GUIDANCE FOR MONITORING DRUG THERAPY IN ADULTS

This documented 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 December 2020.

GP surgeries using ICE ordercomms (and samples going to Treliske) please note ordersets have been set up and can be found under the 'Ordersets' panel on the 'Drugs' page.

DRUG NAME	PRE-TREATMENT	WHEN	ACTION TO BE TAKEN IF RESULTS ABNORMAL
ACE INHIBITORS and ANGIOTENSIN II ANTAGONISTS **See separate entry for sacubitril valsartan**	Electrolytes (GP) BP	**HEART FAILURE -** Request electrolytes (GP) and urea 1-2 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. **HYPERTENSION -** Electrolytes (GP) should be requested one week after starting treatment or changing dose in patients with hypertension. Request electrolytes (GP) least annually in stable hypertensive patients that do not have diabetes. **CKD -** Request electrolytes (GP) and urea 1-2 weeks after initiation and after each dose increment. Then BP should be measured every 3–6 months, and request electrolytes (GP) and urea every 12 months (unless required more frequently because of impaired renal function). **POST-MI -** Request Electrolytes (GP) and measure BP 1-2 weeks after initiation and after each dose increment. Then request electrolytes (GP) and BP at least annually. More frequent monitoring may be needed in patients who are at increased risk of deterioration in renal function. Patients with chronic heart failure should be monitored in line with 'heart failure' described above.	Consider modifying treatment if any of results are: If eGFR falls by 25% or more or plasma creatinine increases by 30% or more from baseline, stop the ACEI/ARB or reduce to a previously tolerated dose once potential alternative causes of renal impairment have been ruled out. If the changes indicating a decrease in renal function are less than described do not modify the dose but repeat the test in 1-2 weeks. Potassium rises above 6mmol/L and other drugs known to promote hyperkalaemia have been discontinued. If Na <132mmol/L specialist advice should be obtained
AMIODARONE	TSH, LFT's, Electrolytes (GP) Chest X-ray, ECG,	TSH every 6 months and for up to 12 months after cessation. Serum TSH should also be measured when thyroid dysfunction is suspected. On requesting please state the patient is on Amiodarone. LFTs every 6 months. Electrolytes (GP) every 6 months. Chest X-ray every 12 months. 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).	If biochemistry results 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, chest X ray should be repeated 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.
AZATHIOPRINE and MERCAPTOPURINE (which is the active moiety of azathioprine)	FBC, LFTs, Electrolytes (GP) TPMT Consider screening for hepatitis B & C, EBV, VZV serology, & HIV serology in all patients.	**RHEUMATOLOGY** - FBC, LFTs, CRP, Electrolytes (GP) fortnightly until dose stable for 6 weeks, then monthly for three months, then at least once every 12 weeks (closer monitoring may be advised in high-risk patients). **DERMATOLOGY** - FBC and LFTs weekly until stable on maintenance dose. Otherwise same as for rheumatology. Once the 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 and LFT weekly for first 8 weeks and if stable 3-MONTHLY thereafter. Frequency of monitoring may be changed at discretion of specialist e.g. One	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, ALT and/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. Abnormal bruising or severe sore throat occurs (withhold until FBC available) MCV>10^5 particularly if rising trend Check serum folate and B12 and TSH and discuss results with relevant team

		fairly common practice is to perform a full blood count every 2-4 weeks for 2 months and then every 4-8 weeks. Repeat FBC and LFTs 2 weeks after dose change and then 3-monthly (as above). Electrolytes (GP) should be checked 6 monthly **NOTE** that for renal transplant patients, azathioprine monitoring is generally conducted by the Renal Unit (unless requested otherwise) and, for stable patients, may be less frequent than above.	
BALSALAZIDE and MESALAZINE and OLSALAZINE	Electrolytes (GP)	Electrolytes (GP) requested at 3 months, then annually. British Society of Gastroenterology support annual assessment of renal function as being sensible Urgent FBC if unexplained bruising, bleeding, sore throat, fever.	British Society of Gastroenterology recommends to stop therapy if renal function deteriorates.
CARBAMAZEPINE Discuss risks of teratogenicity with women of child-bearing age	FBC, LFTs, Electrolytes (GP) – at the discretion of the physician	FBC, Electrolytes (GP), LFTs only if clinically indicated	Modify treatment if any of results are: WBC<$3.5x10^9$ /l Neutrophils <$1.6x10^9$ /l Platelets <$140x10^9$/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.
CARBIMAZOLE	TSH, WBC	TSH every 4-6 weeks after initiation. Reduce frequency to every 3 months once a maintenance dose is achieved. Note laboratory will auto-add on fT4 if TSH is abnormal, please state in clinical details that patient is on carbimazole. Following the onset of any signs and symptoms of hepatic disorder, stop carbimazole and perform liver function tests immediately Urgent FBC if patient has signs of significant infection / sore throat	Maintain reference range for TSH of 0.3-5.5 mU/l Withhold and discuss with relevant clinical team if any results are: leucocyte count falls to <$1500x10^6$/L or neutrophil count to <$500x10^6$/L
CICLOSPORIN (to be prescribed by brand name as bioavailability is influenced by the preparation used)	FBC, Electrolytes (GP), LFTs, BP, Lipid profile, magnesium. Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients.	**RHEUMATOLOGY & DERMATOLOGY** - FBC, LFTs Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three months, then at least once every 12 weeks. Fasting blood glucose and/or HbA1c at least annually of if there is clinical suspicion. Check BP each time patient attends clinic for blood test and maintain </=140/90	Withhold and discuss with relevant clinical team if any results are: WCC < 3.5 x 109/l, particularly if falling trend Neutrophils < 1.6 x 10^9/l particularly if falling trend MCV > 105 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/l, ALT and/or AST > 100 U/L Unexplained reduction in albumin (below 30g/L) Creatinine increased 30% above baseline on more than one occasion eGFR decreases <60mL/min/1.73m^2 and there is significant falling trend Significant rise in fasting lipids
DOACs apixaban, dabigatran, edoxaban, rivaroxaban	Electrolytes (GP) Liver function should be checked prior to initiating apixaban and edoxaban FBC, clotting screen (results obtained in the previous 6 weeks are acceptable in stable patients) Weight (recent i.e. within last 12 months or more recently if suspected weight loss/gain)	Electrolytes (GP), LFT, FBC annually. More frequent Electrolytes (GP), / LFTs advised if intercurrent illness that may impact on renal or liver function.	If renal function has declined, review treatment, as DOAC may need to be stopped or a lower dose may be required
HYDROXY-CHLOROQUINE	FBC, Electrolytes (GP), LFTs Ask about visual	Formal assessment of the retinas and visual acuity at baseline (within first 12 months of treatment), then on an annual basis after 5 years of treatment. Can be undertaken by optometrist in primary care. If patient reports visual symptoms (blurring, difficulty reading text, or flashing lights) stop treatment and arrange ophthalmology review.	

	impairment (not corrected by glasses). Record near visual acuity using a standard reading chart (with reading glasses if worn). Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients	Maximum daily dose prescribed should not exceed 5mg/kg actual body weight and 6.5mg/kg calculated lean body weight.	
LEFLUNOMIDE	FBC, Electrolytes (GP), LFTs BP on 2 occasions 2 weeks apart (if > 140/90 treat before commencing leflunomide) Body weight Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients	FBC, LFTs Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three months, then at least once every 12 weeks. BP (as hypertension is a possible side effect) and weight should be checked at these intervals.	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 MCV > 105 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/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
LITHIUM - Priadel® Exclude pregnancy, consider contraception as appropriate, as risk of teratogenicity with lithium.	Electrolytes (GP),Urea TSH FBC Bone profile ECG if existing cardiac disease or risk factors BMI	Serum lithium 5-7 days after initiation, then weekly after each dose change until the level is stable within the therapeutic range for that patient, then after one month, then if stable every 3 months for the first year. After the first year, measure plasma lithium levels every 6 months, or every 3 months for people in any of the following groups: older people (65 years and over); people taking drugs that interact with lithium; people who are at risk of impaired renal or thyroid function, raised calcium levels or other complications; people who have poor symptom control; people with poor adherence; people 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. Note laboratory will auto-add on fT4 if TSH is abnormal, please state in clinical details that patient is on Lithium.	The recommended therapeutic range in bipolar disorder is usually 0.6–0.8mmol/L in healthy adults, but lower (eg 0.4mmol/L) in elderly or frail patients. Prescribe lithium products by brand name – RCHT and CPT use Priadel. **Serious lithium interactions occur with: thiazides and related diuretics; NSAIDs; sodium bicarbonate containing, non-prescription antacids or urinary alkalinising agents**

METHOTREXATE (Injection and oral)	FBC, Electrolytes (GP), LFT's, CXR Pulmonary function tests should be considered in selected patients (e.g. abnormal shadowing on CXR. Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients.	FBC, LFTs, Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three months, then at least once every 12 weeks. *Consider checking FBC if an interacting drug is prescribed*	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 MCV > 105 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/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
MINERALO-CORTICOID RECEPTOR ANTAGONISTS **EPLERENONE AND SPIRONOLACTONE**	Electrolytes (GP)	In severe heart failure Electrolytes (GP) 1 week after initiation and after any dose increase, monthly for first 3 months, then every 3 months for 1 year, and then every 6 months.	Eplerenone should not be started in patients with a baseline serum potassium greater than 5.0mmol/L, an eGFR of less than 30 mL/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 if potassium rises to >6.0mmol/L or creatinine rises to >220micromol/L. Discontinue or interrupt spironolactone treatment for serum potassium >6 mmol/L or creatinine rises to >220micromol/L.
MYCOPHENOLATE	FBC, Electrolytes (GP) LFT & CXR Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients	FBC, LFTs Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three months, then at least once every 12 weeks	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 MCV > 105 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/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
PHENYTOIN Discuss teratogenicity risks with women of child-bearing age	LFTs, FBC	FBC only if clinically indicated. NICE suggest FBC, Electrolytes (GP), LFTs, Vitamin D levels, and other tests of bone metabolism every 2-5 years for adults taking enzyme-inducing drugs.	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		FBC and LFTs monthly for 3 months, 3 monthly for 9 months then annually	Withhold and discuss with relevant clinical team if any results are: WBC<3.5x10^9 /l Neutrophils <1.6x10^9 /l Platelets <140x10^9/l ALT or Alk. Phos greater than 2 x upper limit
SACUBITRIL VALSARTAN (Entresto)	Electrolytes (GP) and urea At least a 36-hour washout period if patient previously on ACE-I, and any previous ARB has been stopped	Measure serum urea, Electrolytes (GP) 1-2 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.	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 and/or AST > 100U/L Unexplained reduction in albumin (below 30g/L)

SODIUM AUROTHIOMALATE (GOLD INJECTION)	Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients	Before each injection check a urine specimen for proteinuria. FBC, LFTs Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three months, then at least once every 12 weeks.	Urinalysis for blood and protein prior to each dose. If protein is detected by urine dip: Trace or +1: Send an MSU +2 or more: Random urine Protein:Creatinine ratio 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 MCV > 10^5 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/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
SODIUM VALPROATE & 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.	LFTs, 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	**Until stable** LFTs and PT periodically within first 6 months of treatment. **Ongoing monitoring** FBC, coagulation screen is recommended before surgery, and in cases of spontaneous bruising or bleeding. LFTs, 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 (incl pulse and BP), metabolic status (incl fasting blood glucose, HbA1c, and blood lipid profile, and weight. Valproate levels are not needed unless there is suspected non-compliance or toxicity.	Raised liver enzymes are usually transient but patients should be assessed clinically; and FBC, liver function and coagulation monitored until return to normal. Discontinue if abnormally prolonged prothrombin time, abnormal liver function or blood dyscrasias
SULFASALAZINE	FBC, LFTs Electrolytes (GP) Consider screening for hepatitis B & C, VZV serology, & HIV serology in all patients	FBC, LFTs Electrolytes (GP) fortnightly until stable dose for 6 weeks, then monthly for three 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.	Withhold and discuss 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 MCV > 10^5 particularly if rising trend Unexplained eosinophilia >0.5 x 10^9/L Platelets < 140 x 10^9/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