NHS
Cornwall and
Isles of Scilly

Guidance for monitoring drug therapy in adults

This document is intended to act as a practical guide on the monitoring requirements of specific drugs. The list of drugs is not exhaustive and the information provided is based on a variety of sources: individual clinicians may advise slightly different monitoring requirements. Current BNF and individual summary of product characteristics should be consulted for further details. The original concept was approved by the Cornwall area prescribing committee. This document will be reviewed no later than January 2025.

For GP surgeries using ICE order comms (and samples going to Treliske), please note order sets have been set up and can be found under the order sets panel on the drugs page.

The tests included in the test profiles are below.

- Electrolytes (GP): Sodium, potassium, creatinine and GFR.
- Bone: Adjusted calcium, phosphate, albumin, alkaline phosphatase, globulin and total protein.
- LFT: Bilirubin, albumin, alanine transferase (ALT), alkaline phosphatase, globulin and total protein.
- Lipid: Cholesterol, triglyceride, high-density lipoprotein (HDL), non-HDL, low-density lipoprotein (LDL) and HDL:cholesterol ratio.

Cholesterol and triglyceride can also be requested as standalone tests too, if whole profile not required.

If you have any questions about the information in this document, please email marco.motta@nhs.net or email mike.wilcock@nhs.net.

Last updated: June 2022.

Contents

ACE inhibitors and angiotensin II antagonists

See separate entry for sacubitril valsartan.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• Electrolytes (GP) and BP.
 	
ICE ordersets: 'ACE inhibitors: pre-treatment' or 'Angiotensin II antagonists (ARBs): Pre-treatment' (Electrolytes (GP))
	• There are minor differences between the monitoring recommendations for each indication. The most comprehensive monitoring is for patients with heart failure and this is adopted below as the standard monitoring requirements for all patients starting ACEIs or ARBS.
	• Request electrolytes (GP) 1 to 2 weeks after initiation and after each dose increment. Earlier monitoring (after 5 to 7 days) may be required for people with:
	  • existing CKD stage 3 or higher
	  • aged 60 years or over
	  • with relevant comorbidities such as diabetes mellitus or peripheral arterial disease
	  • taking a combination of an ACE-inhibitor plus a diuretic or an aldosterone antagonist.
	• Once at target dose or maximum tolerated dose monitor these parameters monthly for 3 months and at any time the patient becomes acutely unwell.
	
	Ongoing monitoring
	• Electrolytes (GP) every 6 months and at any time the patient becomes unwell.
	• Monitor BP routinely.
	
	ICE ordersets: 'ACE inhibitors: monitoring' or 'Angiotensin II antagonists (ARBs): monitoring' (Electrolytes (GP))
		• Consider modifying treatment if any of results are:
		  • increases in creatinine of >100% (or a level > 310micromol/l or an eGFR < 20ml/min/1.73m^2) should lead to stopping ACEI/ARB and referral to a specialist
		  • an increase in creatinine of >50% but </= 100% (or level > 256micromol/l or eGFR approx
		  • between 20 and 25ml/min/1.73m^2) should prompt dose reduction or withdrawal of diuretic (if applicable) and/or stopping ACE or ARB and consideration of specialist referral.
		  • increases in creatinine of 30% to 50% (or level > 200micromol/l or eGFR < 30ml min/1.73m^2) should prompt a review of volume status, temporary dose reduction or withdrawal of diuretic (if applicable) or ACE or ARB - if the serum creatinine level increases by more than 20% or the eGFR falls more than 15%, re-measure renal function within 2 weeks; an increase of the serum creatinine level of less than 30% does not require further action
		  • potassium rises above 5.5 to 6mmol/l and other drugs known to promote hyperkalaemia have been discontinued
		  • if Na <132mmol/l specialist advice should be obtained

Amiodarone

Shared care guideline on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• TSH, LFT, electrolytes (GP). • Chest X-ray within last 12 months. • ECG. **ICE orderset**: 'Amiodarone: Pre-treatment and monitoring' (Electrolytes (GP), LFT and TSH)	• TSH (and if required fT4 and fT3) every 6 months and for up to 12 months after cessation. Serum TSH should also be measured when thyroid dysfunction is suspected. • Note fT4 is automatically added by the laboratory computer if TSH is found to be outside the reference range, and fT3 requests are reviewed by the duty biochemist. On requesting please state the patient is on amiodarone. • LFTs every 6 months. • Electrolytes (GP) every 6 months. • Urgent CT scan if pulmonary toxicity suspected. • ECG every 12 months. • Unless blurred or decreased vision occurs, ophthalmological examination is recommended annually (though also advised that these are usually only necessary for patients with visual symptoms). • In warfarinised patients, more frequent monitoring of INR both during and after amiodarone treatment is recommended; initially weekly for first 7 weeks. **ICE orderset**: 'Amiodarone: Pre-treatment and monitoring' (Electrolytes (GP), LFT and TSH)	• If TFTs are borderline repeat test in 6 weeks. If no improvement seen refer to relevant clinical team. • Treatment should be discontinued if severe liver function abnormalities or clinical signs of liver disease develop. • If pulmonary toxicity is suspected, CT scan should be undertaken and lung function tested, including where possible, measurement of transfer factor. Specialist referral advised. • If blurred or decreased vision occurs, complete ophthalmologic examination including fundoscopy should be promptly performed. • Appearance of optic neuropathy and/or optic neuritis requires amiodarone withdrawal due to potential progression to blindness: expert opinion sought.

Antipsychotics

Amisulpride, Aripiprazole, Olanzapine, Quetiapine, Risperidone, Lurasidone and Paliperidone. See separate entry for Clozapine.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• Fasting blood glucose or if not then non-fasting and HbA1c.
• FBC, LFT, Electrolytes (GP) and lipid profile.
• BP, pulse, smoking history, weight (include waist circumference) and BMI. NICE also advise an assessment of nutritional status, diet and level of physical activity.
 	
ICE orderset: 'Antipsychotics (exc Clozapine): Pre-treatment' (Electrolytes GP, LFT, lipid, fasting glucose and FBC)
	• Monitoring until patient is stabilised:
	  • BP and pulse at 12 weeks in schizophrenia and after each dose change in bipolar disorder
	  • fasting blood glucose or if not then non-fasting and HbA1c at 12 weeks
	  • weight weekly for first 6 weeks and then at 12 weeks and 1 year plotted on a chart
	  • full Lipid profile at 12 weeks
	  • ECG after each dose change or if clinically indicated
	  • Prolactin for amisulpride, olanzapine at dose >20mg day, risperidone, and paliperidone at 6 months and if clinically indicated
	  • smoking history at 3 months
	• Annual check up should include:
	  • BP and pulse
	  • lifestyle review
	  • BMI and waist size
	  • electrolytes (GP), FBC, LFTs and full lipid profile
	  • fasting blood glucose or HbA1c for all antipsychotics.
	• Olanzapine has a higher risk of metabolic adverse effects, so glucose and lipids 4 to 6 months after starting and then annually as above.
	• ECG monitoring should be assessed only if known additional risk factors for QTc prolongation and arrhythmia.
	
	ICE orderset: 'Antipsychotics (exc Clozapine): Annual monitoring' (Electrolytes GP, LFT, lipid, fasting glucose and FBC)
		• Reduce dose of amisulpride if eGFR < 60ml/minute/1.73 m^2.
		• If blood lipids outside range, offer lifestyle advice or consider changing antipsychotic and/or initiating statin therapy.
		• If weight outside range, offer lifestyle advice. Consider changing antipsychotic and/or dietary or pharmacological intervention.
		• If hyperprolactinaemia confirmed and symptomatic, switch drugs.
		• If NMS suspected, stop therapy.
		• If LFTs indicate hepatitis (transaminases x3 normal) or functional damage (PT or albumin change), stop therapy.

Azathioprine and mercaptopurine

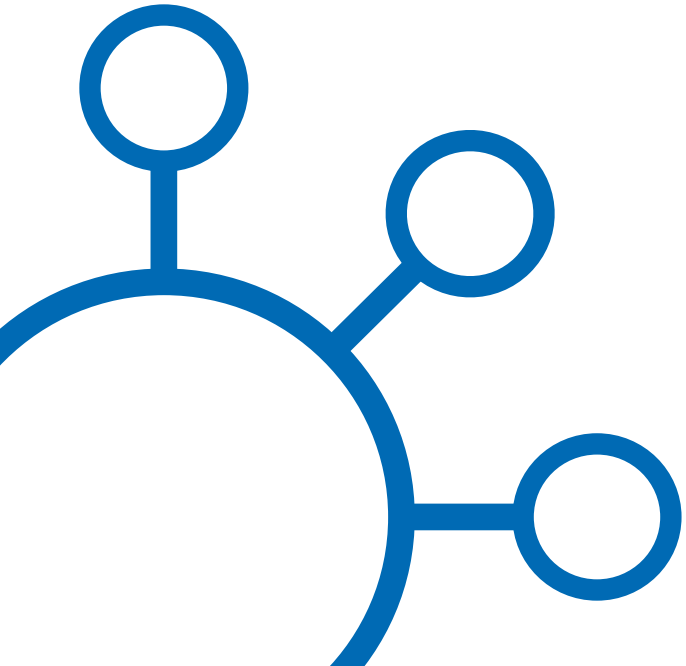
Mercaptopurine is the active metabolite of Azathioprine. Shared care guideline in IBD on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• FBC, LFT, electrolytes (GP), TPMT.
• Consider screening for hepatitis B and C, EBV, VZV serology, and HIV serology in all patients.
• Weight, BP (advised by BSR and in local SCG for IBD). BSR also recommend height.
 	
ICE orderset: 'Azathiopurine and Mercaptopurine: Pre-treatment' (Electrolytes (GP), LFT, FBC and TPMT)
	Rheumatology
	• FBC, LFT, CRP, Electrolytes (GP) fortnightly until dose stable for 6 weeks, then monthly for 3 months, then at least once every 12 weeks (closer monitoring may be advised in high-risk patients).
	
	Dermatology
	• FBC and LFT weekly until stable on maintenance dose. Otherwise same as for rheumatology.
	• Once maintenance dose has been achieved and stable for 6 months consider discussing with patient to reduce monitoring of FBC and LFTs to 3-monthly unless the patient is heterozygote for TPMT in which case monitoring should continue at monthly intervals at a minimum.
	• Electrolytes (GP) should be monitored every 6 months.
	
	Gastroenterology
	• FBC, LFT, and electrolytes (GP), 14 days after starting; then at 4, 8, and 12 weeks; then 3 monthly. Frequency of monitoring may be changed at discretion of specialist.
	• Repeat FBC and LFTs 2 weeks after dose change and then 3-monthly (as above).
	• Electrolytes (GP) should be checked 3 monthly.
	
	Renal transplant patients
	• Azathioprine monitoring is conducted by the renal unit (unless requested otherwise) and, for stable patients, may be less frequent than above.
		• Withhold and discuss with relevant clinical team if any results are:
		  • WCC < 3.5 x 10^9/L, particularly if falling trend
		  • Neutrophils < 1.6 x 10^9/L particularly if falling trend
		  • platelets < 140 x 10^9/L
		  • unexplained eosinophilia > 0.5x 10^9/L
		  • ALT or AST > 100 U/L
		  • unexplained reduction in albumin (below 30g/L)
		  • Creatinine increased > 30% over 12 months
		  • eGFR decreases <60ml/min/1.73m^2 and there is significant falling trend
		  • rash or oral ulceration occurs
		  • severe or persistent infections, fever, chills and/or persistent sore throat
		  • abnormal bruising or bleeding refer to specialist to discuss FBC results as soon as possible (ideally within 24 hours)
		  • MCV>105 fl particularly if rising trend
		• Check serum folate and B12 and TSH and discuss results with relevant team.

Balsalazide, mesalazine and olsalazine

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• Electrolytes (GP), LFTs, FBC, urine dipstick. **ICE orderset**: 'Balsalazide, Mesalazine and Olsalazine: Pre-treatment' (Electrolytes (GP), LFT and FBC)	• Electrolytes (GP) LFT, FBC, urine dipstick. These tests should be monitored 14 days after starting; then at 4, 8, and 12 weeks; then 3 monthly. • Urgent FBC if unexplained bruising, bleeding, sore throat, fever. **Ongoing monitoring** • Every 6 months or annually (dependent on risk factors). • Electrolytes (GP), LFTs, FBC, urine dipstick. • Note: serum creatinine and eGFR (both included in electrolytes profile) is advised every 6 months for first 4 years, then annually. **ICE orderset**: 'Balsalazide, Mesalazine and Olsalazine: Monitoring' (Electrolytes (GP), LFT and FBC)	• British Society of Gastroenterology recommends to stop therapy if renal function deteriorates. • ALT > twice upper limit of reference range, withhold treatment until discussed with the specialist team. • Perform haematological investigations if patient develops unexplained bleeding, bruising, purpura, anaemia, fever or sore throat. • Stop if suspicion or evidence of blood dyscrasia.



Carbamazepine

Discuss risks of teratogenicity with women of child-bearing age.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

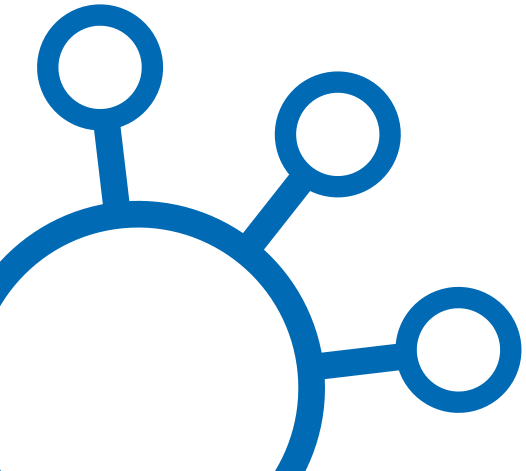
• FBC, LFT, electrolytes (GP).
• Weight and height (BMI).
• ECG if indicated for patients with prior cardiovascular disease history.
 	
ICE orderset: 'Carbamazepine: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
	• In bipolar disorder, plasma levels should be measured 2 weeks after initiation and 2 weeks after each dose change.
	• Electrolytes (GP), FBC, and LFTs should be monitored at 6 months post-initiation of treatment. BMI should be measured if the patient gains weight rapidly.
	
	Ongoing monitoring
	• electrolytes (GP) to be repeated every 6 months during treatment but more frequently if clinically indicated.
	• LFTs should also be reviewed periodically if indicated, particularly in patients with a history of liver disease or the elderly.
	• Annual review of physical health is recommended in patients with bipolar disorder taking Carbamazepine. The following should be assessed:
	  • TSHs
	  • lipid profile
	  • ECG (if indicated by history or clinical picture)
	  • plasma glucose levels (including HbA1c)
	  • BP
	• FBC, Electrolytes (GP), LFT, Vitamin D and a bone profile should be monitored every 2 to 5 years for adults with epilepsy taking enzyme-inducing drugs.
	
	ICE orderset: 'Carbamazepine: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
		• Modify treatment if any of results are:
		  • WBC<3.5×10^9/L
		  • neutrophils <1.6×10^9/L
		  • platelets <140×10^9/L
		• Low sodium secondary to inappropriate ADH is well recognised with carbamazepine. Low WBC is also common. For both of these, action may not be needed depending on extent of fall, and if still falling.
		• Treatment should be discontinued if leucopenia develops that is severe, progressive or accompanied by clinical manifestations (for example fever or sore throat), or if any evidence of significant bone marrow suppression occurs.
		• Withdraw treatment immediately in cases of aggravated liver dysfunction or acute liver disease.

Carbimazole

For a new hyperthyroid case, the duty biochemist will add a TSH-receptor antibody (TRAb), as per NICE guidance.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• TSH, FT4 and FT3, LFT, FBC (which includes white blood cell count and differential).
 	
ICE orderset: 'Carbimazole: Pre-treatment' (TSH and FBC). FT4 is auto added if TSH is outside reference range, and fT3 added by the duty biochemist dependant on the TSH amd fT4.
	• Request TSH (with appropriate cascade of FT4 and FT3) every 6 weeks until the TSH is within the reference range provided by the local lab. Then TSH every 3 months until carbimazole stopped. Please ensure 'on carbimazole' is in the clinical details.
	• Do not monitor FBC and LFT unless there is a clinical suspicion of agranulocytosis or liver dysfunction.
	• Consider periodically Creatine Kinase (CK)· if patient experiencing myalgia.
	• FBC in patients who may be confused or have poor memory.
	• Urgent FBC if patient has signs of significant infection or sore throat.
	• Note: RCHT endocrinology team want all new hyperthyroid cases referred to them.
	
	ICE orderset: 'Carbimazole: Monitoring' (TSH). FT4 is auto added if TSH is outside reference range, and fT3 added by the duty biochemist dependant on the TSH and fT4.
		• Maintain TSH within the reference range of local lab.
		• Withhold and discuss with relevant clinical team if any results are:
		  • leucocyte count falls to <1500x10^6/L
		  • neutrophil count to <500x10^6/L
		• If the patient develops any signs and symptoms of hepatic disorder, temporarily stop carbimazole and perform LFTs immediately. If abnormal liver function is discovered, treatment should be stopped.
		• If the patient develops any signs or symptoms of agranulocytosis or neutropenia, perform WBC count immediately, particularly where there is any clinical evidence of infection. Stop carbimazole promptly if there is clinical or laboratory evidence of neutropenia, and consider specialist referral for further management options.
		• If acute pancreatitis occurs, carbimazole should be stopped immediately and permanently.
		• Refer to specialist endocrinologist if FT4 level falls below reference range or TSH is raised.

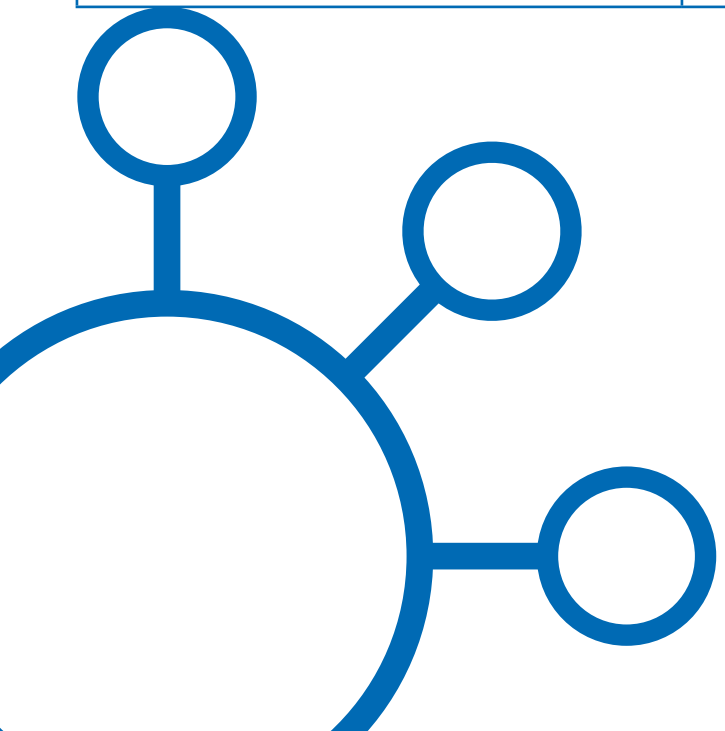


Ciclosporin

Shared care guideline for use in dermatology on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• FBC, electrolytes (GP), LFT, BP, lipid and magnesium.
• Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients.
• Height and weight for rheumatology.
• Urate, urinalysis in dermatology.
 	
ICE orderset: 'Cyclosporin or Ciclosporin: Pre-treatment' (Electrolytes (GP), LFT, lipid, magnesium and FBC)
	Rheumatology and dermatology
	• FBC, LFTs, electrolytes (GP), HbA1c fortnightly for first 6 weeks, then monthly for 12 months, then every 3 months.
	• Check BP each time patient attends clinic for blood test and maintain </=140/90.
	• Consider periodically (for example annually) serum potassium, magnesium and urate.
	• Check BP each time patient attends monitoring clinic and maintain below targets as advised in NICE hypertension in adults guidance.
	
	ICE orderset: 'Cyclosporin or Ciclosporin: Monitoring rheum and derm pts' (Electrolytes (GP), LFT, HbA1c and FBC)
		• Withhold and discuss with relevant clinical team if any results are:
		  • WCC < $3.5x10^9$/L, particularly if falling trend
		  • Neutrophils <$1.6x10^9$/L particularly if falling trend
		  • MCV>105fl particularly if rising trend
		  • unexplained eosinophilia >$0.5x10^9$/L
		  • platelets < $140x10^9$/L,
		  • AST, ALT or Alk. Phos are twice normal upper limit
		  • unexplained reduction in albumin (below 30g/l)
		  • Creatinine increased 30% above baseline on more than 1 occasion
		  • eGFR decreases <60ml/min/1.73m^2 and there is significant falling trend
		• Significant rise in fasting lipids.



Clozapine

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• FBC, electrolytes (GP), LFT, lipid, glucose should be fasting if possible or non-fasting and HbA1c.
 	
Due to the stability of TNI samples must be taken in the morning and sent to the RCHT laboratory on the morning courier.
 	
ICE orderset: 'Clozapine: Pre-treatment' Electrolytes (GP), LFT, lipid, FBC, fasting glucose, CRP, CK, prolactin and TNI)
	• Weekly CRP and TNI for first 4 weeks. Note: Due to the stability of TNI samples must be taken in the morning and sent to the RCHT laboratory on the morning courier.
	• Clozapine has a higher risk of metabolic adverse effects, so get glucose and lipids 4 to 6 months after starting and then annually as below.
	• Annual check up should include:
	  • BP and pulse
	  • lifestyle review
	  • BMI and waist size
	  • electrolytes (GP), LFTs and lipid profile
	  • plasma glucose should be fasting if possible, or non-fasting and HbA1c
	  • hyper salivation
	  • constipation
	  • sedation
	• FBC as per Clozapine protocol. Weekly for 18 weeks, then 2 weekly for up to 1 year then 4 weekly. This is done at GP surgery. Some are sent to RCHT but some are sent to CPMS. CPMS ones include a blood pack with the tubes.
	
	Annual monitoring
	ICE orderset: 'Clozapine: Annual monitoring' Electrolytes (GP), LFT, lipid, and fasting glucose
		• Monitoring blood clozapine levels for toxicity is now advised in certain clinical situations such as when a patient stops smoking or switches to an e-cigarette, concomitant medicines may interact to increase blood clozapine levels, a patient has pneumonia or other serious infection, poor (reduced) clozapine metabolism is suspected, or toxicity is suspected.
		• If CRP >100mg/ml or troponin > twice upper limit of normal, stop clozapine, undertake echo.
		• If fever + tachycardia + raised CRP or troponin (but not as above), daily CRP and troponin measures.

DOACs

Apixaban, dabigatran, edoxaban, rivaroxaban

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• Electrolytes (GP), LFT, FBC, clotting screen (results obtained in the previous 6 weeks are acceptable in stable patients). • Weight (recent, for example within last 12 months, or more recently if suspected weight loss or gain). **ICE orderset**: 'DOACs: Pre-treatment' (Electrolytes (GP), LFT, FBC and coag)	• Electrolytes (GP), LFT, FBC annually, or 6-monthly if the patient is older than 75 years or fragile. • More frequent electrolytes (GP) and LFTs advised if inter-current illness that may impact on renal or liver function. **ICE orderset**: 'DOACs: Monitoring' (Electrolytes (GP), LFT and FBC)	• If renal function has declined, review treatment, as DOAC may need to be stopped or a lower dose may be required. • If CrCl is calculated from Cockcroft Gault formula as below 60ml/min consider retest x-months (where x=CrCl/10, for example if CrCl=30ml/min every 3 months).

Hydroxychloroquine

Pre-treatment	Suggested monitoring requirements and action to be taken if results abnormal
• FBC, electrolytes (GP), LFT. • Ask about visual impairment (not corrected by glasses). Record near visual acuity using a standard reading chart (with reading glasses if worn). • Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients **ICE orderset**: 'Hydroxychloroquine: Pre-treatment' (Electrolytes (GP), LFT and FBC)	• Annual monitoring for retinopathy after 5 years of therapy and reviewed annually thereafter whilst on therapy, hence refer to ophthalmology once patient has been on treatment for 4.5 years. At each monitoring visit, patients should undergo imaging with both spectral-domain optical coherence tomography (SD-OCT) and wide-field fundus autofluorescence imaging (FAF). • Monitoring may be started 1 year after therapy is initiated if additional risk factors exist, for example concomitant tamoxifen use, impaired renal function (eGFR <60ml/min/1.73m^2), dose of hydroxychloroquine greater than 5mg per kg per day. • If patient reports visual symptoms (blurring, difficulty reading text, or flashing lights) stop treatment and arrange ophthalmology review. • Maximum daily dose prescribed should not exceed 5mg/kg actual body weight and 6.5mg/kg calculated lean (or ideal) body weight.

Leflunomide

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• FBC, electrolytes (GP), LFT, BP on 2 occasions 2 weeks apart (if > 140/90 treat before commencing leflunomide), height and weight. • Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients. **ICE orderset**: 'Leflunomide: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)	• FBC, LFT, electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for 3 months, then at least once every 12 weeks. • BP (as hypertension is a possible side effect) and weight should be checked at these intervals. • Dose increases should be monitored by FBC, creatinine and eGFR (electrolytes profile), ALT and albumin (LFT) every 2 weeks until dose stable for 6 weeks then revert back to previous schedule. • For combination treatment (used infrequently) of leflunomide and methotrexate the specialty team will advise on monitoring requirements. **ICE orderset**: 'Leflunomide: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)	Withhold and discuss with relevant clinical team if any results are: • WCC < $3.5x10^9$/L, particularly if falling trend • Neutrophils < $1.6x10^9$/L particularly if falling trend • unexplained eosinophilia >$0.5x10^9$/L • platelets < $140x10^9$/L • ALT > 100u/l • unexplained reduction in albumin (below 30g/l) • Creatinine increased > 30% over 12 months • eGFR decreases <60ml/min/1.73m^2 and there is significant falling trend • reticulocytes less than $80x10^9$/L and haemoglobin less than 90g/l • haemoglobin below 45g/l or dropped by over 30g/l from baseline • MCV > 105 fl particularly if rising trend

Levothyroxine

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• ECG and TSH. • FT4 is auto added if TSH is outside reference range.	• From 6 weeks, TSH every 3 months until the level has stabilised (2 similar measurements within the reference range 3 months apart), and then once a year. • Consider measuring FT4 as well as TSH for adults who continue to have symptoms of hypothyroidism after starting levothyroxine. Please phone the duty biochemist to discuss. • FT4 is auto added if TSH is outside reference range.	• Aim to maintain TSH levels within the reference range when treating primary hypothyroidism with levothyroxine. • Be aware that the TSH level can take up to 6 months to return to the reference range for people who had a very high TSH level before starting treatment with levothyroxine or a prolonged period of untreated hypothyroidism.

Lithium: Priadel®

Exclude pregnancy, consider contraception as appropriate, as risk of teratogenicity with lithium. Shared care guideline on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

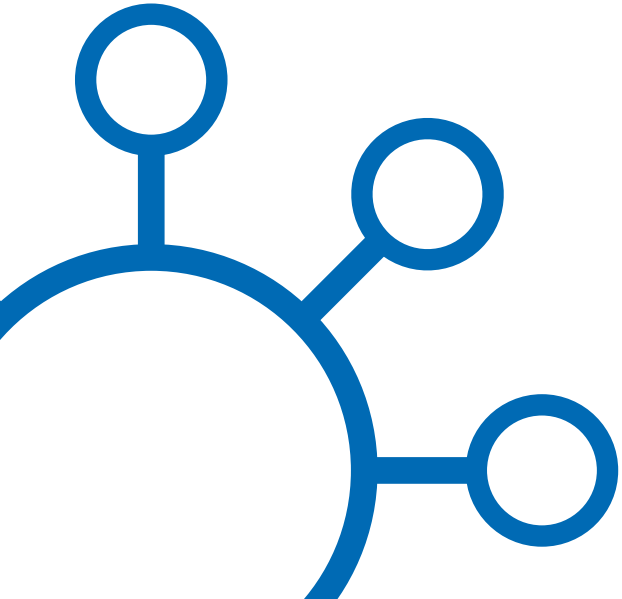
• Electrolytes (GP), TSH, FBC, bone profile.
• ECG if existing cardiac disease or risk factors.
• BMI.
 	
ICE orderset: 'Lithium: Pre-treatment' (Electrolytes (GP), bone, TSH and FBC)
	• Serum lithium 5 to 7 days after initiation, then weekly after each dose change until the level is stable within the therapeutic range for that patient, then after 1 month, then if stable every 3 months for the first year.
	• After first year, measure plasma lithium levels every 6 months, or at least 3 months for people in any of the following groups:
	  • aged 65 years and over
	  • taking drugs that interact with lithium
	  • at risk of impaired renal or thyroid function, raised calcium levels or other complications
	  • have poor symptom control
	  • poor adherence
	  • whose last plasma lithium level was 0.8 mmol per litre or higher
	• Sample to be taken 12 hours post-dose, so prescribe lithium as a single night dose.
	• Electrolytes (GP), TSH, BMI every 6 months. Bone profile and ECG (if cardiac disease or risk factors) annually. Annual physical health review in those with bipolar disorder.
	• Laboratory will auto-add on fT4 if TSH is abnormal, please state in clinical details that patient is on lithium.
	
	ICE orderset: 'Lithium: Monitoring' (Electrolytes (GP), bone, TSH and lithium)
		• Recommended therapeutic range in bipolar disorder is usually 0.6 to 0.8mmol/l (0.75mmol/l) in healthy adults, but lower (for example 0.4mmol/l) in elderly or frail patients. Prescribe lithium products by brand name. RCHT and CFT use Priadel.
		• Serious lithium interactions occur with:
		  • thiazides and related diuretics
		  • NSAIDs
		  • sodium bicarbonate containing
		  • non-prescription antacids
		  • urinary alkalinising agents

Methotrexate (injection and oral)

Shared care guideline on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• FBC, electrolytes (GP), LFT, CXR.
• Pulmonary function tests should be considered in selected patients (for example abnormal shadowing on CXR).
• Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients.
 	
ICE orderset: 'Methotrexate (Inj/Oral): Pre-treatment and monitoring' (Electrolytes (GP), LFT, CRP and FBC)
	• FBC, LFT, electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for 3 months, then at least once every 12 weeks. CRP should be measured at the same intervals.
	• Dermatology request FBC, LFT and electrolytes (GP) weekly (rather than fortnightly as their patients more prone to fluctuations in liver enzymes) for first 4 weeks, then monthly for 3 months. Dermatology also request pro-collagen III (PIIINP) test at regular intervals. This will be carried out by secondary care if indicated.
	• Consider checking FBC if an interacting drug is prescribed.
	• For combination treatment (used infrequently) of Methotrexate and Leflunomide the specialty team will advise on monitoring requirements.
	
	ICE orderset: 'Methotrexate (Inj/Oral): Pre-treatment and monitoring' (Electrolytes (GP), LFT, CRP and FBC)
		• Withhold and discuss with relevant clinical team if any results are:
		  • WCC < $3.5x10^9$/L, particularly if falling trend
		  • Neutrophils < $1.6x10^9$/L particularly if falling trend
		  • MCV > 105 fl particularly if rising trend
		  • unexplained eosinophilia > $0.5x10^9$/L
		  • platelets < $140x10^9$/L
		  • ALT and/or AST> 100U/L
		  • unexplained reduction in albumin (below 30g/L)
		  • Creatinine increased > 30% over 12 months
		  • eGFR decreases <60ml/min/1.73m^2 and there is significant falling trend
		  • eGFR decreases < 30mL/min/1.73m^2, discontinue methotrexate and repeat the test 10 to 14 days later
		  • severe nausea or diarrhoea, Severe mouth or genital ulceration



Mineralocorticoid receptor antagonists: eplerenone and spironolactone

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• Electrolytes (GP). **ICE ordersets**: 'Eplerenone: Pre-treatment and monitoring' or 'Spironolactone: Pre-treatment and monitoring' (Electrolytes (GP))	• In severe heart failure electrolytes (GP) 1 week after initiation and after any dose increase, then monthly for first 3 months, then every 3 months for 1 year, and then every 3 to 6 months. **ICE ordersets**: 'Eplerenone: Pre-treatment and monitoring' or 'Spironolactone: Pre-treatment and monitoring' (Electrolytes (GP))	• Eplerenone should not be started in patients with a baseline serum potassium greater than 5.0mmol/l, an eGFR of less than 30ml/min/1.73m^2 or severely impaired liver function (Childs-Pugh Class C). • Decrease the dose of eplerenone if the potassium rises to >5.5-5.9 mmol/l. • Stop eplerenone if potassium rises to >6.0mmol/l or creatinine rises to >220micromol/l. • Reduce dose of spironolactone to 25mg on alternate days or halve the dose if potassium > 5.5 mmol/L or creatinine > 220 micromol/L or eGFR < 30mL/min/1.73m^2. • Stop spironolactone and seek specialist advice if potassium is > 6 mmol/L or creatinine > 310 micromol/L or eGFR < 20mL/min/1.73m^2.

Mycophenolate

Shared care guideline for use in rheumatology on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• FBC, electrolytes (GP), LFT and CXR.
• Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients.
 	
ICE orderset: 'Mycophenolate: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
	• FBC, LFT, electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for 3 months, then at least once every 12 weeks.
	
	ICE orderset: 'Mycophenolate: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
		• Withhold and discuss with relevant clinical team if any results are:
		  • WCC < 3.5x10^9/L, particularly if falling trend
		  • Neutrophils < 1.6x10^9/L particularly if falling trend
		  • MCV > 105fl particularly if rising trend
		  • unexplained eosinophilia >0.5x10^9/L
		  • platelets < 140x10^9/L
		  • ALT > 100u/l
		  • unexplained reduction in albumin (below 30g/l)
		  • Creatinine increased > 30% over 12 months
		  • eGFR decreases <60ml/min/1.73m^2 and there is significant falling trend

Phenytoin

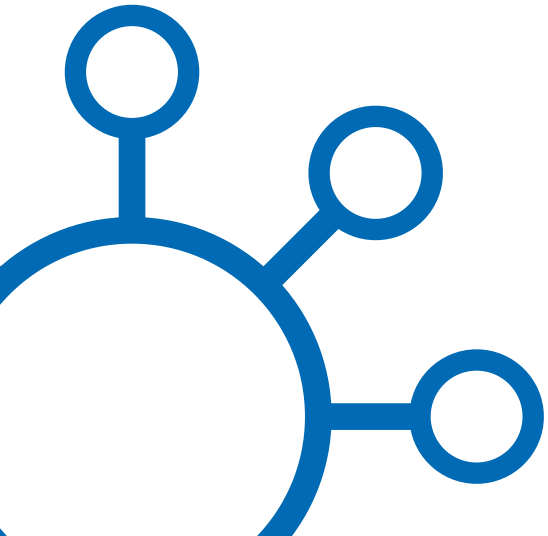
Discuss teratogenicity risks with women of child-bearing age.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• LFT, FBC, electrolytes (GP) and vitamin D. **ICE orderset**: 'Phenytoin: Pre-treatment' (Electrolytes (GP), LFT, FBC and VitD)	• NICE suggest FBC, electrolytes (GP), LFT, bone and vitamin D every 2 to 5 years. **ICE orderset**: 'Phenytoin: Monitoring' (Electrolytes (GP), bone, LFT, FBC and VitD)	• Leucopenia, which is severe, progressive, or associated with clinical symptoms requires withdrawal (if necessary under cover of suitable alternative). Chronically, Phenytoin can cause megaloblastic anaemia and osteomalacia by interfering respectively with folic acid and vitamin D metabolism.

Riluzole

Shared care guideline on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal
• FBC and LFT. **ICE orderset**: 'Riluzole: Pre-treatment and monitoring' (LFT and FBC)	• FBC and LFTs monthly for 3 months, then 3 monthly for 9 months then annually. **ICE orderset**: 'Riluzole: Pre-treatment and monitoring' (LFT and FBC)	• Withhold and discuss with relevant clinical team if any results are: • WBC<$3.5x10^9$ /l • Neutrophils <$2x10^9$ /l • ALT greater than 5 times the upper limit of normal



Sacubitril valsartan (Entresto)

Shared care guideline on Eclipse formulary.

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• Electrolytes (GP).
• Entresto should not be co-administered with an ACE-I or an ARB. Due to the potential risk of angioedema when used concomitantly with an ACE-I, it must not be started for at least 36 hours after discontinuing ACE-I therapy.
 	
ICE orderset: 'Sacubitril Valsartan: Pre-treatment and monitoring' (Electrolytes (GP))
	• Measure electrolytes (GP) 1 to 2 weeks after initiation and after each dose increment.
	• Once dose stable every 6 months and consider more frequently in patients taking combined loop and thiazide diuretic therapy, and in those taking mineralocorticoid receptor antagonist.
	• Monitor BP routinely.
	
	ICE orderset: 'Sacubitril Valsartan: Pre-treatment and monitoring' (Electrolytes (GP))
		• If serum potassium level is >5.4 mmol/l discontinuation should be considered.
		• Withhold and discuss with relevant clinical team if any results are:
		  • ALT > 100U/L
		  • Unexplained reduction in albumin (below 30g/L)

Sodium valproate and valproic acid

Discuss very significant teratogenicity risks in women of child-bearing age. A patient guide and card should be provided to all female patients. Follow the valproate pregnancy prevention programme.

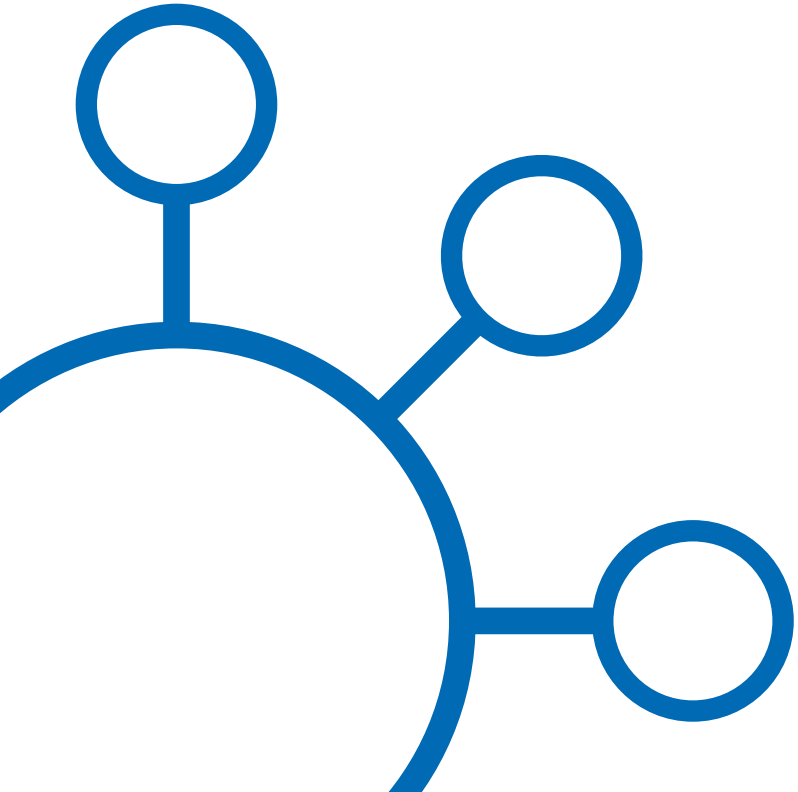
Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• LFT, FBC, coagulation screen, and BMI.
• If used for bipolar disorder NICE additionally recommend assessment of:
  • diet, nutritional status and level of physical activity
  • cardiovascular status, including pulse and blood pressure
  • metabolic status, including fasting blood glucose, glycosylated haemoglobin (HbA1c) and blood lipid profile
 	
ICE orderset: 'Sodium valproate and valproate: Pre-treatment' (LFT, FBC and coag)
	• Until stable LFT and PT periodically within first 6 months of treatment.
	• Valproate levels are not needed unless there is suspected non-compliance or toxicity.
	
	Ongoing monitoring
	• FBC, coagulation screen is recommended before surgery, and in cases of spontaneous bruising or bleeding.
	• LFT, FBC and BMI (in those who gain weight rapidly) after 6 months.
	• As part of annual physical monitoring for patients with bipolar disorder NICE additionally recommend CV status (including pulse and BP), metabolic status (including fasting blood glucose, HbA1c, and lipid profile), and weight.
		• Raised LFT are usually transient but patients should be assessed clinically.
		• FBC, LFT and coagulation monitored until return to normal.
		• Discontinue if abnormally prolonged prothrombin time, abnormal liver function or blood dyscrasias.

Sulfasalazine

Pre-treatment	Suggested monitoring requirements	Action to be taken if results abnormal

• Electrolytes (GP), FBC, LFT.
• Consider screening for hepatitis B and C, VZV serology, and HIV serology in all patients.
 	
ICE orderset: 'Sulfasalazine: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
	• FBC, LFT, Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for 3 months, then at least once every 12 weeks.
	• After first year there is no requirement to monitor bloods, but may be advisable if the patient has other co-morbidities for monitoring their condition.
	
	ICE orderset: 'Sulfasalazine: Pre-treatment and monitoring' (Electrolytes (GP), LFT and FBC)
		• Withhold and discuss relevant clinical team if any results are:
		  • WCC < $3.5x10^9$/L, particularly if falling trend
		  • Neutrophils < $1.6x10^9$/L particularly if falling trend
		  • MCV > 105 fl particularly if rising trend
		  • Unexplained eosinophilia > $0.5x10^9$/L
		  • Platelets < 140x 10^9/L
		  • ALT > 100U/L
		  • Unexplained reduction in albumin (below 30g/L)
		  • Creatinine increased > 30% over 12 months
		  • eGFR decreases <60mL/min/1.73m^2 and there is significant falling trend



Glossary of abbreviations

ACE-Is
Angiotensin-converting-enzyme inhibitors

ADH
Anti-diuretic hormone

ARBs
Angiotensin receptor blocker

BMI
Body mass index

BP
Blood pressure

BSR
British Society for Rheumatology

CKD
chronic kidney disease

CPMS
Clozapine patient monitoring service

CRP
C-reactive protein

CV
Cardiovascular

CXR
Chest X-ray

DOACs
Direct oral anti-coagulants

EBV
Epstein-Barr virus

ECG
Electrocardiogram

eGFR
Estimated glomerular filtration rate

FBC
Full blood count

fT3
Tri-iodothyronine

fT4
Thyroxine

HbA1c
Glycated hemoglobin

HIV
Human immunodeficiency virus

IBD
Inflammatory bowel disease

ICE
Integrated clinical environment

LFT
Liver function tests

MCV
Mean corpuscular volume

NICE
National Institute for Health and Care Excellence

NMS
Neuroleptic malignant syndrome

NSAIDs
Non-steroidal anti-inflammatory drugs

PT
Prothrombin time

QTc
Corrected QT interval

TFTs
Thyroid function tests

TMPT
Thiopurine S-methyltransferase

TNI
Troponin

TSH
Thyroid stimulating hormone

VZV
Varicella-zoster virus

WBC
White blood cells

WCC
White cell counts