0.46–0.81)
23	Low vaginal swab	167	0.60 (0.18–1.02)
24	Lipids	152	0.54 (0.35–0.74)
25	Progesterone	150	0.54 (0.36–0.71)

* Detailed definitions of the test (or panel of tests) groups are provided in Appendix 1.

**Each test request record may consist of multiple different test requests, eg, one single record may contain HbA_{1c}, UEC, LFT and FBC, that the GP ordered for the patient on that date. Therefore, the sum of the percentages exceeds 100.

CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; HbA_{1c}, glycated haemoglobin; HCG, human chorionic gonadotropin; MCS, microscopy, culture and sensitivity; NIPT, non-invasive prenatal test.

* Includes scans/tests performed during the first trimester eg, nuchal translucency (NT) scan, pregnancy-associated plasma protein A (PAPP A), antenatal scan, down syndrome, obstetric scan, viability scan, early pregnancy scan

GUIDE TO INTERPRETING THE DATA

When interpreting the information presented in this report, readers should note the following caveats and/or assumptions related to the MedicineInsight data.

- ▷ MedicineInsight data are dependent on the accuracy and completeness of data recorded in, and available for extraction from, the general practice clinical systems.
- ▷ Identification of conditions is dependent on GPs recording these items in their clinical software systems. Conditions may be underreported in MedicineInsight data depending on GPs' recording practices.
- ▷ Information on procedures, diagnoses and medical tests from non-MedicineInsight practices and specialist / hospital settings aren't necessarily available to MedicineInsight, depending on GPs' recording practices. Information from other settings provided to GPs in PDF format (such as discharge summaries, letters, faxes etc) are not extracted by MedicineInsight. Therefore, conditions that are managed in specialist or hospital settings, may not be fully captured in general practice datasets potentially leading to an underestimate of the true proportion of patients with these conditions and the medical tests.
- ▷ Medical tests or medical imaging requested at non-MedicineInsight practices or by specialists may not be routinely available to MedicineInsight.
- ▷ Medical tests for patients with specific conditions may have been requested for other co-existing conditions and not necessarily for the specified condition.
- ▷ While findings from the sensitivity analyses (limited to test requests where the test reason is relevant to the specified condition/event) may provide a better indication of the tests requested for patients with the specified condition/event compared to those for the primary analysis (that included all test requests), these results should be interpreted with caution as almost half of the test requests do not have a reason for request recorded. Similarly, findings about the test requests where fatigue or tiredness was recorded as the reason for test should be interpreted cautiously.
- ▷ The CCI score may have been an overestimate because it was based on data for the 2-year study period (1 January 2018 to 31 December 2019) whereas patients with specified conditions were included if the diagnosis was prior to January 2018.
- ▷ Calculation of the relative proportion of different indications assumes that non-recording of conditions occurs at random.
- ▷ Practices were recruited to MedicineInsight using non-random sampling, and systematic sampling differences between regions cannot be ruled out. Comparisons between regions should be interpreted with caution.
- ▷ Due to confidentiality issues we do not have access to progress notes, which may contain further information on symptoms, family history, reasons for encounters and diagnoses.
- ▷ Patients are free to visit multiple other practices. We do not have data on patients from non-MedicineInsight clinics. Currently we cannot identify patients who have attended multiple MedicineInsight practices.

Future directions

Future research may look at:

- ▷ including data from other settings, such as specialist care and hospitals, to provide a more complete picture of tests requested.
- ▷ assessing tests requested for patients with other conditions such as cardiovascular disease, pulmonary conditions or communicable conditions.
- ▷ comparison studies with other countries, as more information on this topic becomes available.

GLOSSARY

Abbreviation	Definition
25-OHD	25-hydroxyvitamin D
ABS	Australian Bureau of Statistics
ACR	Urine albumin-to-creatinine ratio – a measure of kidney function
BEACH	Bettering the Evaluation and Care of Health
CCI	Charlson Comorbidity Index – a measure of comorbidity burden
CI	Confidence interval
CIS	Clinical information system
CKD	Chronic kidney disease
CK	Creatinine kinase
CRP	C-reactive protein, a marker of inflammation
CT	Computed tomography
DGP	Deamidated gliadin peptide
DOH	Department of Health
EHR	Electronic health record
eGFR	Estimated glomerular filtration rate – a measure of kidney function
EIA	Enzyme immunoassay
ESR	Erythrocyte sedimentation rate
FBC	Full blood count
FOB	Faecal occult blood
GP	General practitioner
HbA _{1c}	Glycated haemoglobin – a measure of the average of blood glucose levels during the previous 2 to 3 months
HbsAg	Hepatitis B surface antigen
HCG	Human chorionic gonadotropin
HDL	High-density lipoprotein cholesterol
HIV	Human immunodeficiency virus
HLA	Human leukocyte antigen
IgA	Immunoglobulin A
IgG	Immunoglobulin G
IRSAD	ABS Index of Relative Socioeconomic Advantage and Disadvantage
LDL	Low-density lipoprotein cholesterol
LFT	Liver function test(s)
MBS	Medical Benefits Schedule
MCS	Microscopy, culture and sensitivity
MRI	Magnetic resonance imaging
NAAT	Nucleic acid amplification test
NHMRC	National Health and Medical Research Council

Abbreviation	Definition
NIPT	Non-invasive prenatal test
NREEC	National Research and Evaluation Ethics Committee
NT	Nuchal translucency
OGTT	Oral glucose tolerance test
PCR	Polymerase chain reaction
RACGP	Royal Australian College of General Practitioners
RCPA	Royal College of Pathologists of Australasia
RhD	Rhesus D
RNA	Ribonucleic acid
SAS	Statistical analysis software – a statistical software package
SEIFA	ABS Socio-Economic Indexes for Areas
T3	Triiodothyronine
T4	Thyroxine
TFT	Thyroid function test(s)
TgAb	Thyroglobulin antibody
TIBC	Total iron binding capacity
TPOAbs	Thyroid peroxidase antibodies
TRAbs	Thyroid stimulating hormone receptor antibodies
TSH	Thyroid stimulating hormone
tTG	Transglutaminase
UEC	Urea, electrolytes and creatinine

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APPENDIX 1: TEST REQUEST GROUPS

Table A1.1 shows the 58 test (or panel of tests) groups where most test requests were classified.

TABLE A1.1 TEST (OR PANEL OF TESTS) GROUPS

Test (or panel of tests)	Test (panel of tests) definition	Notes/inclusions
AFP	Alpha-fetoprotein	
Blood group	Blood group	
BNP	Brain natriuretic peptide	
BP monitor	Blood pressure monitor	
CA125	Cancer antigen 125	
Calcium, magnesium and phosphate		Would include individual element requests if these were to occur
Calprotectin	Calprotectin	
CEA	Carcinoembryonic antigen	
Cervical	Cervical tests	Any cervical tests, in particular cervical screening tests, (or, previously, pap smears) to detect early cervical cancer
CK and troponin	Creatinine kinase and troponin	The two tests can be ordered separately but have been combined for analysis
Coagulation	Coagulation	D dimer, INR, thrombin
Coeliac test	Coeliac test	Includes any one or a panel of coeliac tests eg, coeliac serology, coeliac antibodies (anti-tTG, AGA)
CT	Computed tomography	Includes entries with CT, HRCT recorded
Densitometry	Densitometry	Bone mineral density, DEXA
Diabetes screen	Diabetes screen	
Digoxin	Digoxin	
ECG	Electrocardiogram	
ESR and CRP	Erythrocyte sedimentation rate and C-reactive protein	The two tests are ordered separately but have been combined for analysis
EUC	Electrolytes, urea and creatinine	Would include individual electrolyte requests eg, sodium, potassium or creatinine if these were to occur. Also includes eGFR.
Exercise stress	Exercise stress	
FBC	Full blood count	Full blood count, haemoglobin
First trimester scan	First trimester scan	Includes scans/tests performed during the first trimester eg, NT scan, PAPP A, date scan, 12-week scan, antenatal scan, triple test, down syndrome, obstetric scan, viability scan, early pregnancy scan
FOB	Faecal occult blood	
Glucose	Glucose	Includes all glucose tests, fasting, random, oral glucose tolerance test. Does not include HbA _{1c} test
HbA _{1c}	Glycated haemoglobin	
HCG (blood)	Human chorionic gonadotropin	
Histology	Histology	Histology, histopathology, biopsy, cytology, excision
HPV	Human papillomavirus	

Test (or panel of tests)	Test (panel of tests) definition	Notes/inclusions
H pylori	Helicobacter pylori	
Iron	Iron tests	Transferrin, ferritin, total iron binding capacity (TIBC), iron. Includes tests requested individually or as a group
LFT	Liver function tests	
Lipase	Lipase	
Lipids	Lipid profile	Total cholesterol, LDL, HDL, triglycerides. Would include individual lipid requests if these were to occur
Lithium	Lithium	
LVS	Low vaginal swab	
Maternal screen	Maternal screen	Maternal serum testing, antenatal screen
MBA	Multiple biochemical analysis (electrolytes, urea, creatinine, glucose, urate, phosphate, total calcium, albumin, total protein, total bilirubin, GGT, ALP, ALT, AST, LDH, globulins and total cholesterol)	Restricted MBA panels can also be requested that include some but not necessarily all of the elements listed
Morphology scan	Morphology scan (foetus)	Scans usually done later in the gestation period, assessing the foetus, also known as an 'anomaly scan' or an '18 to 20-week scan'
MRI	Magnetic resonance imaging	Includes any entry with MRI recorded
NIPT	Non-invasive prenatal test	Also known as non-invasive prenatal screening (NIPS)
Non-urine MCS	Non-urine microscopy, culture and sensitivity	For example, from sputum, stool, skin or wound swab etc
Nuclear med	Nuclear medicine	Myocardial perfusion scan, VQ scan, bone scan, Sestamibi scan
Progesterone	Progesterone	
Prolactin	Prolactin	
PSA	Prostate-specific antigen	
PTH	Parathyroid hormone	
Serology	Serology	Entry contains term serology or relevant synonyms.
Spirometry	Spirometry	
Testosterone	Testosterone	
TFT	Thyroid function tests	TSH, T3, T4. Includes tests requested individually or as a group.
Urate	Urate	
Urine ACR or Albumin	Urine albumin creatinine ratio or urine albumin	
Urine drug screen	Urine drug screen	
Urine MCS	Urine microscopy, culture and sensitivity	
US	Ultrasound scan	Entries with ultrasound doppler, echo
Vitamin B12 and folate	Vitamin B12 or folate	The two tests are ordered separately but have been combined for analysis
Vitamin D	Vitamin D	
Xray	X-rays	Includes mammograms and any entry with x-ray recorded, CXR, AXR

APPENDIX 2: SOCIODEMOGRAPHICS

Sociodemographic characteristics for the baseline population and the sub-populations appear below.

TABLE A2.1 SOCIODEMOGRAPHIC CHARACTERISTICS OF THE BASELINE POPULATION

Characteristic	Baseline study population (N = 1,703,338)	
	Number	% (95% CI)
Mean age, years (95% CI)	41.8 (41.0–42.7)	
Age group (years)		
0–9	218,241	12.8 (12.2–13.4)
10–19	158,836	9.3 (9.0–9.6)
20–29	194,410	11.4 (10.8–12.0)
30–39	230,994	13.6 (12.9–14.2)
40–49	219,158	12.9 (12.6–13.2)
50–59	217,894	12.8 (12.5–13.1)
60–69	204,701	12.0 (11.5–12.5)
70–79	158,593	9.3 (8.7–9.9)
80–89	77,753	4.6 (4.2–4.9)
90+	22,758	1.3 (1.2–1.5)
Gender		
Female	957,443	56.2 (55.7–56.7)
Male	745,895	43.8 (43.3–44.3)
Indigenous status		
Aboriginal and/or Torres Strait Islander	54,787	3.2 (2.5–4.0)
Other Australian	1,348,666	79.2 (76.1–82.3)
Not known	299,885	17.6 (14.4–20.8)
State/Territory		
ACT	21,303	1.3 (0.2–2.3)
NSW	648,149	38.1 (31.8–44.3)
NT	29,230	1.7 (0.3–3.1)
QLD	349,359	20.5 (15.7–25.3)
SA	46,964	2.8 (1.0–4.5)
Tas	104,921	6.2 (3.3–9.0)
Vic	281,977	16.6 (11.7–21.4)
WA	221,435	13.0 (8.6–17.4)
Remoteness		
Major city	1,091,401	64.1 (58.5–69.6)
Inner regional	396,495	23.3 (18.6–28.0)
Outer regional	183,221	10.8 (7.6–13.9)
Remote or very remote	32,221	1.9 (0.8–3.0)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	261,326	15.3 (12.3–18.4)
2	300,276	17.6 (14.6–20.6)
3	402,006	23.6 (19.9–27.3)
4	349,774	20.5 (17.3–23.8)
5 (most advantaged)	389,956	22.9 (18.9–26.9)

SEIFA, socioeconomic index for areas

TABLE A2.2 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS IDENTIFIED AS HAVING TYPE 2 DIABETES

Characteristic	Patients with type 2 diabetes (N = 90,252)	
	Number	% (95% CI)
Mean age, years (95% CI)	67.5 (67.0–68.0)	
Age group (years)		
0–9	77	0.1 (0.1–0.1)
10–19	230	0.3 (0.2–0.3)
20–29	625	0.7 (0.6–0.8)
30–39	2,277	2.5 (2.2–2.8)
40–49	6,279	7.0 (6.4–7.5)
50–59	13,977	15.5 (14.8–16.1)
60–69	23,373	25.9 (25.4–26.4)
70–79	25,829	28.6 (27.8–29.4)
80–89	14,235	15.8 (15.1–16.5)
90+	3,350	3.7 (3.4–4.0)
Gender		
Female	41,665	46.2 (45.5–46.8)
Male	48,587	53.8 (53.2–54.5)
Indigenous status		
Aboriginal and/or Torres Strait Islander	3,844	4.3 (2.9–5.7)
Other Australian	75,500	83.7 (81.0–86.3)
Not known	10,908	12.1 (9.6–14.6)
State/Territory		
ACT	799	0.9 (0.1–1.7)
NSW	34,879	38.6 (32.4–44.9)
NT	1,194	1.3 (0.2–2.4)
QLD	16,862	18.7 (13.9–23.4)
SA	3,291	3.6 (1.2–6.1)
Tas	6,808	7.5 (4.1–11.0)
Vic	15,697	17.4 (12.2–22.5)
WA	10,722	11.9 (7.6–16.2)
Remoteness		
Major city	51,932	57.5 (51.5–63.6)
Inner regional	24,490	27.1 (21.8–32.5)
Outer regional	12,073	13.4 (9.5–17.2)
Remote or very remote	1,757	1.9 (0.9–3.0)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	19,863	22.0 (17.9–26.2)
2	19,252	21.3 (17.6–25.0)
3	21,166	23.5 (19.7–27.2)
4	14,878	16.5 (13.7–19.3)
5 (most advantaged)	15,093	16.7 (13.5–19.9)

SEIFA, socioeconomic index for areas.

TABLE A2.3 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS IDENTIFIED AS HAVING CHRONIC KIDNEY DISEASE

Characteristic	Patients with chronic kidney disease (N = 17,635)	
	Number	% (95% CI)
Mean age, years (95% CI)	76.0 (75.4–76.6)	
Age group (years)		
0–9	13	0.1 (0.0–0.1)
10–19	25	0.1 (0.1–0.2)
20–29	82	0.5 (0.4–0.6)
30–39	203	1.2 (0.9–1.4)
40–49	477	2.7 (2.3–3.1)
50–59	1,091	6.2 (5.6–6.8)
60–69	2,399	13.6 (12.8–14.4)
70–79	5,358	30.4 (29.5–31.3)
80–89	5,812	33.0 (31.7–34.2)
90+	2,175	12.3 (11.4–13.2)
Gender		
Female	9,003	51.1 (50.0–52.2)
Male	8,632	48.9 (47.8–50.0)
Indigenous status		
Aboriginal and/or Torres Strait Islander	555	3.1 (1.5–4.8)
Other Australian	15,302	86.8 (84.1–89.5)
Not known	1,778	10.1 (7.9–12.3)
State/Territory		
ACT	215	1.2 (0.0–2.6)
NSW	6,302	35.7 (28.3–43.2)
NT	146	0.8 (0.1–1.5)
QLD	3,161	17.9 (12.5–23.3)
SA	433	2.5 (0.5–4.4)
Tas	2,490	14.1 (6.2–22.1)
Vic	3,001	17.0 (9.1–24.9)
WA	1,887	10.7 (6.2–15.2)
Remoteness		
Major city	8,937	50.7 (42.4–58.9)
Inner regional	5,582	31.7 (24.1–39.2)
Outer regional	2,755	15.6 (9.6–21.6)
Remote or very remote	361	2.0 (0.7–3.4)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	4,573	25.9 (19.5–32.4)
2	3,943	22.4 (17.1–27.7)
3	4,134	23.4 (18.2–28.6)
4	2,430	13.8 (11.0–16.5)
5 (most advantaged)	2,555	14.5 (10.8–18.2)

SEIFA, socioeconomic index for areas.

TABLE A2.4 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS IDENTIFIED AS HAVING THYROID DYSFUNCTION

Characteristic	Patients with thyroid dysfunction (N = 67,078)	
	Number	% (95% CI)
Mean age, years (95% CI)	60.3 (59.5–61.1)	
Age group (years)		
0–9	176	0.3 (0.2–0.3)
10–19	534	0.8 (0.7–0.9)
20–29	2,273	3.4 (3.1–3.6)
30–39	7,032	10.5 (9.3–11.7)
40–49	8,499	12.7 (12.0–13.3)
50–59	11,775	17.6 (17.0–18.1)
60–69	14,147	21.1 (20.5–21.7)
70–79	12,957	19.3 (18.5–20.2)
80–89	7,282	10.9 (10.2–11.5)
90+	2,403	3.6 (3.3–3.9)
Gender		
Female	55,747	83.1 (82.6–83.6)
Male	11,331	16.9 (16.4–17.4)
Indigenous status		
Aboriginal and/or Torres Strait Islander	1,295	1.9 (1.5–2.4)
Other Australian	56,485	84.2 (81.3–87.1)
Not known	9,298	13.9 (10.9–16.8)
State/Territory		
ACT	804	1.2 (0.2–2.2)
NSW	25,901	38.6 (32.5–44.8)
NT	643	1.0 (0.2–1.8)
QLD	13,164	19.6 (14.8–24.4)
SA	2,176	3.2 (1.2–5.3)
Tas	4,623	6.9 (3.8–10.0)
Vic	10,515	15.7 (11.0–20.3)
WA	9,252	13.8 (8.9–18.6)
Remoteness		
Major city	41,571	62.0 (56.2–67.7)
Inner regional	16,910	25.2 (20.1–30.3)
Outer regional	7,455	11.1 (7.8–14.4)
Remote or very remote	1,142	1.7 (0.8–2.6)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	11,373	17.0 (13.5–20.4)
2	12,695	18.9 (15.3–22.5)
3	15,703	23.4 (19.7–27.1)
4	12,534	18.7 (15.7–21.7)
5 (most advantaged)	14,773	22.0 (18.1–25.9)

SEIFA, socioeconomic index for areas.

TABLE A2.5 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS IDENTIFIED AS HAVING EXISTING AND NEWLY DIAGNOSED COELIAC DISEASE

Characteristic	Patients with existing coeliac disease (N = 6,939)		Patients with newly diagnosed coeliac disease (N = 582)	
	Number	% (95% CI)	Number	% (95% CI)
Mean age, years (95% CI)	47.9 (47.0–48.8)		35.2 (33.5–36.8)	
Age group (years)				
0–9	148	2.1 (1.8–2.5)	69	11.9 (9.2–14.5)
10–19	616	8.9 (8.1–9.7)	102	17.5 (14.5–20.5)
20–29	814	11.7 (10.8–12.7)	91	15.6 (12.8–18.5)
30–39	922	13.3 (12.3–14.3)	87	14.9 (12.0–17.9)
40–49	1,032	14.9 (14.0–15.7)	81	13.9 (11.2–16.7)
50–59	1,118	16.1 (15.2–17.1)	59	10.1 (7.7–12.5)
60–69	1,126	16.2 (15.1–17.3)	50	8.6 (6.3–10.9)
70–79	746	10.8 (9.8–11.7)	34	5.8 (3.9–7.8)
80–89	345	5.0 (4.3–5.7)	9	1.5 (0.5–2.5)
90+	72	1.0 (0.8–1.3)	0	-
Gender				
Female	5,238	75.5 (74.2–76.7)	427	73.4 (69.8–77.0)
Male	1,701	24.5 (23.3–25.8)	155	26.6 (23.0–30.2)
Indigenous status				
Aboriginal and/or Torres Strait slander	132	1.9 (1.5–2.3)	21	3.6 (1.8–5.4)
Other Australian	5,718	82.4 (78.1–86.7)	437	75.1 (67.5–82.7)
Not known	1,089	15.7 (11.3–20.1)	124	21.3 (13.6–29.1)
State/Territory				
ACT	91	1.3 (0.3–2.4)	9	1.5 (0.0–3.2)
NSW	2,677	38.6 (32.0–45.1)	216	37.1 (29.2–45.0)
NT	66	1.0 (0.1–1.8)	11	1.9 (0.0–3.9)
QLD	1,441	20.8 (15.5–26.0)	121	20.8 (14.5–27.0)
SA	175	2.5 (0.9–4.2)	7	1.2 (0.0–2.5)
Tas	507	7.3 (3.7–10.9)	35	6.0 (2.5–9.5)
Vic	1,277	18.4 (12.4–24.4)	102	17.5 (9.8–25.2)
WA	705	10.2 (6.2–14.1)	81	13.9 (7.7–20.1)
Remoteness				
Major city	4,183	60.3 (54.1–66.5)	367	63.1 (55.8–70.3)
Inner regional	1,970	28.4 (22.7–34.1)	145	24.9 (18.6–31.3)
Outer regional	693	10.0 (6.9–13.1)	63	10.8 (6.6–15.1)
Remote or very remote	93	1.3 (0.6–2.1)	7	1.2 (0.0–2.4)
Socioeconomic status (SEIFA)				
1 (most disadvantaged)	1,053	15.2 (11.6–18.7)	76	13.1 (9.1–17.0)
2	1,277	18.4 (14.8–22.0)	93	16.0 (11.5–20.5)
3	1,605	23.1 (19.1–27.1)	149	25.6 (20.0–31.2)
4	1,266	18.2 (15.5–21.0)	98	16.8 (12.6–21.1)
5 (most advantaged)	1,738	25.0 (20.4–29.7)	166	28.5 (22.0–35.0)

SEIFA, socioeconomic index for areas.

TABLE A2.6 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS WHO HAD A FULL-TERM BIRTH IN 2019

Characteristic	Patients who had a full-term birth in 2019 (N = 11,933)*	
	Number	% (95% CI)
Mean age, years (95% CI)	31.1 (30.8–31.4)	
Age group (years)		
0–9	-	-
10–19	<160	1.3 (1.0–1.6)
20–29	4,206	35.2 (32.8–37.7)
30–39	6,983	58.5 (56.2–60.8)
40–49	582	4.9 (4.3–5.5)
50–59	<5	0.0 (0.0–0.1)
60–69	-	-
70–79	-	0.0 (0.0–0.0)
80–89	-	-
90+	-	-
Indigenous status		
Aboriginal and/or Torres Strait Islander	572	4.8 (2.9–6.7)
Other Australian	9,803	82.2 (78.6–85.7)
Not known	1,558	13.1 (9.8–16.3)
State/Territory		
ACT	177	1.5 (0.0–3.1)
NSW	4,378	36.7 (29.3–44.1)
NT	114	1.0 (0.0–1.9)
QLD	2,538	21.3 (15.4–27.1)
SA	294	2.5 (0.4–4.5)
Tas	529	4.4 (2.0–6.8)
Vic	1,928	16.2 (9.6–22.8)
WA	1,975	16.6 (8.9–24.2)
Remoteness		
Major city	7,652	64.1 (56.9–71.4)
Inner regional	2,506	21.0 (15.6–26.4)
Outer regional	1,459	12.2 (7.0–17.5)
Remote or very remote	316	2.6 (1.0–4.3)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	1,740	14.6 (10.9–18.3)
2	2,169	18.2 (14.4–22.0)
3	2,959	24.8 (20.2–29.4)
4	2,687	22.5 (18.2–26.9)
5 (most advantaged)	2,378	19.9 (15.5–24.4)

SEIFA, socioeconomic index for areas.

*As a possible recording error, 2 people were recorded as male, 1 person as aged 70–79 and 1 as 0–9 years.

TABLE A2.7 SOCIODEMOGRAPHIC CHARACTERISTICS OF PATIENTS WITH AT LEAST ONE TEST REQUEST WHERE THE REASON FOR THE TEST WAS FATIGUE OR TIREDNESS

Characteristic	Patients with at least one test request where the reason for test was fatigue/tiredness (N = 65,733)	
	Number	% (95% CI)
Mean age, years (95% CI)	43.9 (43.0–44.9)	
Age group (years)		
0–9	1,314	2.0 (1.8–2.2)
10–19	6,072	9.2 (8.7–9.8)
20–29	10,830	16.5 (15.4–17.5)
30–39	12,868	19.6 (18.4–20.8)
40–49	10,756	16.4 (15.8–16.9)
50–59	8,007	12.2 (11.7–12.7)
60–69	6,497	9.9 (9.2–10.6)
70–79	5,414	8.2 (7.5–9.0)
80–89	3,203	4.9 (4.3–5.4)
90+	772	1.2 (1.0–1.4)
Gender		
Female	48,333	73.5 (72.5–74.5)
Male	17,400	26.5 (25.5–27.5)
Indigenous status		
Aboriginal and/or Torres Strait Islander	1,519	2.3 (1.8–2.8)
Other Australian	53,172	80.9 (77.0–84.8)
Not known	11,042	16.8 (12.8–20.8)
State/Territory		
ACT	863	1.3 (0.0–2.6)
NSW	22,146	33.7 (25.7–41.7)
NT	306	0.5 (0.0–1.3)
QLD	13,803	21.0 (14.6–27.4)
SA	1,248	1.9 (0.2–3.6)
Tas	5,775	8.8 (3.8–13.8)
Vic	10,754	16.4 (10.2–22.5)
WA	10,838	16.5 (9.4–23.6)
Remoteness		
Major city	41,739	63.5 (55.9–71.1)
Inner regional	15,830	24.1 (17.5–30.6)
Outer regional	6,629	10.1 (5.9–14.3)
Remote or very remote	1,535	2.3 (0.7–4.0)
Socioeconomic status (SEIFA)		
1 (most disadvantaged)	9,213	14.0 (10.2–17.8)
2	9,935	15.1 (11.7–18.5)
3	16,674	25.4 (20.3–30.5)
4	13,351	20.3 (16.1–24.6)
5 (most advantaged)	16,560	25.2 (20.0–30.4)

SEIFA, socioeconomic index for areas.