

Clinical Measurements Student Management Group

The role of the Queensland Health Clinical Measurements Student Management Group is to promote and support clinical placements specific to the clinical measurement professions. This includes: cardiac science, respiratory science, sleep science, clinical neurophysiology, critical care science, heart valve bank, urology and vascular ultrasound.

The group work towards developing processes for communication between Queensland Health and Universities who support career pathways for the above professions.

What is Clinical Measurements?

Clinical Measurements is an Allied Health Profession supporting the care of patients in hospitals. They form a key part of the multidisciplinary teams responsible for the investigation and treatment of patients. The four major disciplines within the field are Sleep Science, Neurophysiology, Respiratory Science and Cardiac Science. Discipline specific information starts on page 3.

Discipline Placement Locations?

Division	Hospital	Discipline				
		Sleep	Neurophysiology	Respiratory	Vascular	Cardiac
Metro North	The Prince Charles Hospital	X		X		X
Metro North	Royal Brisbane Women's & Children Hospital	X	X	X	X	X
Metro South	Princess Alexandra Hospital	X		X		X
Metro South	Logan					X
Metro South	Mater Brisbane			X		X
Sunshine Coast	Nambour					X
Mackay	Mackay		X			
Gold Coast	Gold Coast					X
Townsville	Townsville	X		X		X
Central Queensland	Rockhampton					X
Cairns & Hinterland	Cairns			X		
<i>Cape York*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>Mt Isa*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>Central West*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>South West*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>Darling Downs*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>Wide Bay*</i>	<i>No Clinical Measurements placements currently offered</i>					
<i>West Moreton*</i>	<i>No Clinical Measurements placements currently offered</i>					

Frequently Asked Questions

I want to do placement within clinical measurements, who do I speak to?

You are required to contact University Student Placement Coordinator. They are in regular contact with Clinical Measurement Disciplines across the state and can best indicate when placements are available

What do I need to do before I start a placement?

The link to Student Deeds & Pre placement gives the best account of paperwork, vaccinations etc required by Queensland Health. Your University Student Placement Coordinator will be aware of this information and anything additional that hasn't been published on the site.

Can I speak to/visit a site to see if it's what I am interested in?

Site visits can be arranged through your University Student Placement Coordinator. Most Universities will hold career information seminars at which the Student Management Group will present and answer any questions pertaining to field you may have.

Where can I find more information about the professions?

Cardiac Science – CSANZ/Picsa

<http://www.picsa.org.au/>

<http://www.csanz.edu.au/>

Neurophysiology – ANTA

<http://www.anta.asn.au/>

Respiratory Science – ANZSRS

<http://www.anzsrs.org.au/>

Sleep Science - ASTA

<http://sleeptechnologists.org/>

Who do I Contact to organise a practicum placement?

To find out more, please contact your University Student Co-ordinator



Clinical Measurement Investigations

Respiratory Sciences

Spirometry

Assessment of dynamic lung capacity and some mechanical aspects of lung function via a maximally forced expiration from completely full lungs, often followed by a maximally forced inspiration.

Gas Transfer Factor/Diffusing Capacity

Assessment of the ability of the lungs to transfer gas from the air spaces in the lungs through to the bloodstream.

Static Lung Volumes

Measurement of total lung capacity and subdivisions thereof, by either dilution of an inert tracer gas during rebreathing, or using body plethysmography.

Cardio-pulmonary Exercise Testing

Maximal stress test with continual monitoring of respiratory & cardiac parameters, including oxygen uptake, carbon dioxide production, etc.

Challenge Tests

Tests to assess hyper-responsiveness of airways in the lungs (usually associated with asthma) via a range of challenge agents, including mannitol, methacholine, histamine, dry air, hypertonic saline, and exercise.

6 Minute Walk Tests

Assessment of functional exercise capacity.

Skin Prick Tests

Assessment of allergic status via response to minute quantity of allergen introduced into the upper layer of the skin.

High Altitude Simulation

Assessment of fitness-to-fly for individuals with lung disease via response to breathing low oxygen mixtures (15%).

Respiratory Muscle Pressures

Assessment of the global respiratory muscle function via pressures generated at the mouth and/or nose (inspiratory and expiratory).

Shunt Fraction

Assessment of degree of blood 'shunting', i.e. amount of blood passing from the venous to arterial systems without passing through gas exchanging regions of the lung.

Lung/Chest Wall Mechanics

Assessment of lung and respiratory system mechanical parameters, especially lung compliance and trans-diaphragm pressures via analysis of pressures generated within the thorax & abdomen

Forced Oscillation Techniques

Non-invasive assessment of respiratory system mechanics via measurement of the response of the system to small, externally applied, pressure changes.

Ambulatory Oxygen Assessments

Assessment of suitability for home oxygen therapy.

Control of Breathing

Assessment of the respiratory control system via response to hypercapnia and/or hypoxia.

Expired Nitric Oxide (eNO) Measurement.

Measure of expired NO fraction used as a marker of eosinophilic airway inflammation



Clinical Measurement Investigations

Sleep Sciences

As a student completing a practicum within a Queensland Health Sleep Disorders Centre you will gain valuable skills in polysomnography (PSG). A sleep sciences placement includes the application of multidisciplinary skill sets including; cardiac, neurophysiology and respiratory sciences.

Students are comprehensively immersed in all the investigations performed within sleep science. Support and training is provided to develop the necessary skills required to contribute to the multidisciplinary team environment within a Sleep Disorders Centre.

Sleep science Clinical Measurement Practitioners (Sleep CMPs) primarily use polysomnography to assist with the diagnosis and treatment of a range of sleep related disorders. Polysomnography is a comprehensive physiological monitoring system for recording respiratory, cardiac, neurological and other parameters for later analysis.

In a clinical setting, a sleep CMP's role extends well beyond polysomnography to include ward rounds, outpatient clinics, patient education and related motivational interviewing techniques, insomnia treatment, sleep related research and information technology development.

The sleep CMP undertakes systematic analysis of PSG data and the preparation of diagnostic or treatment investigation reports. During this process they will work within a multidisciplinary team environment comprised of allied health, nursing and medical professionals.

Diagnostic sleep investigations use polysomnography to identify:

- Sleep apnoea – obstructive and /or central in origin
- Sleep related breathing disorders including respiratory failure
- Behavioural sleep disorders
- Cardiac associated sleep disorders
- Neurological sleep disorders
- Circadian rhythm disorders
- Narcolepsy and excessive sleepiness syndromes
- Sleep related movement disorders

Polysomnography is also used to assess the effectiveness of treatments such as:

- Continuous Positive Airway Pressure (CPAP)
- Adaptive Servo Ventilation (ASV)
- Non-Invasive Ventilation (NIV or BiPAP)
- Mandibular Advancement Splint (MAS)
- Other potential treatments undergoing evaluations
- Pharmacological treatments



Clinical Measurement Investigations

Neurophysiology

Electroencephalography (EEG)

Electroencephalography is the recording and analysis of the electrical activity that is produced by the brain. The EEG is used in the investigation/diagnosis of epilepsy, myoclonus, encephalopathy, encephalitis and other such disorders such as Creutzfeldt-Jakob Disease. The EEG is also useful in the evaluation of comatose patients and in the confirmation of brain death. Twenty-five electrodes are attached to the head using an international measuring system with the intention of recording from known anatomical positions.

Sleep Deprived EEG

Sleep deprived EEG is used for the investigation and diagnosis of epilepsy and is a useful activation procedure to increase the yield of inter-ictal abnormalities. The patient is sleep deprived for 24 hours prior to the test and the EEG is recorded for 40 minutes during sleep, when the patient attends the clinic.

ICU EEG

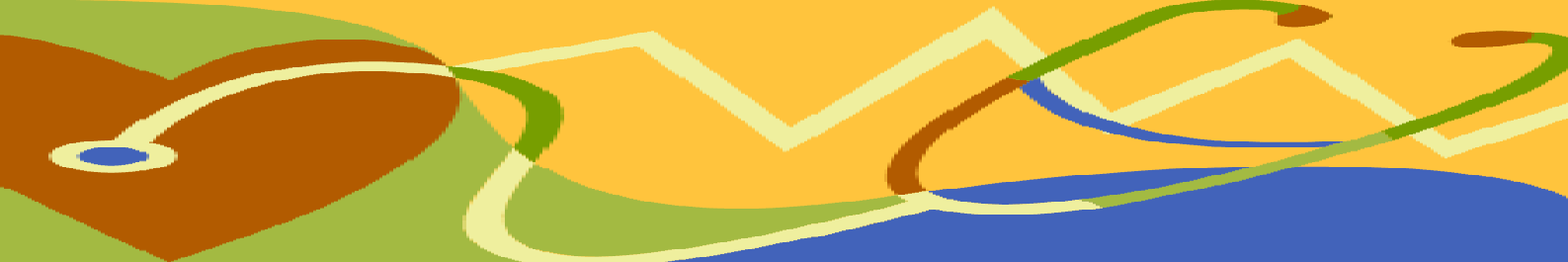
It is often necessary to perform EEG recording at the bedside in cases where the patient is too ill to be brought to the routine setting. One of these situations is the ICU patient where investigation is required for suspected Status Epilepticus (continuous seizures), nonconvulsive Status Epilepticus and Herpes Simplex Encephalitis which are considered emergency cases. Other reasons for referral include coma, seizures associated with traumatic head injury and other encephalitis and encephalopathy.

Video Telemetry EEG

This is a form of long term monitoring EEG performed in a ward setting with the patient being admitted to hospital and synchronously monitored with EEG and video. Patient referrals are for investigation of seizure type and more commonly for a work up to epilepsy surgery. Patients are constantly monitored with the aim of recording a seizure both clinically and electrographically so that the seizure focus or area of the brain causing the seizure can be identified. If all other investigations are concordant such as presence on a lesion on the Magnetic Resonance Imaging in that region and reduced cognitive and mental function related to that particular area of the brain then an option of surgery may be considered to remove that area.

Evoked Potentials

Evoked potentials are involved with recording the electrical brain responses to various modalities of stimuli such as visual, somatosensory and auditory. Responses are recorded from the various visual, motor and auditory cortices with the aim of identifying areas of dysfunction in the peripheral and central nervous system by calculating the time taken for information to be conducted from the moment the stimulus is given to when a response is recorded. Visual stimuli take the form of an alternating checkerboard pattern to stimulate the retina, clicks or tones as a form of auditory stimulus and finally electrical pulses for somatosensory stimuli. Referrals for these tests include investigation of multiple sclerosis, central hearing loss and loss of spinal integrity on all patient groups within the hospital. These test can also be performed in an intra-operative setting to monitor spinal cord integrity when scoliosis surgery or any surgery is performed that may compromise the spinal cord.



Nerve Conduction Studies

Nerve conduction studies are performed for investigation of peripheral nerve dysfunction such as trapped nerves, demyelinating pathology and axonal loss. The nerve is stimulated and the time taken for the information to pass from the site of stimulation to the site of recording is calculated and compared to normal values from control subjects. The site of recording can be another section of the nerve stimulated or the muscle that the nerve innervates. Both sensory and motor nerves can be tested depending on the clinical question posed. Nerves are stimulated using an electrical pulse. A common referral is for investigation of Carpal Tunnel Syndrome where pathology of the nerve occurs in the carpal tunnel of the hand leading to clinical symptoms such as numbness and tingling and slowing of nerve conduction through that area.



Clinical Measurement Investigations

Cardiac Sciences

12 lead Electrocardiogram (ECG)

This is the foundation of all cardiac investigations as it looks at the electrical activity of the heart muscle. An electrocardiogram is a graphic record produced by an electrocardiograph. An electrocardiograph is a device that converts the electrical activity of the heart into waveforms that represent the heart's depolarisation/repolarisation cycle. This test is performed to monitor heart rate, evaluate the effect of disease or injury on heart function, evaluate pacemaker function, evaluate response to medications, and/or obtain a baseline recording before, during and after a procedure. An ECG can also provide information about the orientation of the heart in the chest, conduction disturbances, mass of cardiac muscle, and presence of myocardial ischaemia/infarction.

Signal Averaged Electrocardiogram (SAECG)

A SAECG is a more detailed ECG with the purpose of improving the signal to noise ratio to facilitate the detection of low amplitude electrical activity. Multiple ECG tracings are recorded over a 20 minute duration which are averaged to remove interference (usually skeletal muscle) and reveal variations in the terminal section of the QRS complex. SAECG software is used to identify these small variations ("late ventricular potentials") which may predispose a person to ventricular tachyarrhythmias. SAECG may identify patients at risk of developing ventricular tachyarrhythmias who present with ischaemic heart disease, myocardial infarction, or unexplained syncope.

24 hr Holter Monitoring

Patients wear a Holter monitor to record the electrical activity of the heart for 24 or 48 hours. This is designed to look for symptomatic or asymptomatic rhythm disturbances which may not present during an ECG. The patient may keep an activity diary for the purpose of comparing daily events and symptoms with electrographic tracings. The electrical recordings are retrieved from the Holter monitor and are assessed by a Cardiac Scientist to evaluate the cardiac rhythm during these symptomatic periods.

Event Recording

An Event Monitor is worn by patients who experience occasional symptomatic events which are suspected to be of cardiac origin. The monitor is worn for one-several weeks and is designed to be activated by the patient when they are experiencing symptoms. The electrical recordings are retrieved from the event monitor and are assessed by a Cardiac Scientist to evaluate the cardiac rhythm during these symptomatic periods.

24 hr Blood Pressure Monitor

Patients wear a 24 hr blood pressure monitor to assess blood pressure throughout the day. The blood pressure cuff is programmed to inflate every 30 or 60 minutes to record the patient's blood pressure. The patient may keep an activity diary for the purpose of comparing daily events (sleep/wake time, exercise, stress, feelings of dizziness etc.) with BP results. The results are downloaded and interrogated by a Cardiac Scientist to assess irregularities in the blood pressure.

Exercise Stress Testing (EST)

Exercise stress testing is most commonly performed to assist in the diagnosis of flow-limiting coronary artery disease. It involves the monitoring of a patient's ECG and blood pressure during exercise (most commonly on a treadmill using the Bruce or Modified Bruce protocol). The increase in workload of the exercise stress test results in an increase in the patient's myocardial oxygen demand. Any areas of the heart not receiving sufficient oxygen due to a partial or full occlusion of a coronary artery will not depolarise and repolarise in the same manner as the rest of the heart, resulting in characteristic changes on the ECG reading. The role of a Cardiac Scientist during exercise stress testing is to prepare the patient for the test, operate the treadmill and monitor the ECG, alerting the doctor of any ECG changes throughout the test.



Nuclear Medicine Stress Testing

Nuclear medicine stress testing involves taking myocardial perfusion scans to evaluate coronary blood flow at rest and peak cardiac capacity. A nuclear medicine stress test may assist to:

- Find the extent of a coronary artery blockage
- Provide a prognosis for patients who have suffered a myocardial infarct
- Evaluate the effectiveness of cardiac procedures
- Ascertain the cause of chest pain.

Ideally, exercise is used to stress the heart as this is the natural way to increase myocardial oxygen demand, however in the event that the patient cannot exercise, pharmacological agents (adenosine, persantin or dobutamine) are used. At peak heart function, an isotope is injected (myoview or thallium) and myocardial perfusion scans are taken and compared to scans taken at rest. The isotope is detected by the scan and identifies areas of blood flow and blockages within the heart. The role of a Cardiac Scientist during a nuclear medicine stress test is to prepare the patient, operate the treadmill (if necessary) and monitor the ECG and blood pressure, alerting the doctor to any changes throughout the test.

Transthoracic Echocardiography

An echocardiogram (echo) is a test in which ultrasound is used to examine the heart. Using ultrasound technology a real time two dimensional or three dimensional image of the heart is generated. From this image the size, structure, and function of the heart can be measured and evaluated. Doppler ultrasound is also used to measure and assess valvular function blood flow through the heart and associated vessels. The test is performed by a Cardiac Scientist who is trained in cardiac ultrasound.

Trans-oesophageal Echocardiogram

A trans-oesophageal echocardiogram (TOE) may be performed as an alternative to a transthoracic echocardiogram. A TOE involves inserting a specialised trans-oesophageal probe into the patient's oesophagus and acquiring echocardiographic images from there. The primary advantage of conducting a TOE is obtaining clearer images, as the transducer is closer to the heart.

Stress Echocardiogram

A stress echocardiogram (stress echo) is a combination of an exercise stress test and echocardiogram. It involves taking echo pictures at rest and again following stress. Similar to a nuclear medicine stress test, the heart can be stressed using exercise or a dobutamine infusion. Stress echocardiograms are conducted to examine wall motion during peak exercise, diagnose coronary artery disease and to monitor heart function post cardiac procedure. Two Cardiac Scientists are involved in a stress echo. The role of one Cardiac Scientist during a stress echo is to prepare the patient, operate the treadmill (if necessary) and monitor the ECG and blood pressure, alerting the doctor to any changes throughout the test. The role of the second Cardiac Scientist is to perform the echocardiogram.

Tilt Table Testing

A tilt table test is used to diagnose vaso-vagal syncope. The patient is connected to an ECG and BP monitor and tilted upright on a bed to 60 degrees. The patient spends up to 30 mins in this position during which the patient is monitored for changes in ECG and BP. If this stage is uneventful, the doctor will administer a vasodilator (GTN) and the patient is monitored for up to another 30 minutes. The role of a Cardiac Scientist during a tilt test is to monitor the ECG and record BP and HR and record any observations during the test.

Electrical Cardioversion

Electrical cardioversion is the restoration of the heart's normal sinus rhythm through an electric shock delivered by a defibrillator. The electric shock is synchronised to the QRS complex and is used to slow the heart rate and restore rhythm when drug therapy is ineffective.



Left and Right Heart Cardiac Catheterisation

Cardiac catheterisation involves inserting a thin flexible tube (catheter) into the arteries, veins and chambers of the heart. Catheterisation allows several measurements and observations to be made; the catheter is capable of measuring pressures in the heart (haemodynamics) and injecting contrast into the coronary arteries (angiogram) or ventricles (ventriculogram) to obtain x-ray pictures of the cardiac structures. The procedure is known as left heart catheterisation if the catheter is inserted into the femoral artery (or a major artery within the left arm) into the aorta, coronary arteries, or left ventricle. The procedure is known as right heart catheterisation if the catheter is inserted into the right femoral vein (or a major vein within the right arm) into the vena cavae or right ventricle.

Diagnostic Coronary Angiography

Diagnostic coronary angiography is performed in conjunction with cardiac catheterisation. The catheter is positioned with the use of x-ray images within one of the coronary arteries. Contrast is then injected into the artery and x-ray images are taken to observe blood flow through the artery and identify any blockages. The test can diagnose how many arteries are blocked, where they are blocked, and the severity of the blockage(s).

Intravascular Ultrasound (IVUS)

IVUS is a test in which ultrasound technology is used to examine vascular wall architecture. Images are produced by an ultrasound wand that is attached to the distal end of a catheter. Complimenting coronary angiography IVUS is able to provide detailed information about the presence and degree of calcified plaque, quantify luminal dimensions, and characterise the composition of stenotic lesions.

Percutaneous Coronary Interventions (PCIs)

If a coronary artery blockage is detected during catheterisation, the catheter can be used to insert and inflate a balloon (angioplasty) or expand a stent (stenting) in the blocked artery. These procedures are called percutaneous coronary interventions (PCIs). PCIs may also include the removal of atheromatous plaques (atherectomy) and the use of radioactive sources to inhibit restenoses (brachytherapy). PCIs are used to reduce or eliminate the symptoms associated with coronary artery disease and prevent myocardial infarction.

Intra-Aortic Balloon Pump (IABP) Insertion

An IABP is a device placed in the descending thoracic aorta that decreases cardiac work and increases coronary blood flow. A catheter with a balloon tip is inserted and inflates during diastole, thus increasing aortic pressure during diastole and increasing coronary blood flow. The balloon then deflates prior to and during early left ventricular ejection thus reducing aortic pressure and afterload. IABPs are used by patients who present with heart pump failure, acute mitral regurgitation, unstable angina, and other conditions. An IABP can be left in situ from a few days to a month.

Balloon Valvuloplasty

Balloon valvuloplasty is a procedure that aims to improve valve function by enlarging the orifice of a stenosed valve. It is used when medical treatments have been ineffective in correcting or relieving the related problems. A balloon tipped catheter is inserted and inflated across the valve to stretch the valve open and relieve the obstruction. This procedure is often used to avoid or delay open heart surgery and valve replacement and is common in congenital heart valve disease.



Electrophysiology

An EP study involves evaluating the electrical system of the heart. EP studies are most often recommended for patients with symptoms or evidence of heart rhythm disorders. During an EP study, an electrophysiologist may provoke arrhythmias and collect data about the electrical conduction system of the heart. As a result, EP studies can help locate the specific areas of heart tissue that give rise to the abnormal electrical impulses that cause arrhythmias. The procedure involves inserting a catheter into the heart (commonly via the femoral artery). Electrodes at the tip of the catheter gather data and a variety of electrical measurements are made. These data pinpoint the location of the faulty electrical site. During this 'electrical mapping', an electrophysiologist may utilise pacing to induce an arrhythmia. Once the damaged site(s) are confirmed, the doctor may administer medications or electrical impulses to determine their ability to halt the arrhythmia. The doctor may also assess the need for an implantable device or treatment procedure such as ablation. A Cardiac Scientist who has specialised in the area of electrophysiology will assist the electrophysiologist by monitoring the ECG and assisting with the pacing.

Temporary and Permanent Pacemaker Insertion

Permanent artificial pacemakers are devices that provide electrical stimuli to cause cardiac contraction during periods when intrinsic cardiac electrical activity is inappropriately slow or absent. The essential functions of a pacemaker are to sense and pace. By sensing intrinsic cardiac electric potentials, the pacemaker can pace the heart if the contractions are too infrequent or absent. Permanent pacemakers are implanted into the chest or abdomen when the underlying cause of the rhythm disturbance is chronic and unable to be resolved. Temporary pacemakers work in the same manner and are used in emergency settings or when the underlying cause of the abnormal rhythm is expected to resolve itself. Temporary pacing may be accomplished by inserting leads to the heart:

- through a vein (usually by way of a catheter)
- through a needle placed directly through the chest wall
- directly during surgery
- through the oesophagus

Implantable Cardioverter - Defibrillators (ICDs)

An ICD is a specialised device designed to directly treat cardiac tachyarrhythmias. An ICD has three essential functions; sensing, pacing and cardioversion/defibrillation. If a patient has a ventricular ICD and the device senses a ventricular rate that exceeds the programmed cutoff rate of the ICD, the device performs cardioversion/defibrillation. Alternatively, the device may also attempt to pace rapidly for a number of pulses to attempt pace-termination of the VT.

Loop Monitoring

Loop monitoring is a long term monitoring tool to assist in the diagnosis of patients at increased risk of cardiac arrhythmias. The device is implanted subcutaneously and records electrocardiographic tracings for up to 24 months. The device can store >30 minutes of ECG tracings and can be automatically detected or patient activated. Loop monitoring has a greater diagnostic yield than 24 hour Holter monitoring and event recording and is used in patients with unexplained syncope, near syncope, and episodic recurrent palpitations.