MCH Respiratory Medicine Handbook

A quick introduction

Department of Respiratory Medicine

April 2026

Contents

Chapter 1

About the handbook

This handbook provides an introduction to the Department of Respiratory Medicine at Monash Children's Hospital for rotating junior medical staff.

You can also use the online version of this handbook at handbook.happylungs.com.au which offers a search function.

Chapter 2

Introduction

Monash Children's Hospital

Getting started in Respiratory Medicine at Monash Children's.

A quick guide.

2.1 Welcome to the department

Welcome to the Department of Respiratory Medicine at Monash Children's. We are delighted to have you with us and we want to make sure you get the most out of your rotation.

You can expect to see the breadth of Paediatric Respiratory Medicine during your training with us. As a subspecialty department we tend to see children on the more severe end of the illness spectrum. While we do see children with asthma as inpatients, these are usually children with more difficult to control disease or those who frequently need to be cared for in the Intensive Care Unit.

This is equally true for conditions such as pneumonia or bronchiolitis. Our colleagues in General Paediatrics see the brunt of admissions with these diagnoses. We usually get involved with those children who do not seem to follow the usual illness trajectory or difficulties with managing their asthma as outpatients. You will also find that clinical presentations often chose not to follow the plans that textbooks seem have laid down for them.

Children with conditions such as cystic fibrosis, pleural empyema or congenital lung abnormalities are usually admitted under our bed-card, and you can expect to care for a number of children with these conditions during your rotation. Children with chronic disease are often experts in their own health-care and we strongly advocate for this. Take it as an indicator of how empowered many of our young patients are should they point out areas in their care where they might disagree with you.

The Department of Respiratory Medicine works in close collaboration with the Melbourne Children's Sleep Centre. Particularly for children with ventilation requirements you may frequently find both departments involved in the care for the child and family in close collaboration.

Again, a heartfelt welcome to our department. I am looking forward to working with you and truly hope you will enjoy your time with us.

Dr Angela McCullagh
Department of Respiratory Medicine, Director
Monash Children's Hospital

2.1.1 Department structure

The workload in the Respiratory Department at Monash Children's is divided between six Consultant Physicians. Not all Physicians take part in regular ward service.

- Dr Angela McCullagh, Director
- A/Prof David Armstrong
- Prof Nick Freezer
- A/Prof Gillian Nixon
- Dr Rob Roseby
- Dr Marc Theilhaber

In addition, the Respiratory Department is staffed with an Advanced Training Registrar (ATR) responsible for day to day supervision of ward patients and initial evaluation of consults as well as a Resident Medical Officer (RMO). On occasion the department employs an additional ATR or overseas Respiratory trainee.

We closely collaborate with the Department of Sleep Medicine. The following physicians are appointed to the *Melbourne Children's Sleep Centre*:

- A/Prof Margot Davey
- Dr Lauren Nisbet
- A/Prof Gillian Nixon, Director Non-Invasive Ventilation Services

The respiratory consultant on ward service is available for patient-related questions at all times. The best way to contact the on-call consultant is via switch-board (ext 92 or 9594 5813).

Chapter 3

Wellbeing and Support

3.1 You matter

> *"We come unbidden into this life, and if we are lucky we find a purpose beyond starvation, misery, and early death which, lest we forget, is the common lot. I grew up and I found my purpose and it was to become a physician. My intent wasn't to save the world as much as to heal myself. Few doctors will admit this, certainly not young ones, but subconsciously, in entering the profession, we must believe that ministering to others will heal our roundedness. And it can. But it can also deepen the wound."*

Abraham Verghese, author and Professor of Medicine, Stanford University

This part of the booklet — the words you are reading right now — used to come at the end of it all, right before the appendix. You had to work your way through the bits on how to admit patients, how to organise respiratory function tests and how to fill in forms in a way that makes everyone happy with overall form and functionality. In a way, it was sitting there like an afterthought in a conversation about something different altogether but, hey, while we're at it we might as well throw in a bit of an extra line. Cheers, and have a good afternoon!

The fact that this section — where we address our own vulnerability, the way we are coping or no longer coping with stressors in our work and private life — has now moved to the very beginning of this text may give you some hope that things are changing, that your colleagues here at Monash Children's really do care about how you are doing. Coping with the stress of looking after sick children, acting on a stack of nursing calls while worrying about the upcoming FRACP exam and whether you are really, *truly* cut out to get through all of this.

Practising medicine can be an all engulfing job. In fact, the somewhat dated term "occupation" more accurately describes what it is we do. We occupy ourselves with what we do. Just think about where the term "resident" is derived from.

We get involved in people's lives on a deeply intimate level, often in times of severe crisis. We see the best in humans standing by each other. And sometimes we get a glimpse of the worst.

Parents who have so far made every decision to keep their child safe can now seemingly do very little to influence his well-being. In addition, they need to provide reassurance to other family members about things that they may not be so sure about themselves. We often tell parents how stressful their situation is to allow them to reflect on their own situation and take important time to look after themselves.

We see the amount of stress families are experiencing. In fact, it's not too hard for us to spot. It can be much harder to see our own emotional turmoil.

Accepting to be vulnerable

"*When we were children, we used to think that when we were grown-up we would no longer be vulnerable. But to grow up is to accept vulnerability... To be alive is to be vulnerable.*"

Madeleine L'Engle

When you started medical school you may have had a picture in your mind of the doctor you wanted to become. Maybe you imagined yourself as very decisive. Someone who could make good decisions rapidly even under severe mental stress. Chaos to the left, hopeless incompetence to the right and general undecisiveness in the centre — until you arrived to calm those stormy waters, bring order to chaos, fluid to the dehydrated and return hope to half-broken staff who had lost all faith.[1] Because that's how you've always been. Back when you were class captain and also, later, when you made it to school captain. Pride of the family. Hell, let's not hold back — pride of the nation. Up there, making the hard calls as easily as chosing which colour Skittle to next pop into your mouth.

Or you may have envisioned yourself more during those calmer moments, quietly involved in the emotional turmoils of patients, famlies and maybe even the treating team. Just sitting with someone when there's not a lot left to say.

But through all this did you know what working in a hospital would really be like. Outside of *Grey's Anatomy*, *Chicago Hope* or *House M.D*? Ok, so you've prepared diligently by watching all seasons of Scrubs and even made it through the train wreck that was Season 9.[2] But did you have any idea of how it'd really be like?

You had probably heard about long hours, about sick patients. You may also have heard about budget cuts and overworked health care workers, seen the odd report on dwindling satisfaction levels in junior doctors. And then for Covid to come and blow

[1] {$NOTE_LABEL}. https://youtu.be/lIXJEpLOkeg?t=46

[2] . We shall never mention that season again.

every problem we thought we might have had straight out of the water. Nothing like a pandemic to sort out one's perspective on things.

In between all of this you may have heard one of your lecturers talk about the clash experienced by many high achievers between very high self-expectations and the feeling of just not getting there — no matter how hard you try. They weren't talking about you, of course. Because you are just fine. Always have been. Always will be.

Things can get overwhelming in medicine. No, scrap that. Things *do* get overwhelming in medicine. For any of us. Being stressed, overworked, feeling pounded by the emotional impact of tragedy that unfolds in front of our eyes despite all our efforts. The current pandemic did not start any of this — can't blame Covid for everything, can you — but it certainly compounded the pressures particularly junior medical staff are experiencing on a daily basis.

Tick some boxes

When you begin your new rotation you may find it helpful to put into place a few things to help you along your time in the unit.

3.2 Schedule regular meetings with your supervisor.

> *"If you don't know where you're going, you might not get there."*
> *Yogi Berra*

Meetings with your supervisor are not at all designed to gear criticism towards you. Rather, think of them like a pit-stop where we have dedicated, protected time to check with each other that everything is in order. That things are going - or may no longer be going - in the right direction and re-adjust accordingly. Touch on what may currently make it difficult for you to perform your job and how this could be improved. What are the more difficult parts of the job, which ones are the most rewarding? What are areas where you feel you could use some more support?

These meetings are there to support you: for you to feed back on pros and cons, difficulties and joys, communication issues with certain teams or members of staff. To gain some perspective with the help of someone who may be seeing things from a different viewpoint.

3.3 Claim your overtime.

The JMS roster at MCH contains overlapping shifts designed to cover the clinical needs of our patients. There will be times when the clinical load is low and you and your colleagues may not be very busy, giving you time to catch up on your backlog, study or even get in a breather.

There are frequently times though when the clinical workload seems to exceed what the rostered teams can cope with - particularly when the afternoon shift takes over and the daytime teams are supposed to hand over their work and go home. This does not always work, when there are still many children waiting to be admitted, complex patients to sort out and many loops to close with staff and families.

If you find yourself in the situation to do required overtime make sure you put in your overtime request on your timesheet and have it signed by the Department director.

3.4 Protected personal time - afternoon off

The roster at MCH has slightly increased daily hours for JMS to help cover the clinical needs of the wards. To ensure you stay within your contracted weekly hours you have one rostered afternoon off per week. This is a time where you are not supposed or rostered to be working at MCH. It is our clear expectation that you take this afternoon off every week unless there are strong and urgent clinical care needs for you to forgo it.

We ask that the ATR and Resident coordinate their afternoons off so that at least one of you is available to cover the unit. However, please be prepared to have a valid and convincing explanation should we notice that you are not taking your regular rostered afternoon off.

Seek help. Absolutely nothing wrong with that

Almost all services in our hospital get very busy. At times things are so busy that it seems there is little time for anything else but sick children and families in need and chasing the commands your pages is throwing at you.

The thing about lack of time is that you *need to make time for important things*. If you are finding it hard to cope with the additional difficulties of work, if you come home exhausted only to lie awake for hours. If you dread coming to work. We want to know!

We want to know, because we have likely all been there and asked ourselves: "Am I cut out for this?". Some of us may still ask ourselves this question, specialists in our field with the answer to about every conceivable question always at the ready.[3] Come and talk to any team-member you feel comfortable talking to. Whether this is a nurse you get along with well, a consultant you have good rapport with or another colleague. Come find us in person, on the phone or via email.

Monash Health offer a number of services you may find useful. Find an overview on the Intranet at http://intranet.southernhealth.org.au/healthyopportunities/New_Folder/link%20pages/Mental%20Wellbeing.html

Here's a selection of available services:

- *Victorian Doctors Health Program*. Not for profit organisation that arose from the concern of a group of doctors about the difficulty for people of the medical profession - that's you and me - to turn anywhere for help. VDHP is independent of other professional organisations (i.e. AHPRA) and has no ties to any employers. They provide assistance for issues relating to stress, anxiety, substance use problems, mental or physical health concerns as well as any other health issue affecting doctors.

  VDHP have 20 years experience in looking solely after doctors. Your information is confidential (within the limits of the Health Practitioner Regulation Act of 2009). Find out more about them at www.vdhp.org.au or call them on **03 9495 6011**. There is a clinician on call 24/7 - a colleague you can talk to. After hours you leave a message on the answering service. If you are extremely concerned about anonymity either block your outgoing phone number or buy yourself a prepaid SIM card at the supermarket - it'll cost you all of $2. You can also send VDHP an email at vdhp@vdhp.org.au.

- There's a good overview of services available to you on Monash's internal Covid pages.

- ***Employee Assistance Program***
  Conducted for MonashHealth by Converge International. Call **1300 687 327** to initiate contact Mondays-Fridays 8am-8pm (weekend hours vary) or send them an email at customerservice@convergeintl.com.au. You will only need to state that you are an employee of MonashHealth and can otherwise remain anonymous. Services offered include counselling and debriefing. Converge will arrange for 4 counselling sessions, additional sessions may be available upon request. This service is free of charge to you.

[3] . If you're wondering: it is, of course, 42. See also https://en.wikipedia.org/wiki/42_(number)#The_Hitchhiker's_Guide_to_th

You can also log into their portal (use id/pw *monashhealth*) to access more information or request an appointment.

- ***Lifeline***
  Lifeline is an Australia-wide service supporting people in crisis. You're not in a crisis, just want to talk to someone? Fine as well.

  While Lifeline don't particularly specialise in doctors in need they are very experienced with humans in need (doctor or not: that includes you). You can contact them in a variety of ways. Their "chat one-on-one" service is particularly interesting as it has almost no threshold to overcome. Get on your browser and chat with the person on the other end. Feels right? Keep it on screen for a bit longer or maybe want to change over to the phone or even texting? Your call. Chat is available 7 days a week, 24h a day at https://www.lifeline.org.au/crisis-chat/.

  You can reach their direct line on **13 11 14**.

- ***AMA Peer Support***
  Staffed every day from 8 am to 10 pm, your call goes straight to the mobile phone of a trained volunteer peer. This means you're going to speak to a colleague who will know a bit about your professional background. Plus they're trained in counselling. The volunteer can link you into services best suited to your current situation or just lend an ear. The service is anonymous, it is free and you do not need to be a member of the AMA to use it. Call **1 300 853 338**.

- **Victorian Doctors Health Program** Let's have them introduce themselves:

  The Victorian Doctors Health Program (also providing services to practitioners in Tasmania) is a free, confidential service for all doctors and medical students who have concerns about their well being such as stress, mental health problems, substance use problems, or any other health issues.

  VDHP provides assistance to doctors and medical students who have any of the following concerns:

- Stress and anxiety
  Substance use problems
  Mental or physical health concerns
  Any other health issue
  Help you find your own GP/Doctor

- Advice is also provided to anyone who is concerned about a doctor or medical student. This includes family, friends, colleagues, university staff and clinical staff.
- Since the commencement of VDHP, we have assisted doctors and medical students presenting with numerous issues ranging from those having a mild impact on quality of life to those threatening careers and lives. VDHP deals with each individual case on its merits and offers a range of interventions.
- VDHP develops individual management plans and co-ordinates treatment, including arranging appropriate referrals to external treatment providers. We conduct our service with the utmost discretion. Confidentiality is of utmost priority to VDHP. However, like all health practitioners, we are required to remain in compliance with the Health Practitioner Regulation National Law Act 2009.[4]
- Sensitive to the needs of doctors and medical students, we are a non-judgmental service dedicated to improving the health and well being of those within the profession.
- ***Bush Support Telephone Service***
  This might not apply to you while you're with us at MonashHealth but you might find this useful at a different time in your life. CRANA have build a support service specifically for health care workers in rural and remote areas. This is an anonymous and free service. Call them on **1 800 805 391**. Their website has more information crana.org.au/support or a brochure you can download from https://crana.org.au/support/publications-our-survival-guides/.

[4] . Be aware that the Health Practitioner Regulation National Law Act includes sections on *mandatory reporting* should a health practitioner gain information about a colleague who is putting the community at *severe* risk of harm. More information here.

Chapter 4

Clinical Workflow

4.0.1 Role of the Respiratory resident and ATR

As the Respiratory resident or ATR you will be the foremost members of our team on the wards. You are most likely the team members our patients and their families are going to have the most contact with. Ward staff will turn to you with any acute management issues – big and small. Most you will be able to manage on your own. Others you may want to discuss with the unit consultant. Over time, you will grow increasingly confident in making even complex clinical decisions.

Don't feel pressured to make decisions you feel uncomfortable with. The Respiratory consultant on-call is always happy to discuss any clinical issues with you. In fact, the consultants do this amongst each other as well – it helps to bounce around ideas to shape the best way forward.

4.0.2 Weekly timetable

The routine

The Respiratory department offers a variety of clinical meetings and teaching sessions. Some meetings may occur in collaboration with our colleagues from Adult Respiratory Medicine. On these occasions, you may have the opportunity to follow the progress of patients who have been cared for at Monash Health since they were infants. Many are now all "grown-up", some of them may have children of their own. These opportunities of longitudinal care are likely unique in the Australian Respiratory teaching landscape.

All locations listed are at Monash Children's Hospital, unless indicated otherwise.

Monday	Tuesday	Wednesday	Thursday	Friday
9.00 am Ward round (commence in HDU, when operational)				

		8.00 am Bronchoscopy list Alternating Wednesdays MCH theatre	**9.00 am** CF-meeting and consultant ward round. Meet Aviary Ward, L4	
1.15 pm Journal Club Office Aviary ward, L4	**12.00 pm** Dept Research Meeting Lecture Theatre 3 MMC		**11.00 am** General Paediatric Radiology Meeting. Radiology Meeting Room	**12.00 pm** Sleep Teleconference (1st Friday of each month)
2.00 pm Respiratory Radiology Meeting, Radiology Meeting Room			**12.30 pm** Paediatric Grand Rounds, Monash Uni Lecture Theatre, L5	**1.00 pm** Paed Tutorial, Paediatric Seminar Room, L4
2.30 pm Consultant Ward Round	**2.45 pm** CF multi-disciplinary team meeting. **3.30 pm** Paed Sleep Meeting, MCSC, L4 Alternates with sleep teaching for JMS, MCSC, L4			

4.0.3 Ward rounds

As the unit's ATR and Resident you will be conducting daily ward rounds. On occasion the ATR may be unavailable and the resident will be rounding on their own. Most questions coming up during the round can likely be discussed with the ATR after their return.

> **On-call consultant**
>
> The on-call consultant is always available for urgent discussions and advice. Don't hesitate to call them if you have any concerns about a patient or if you are unsure about how to manage a clinical issue. They are there to support you and ensure the best care for our patients.

Ward rounds start after the General Paediatric morning handover that runs from 8.30 am - 9.00 am. Morning handover is essential and mandatory for all JRMOs. All medical teams come together in this meeting, discussing developments and new admissionswith the night team. This is a unique opportunity to stay up to date on patients you might encounter during covering shifts or when being asked to see a child for a consult.

Our unit's patients will frequently come up during these discussions. Management of airway and oxygenation issues are central to paediatric medicine and the most frequent reason for acute deterioration and admission of children to the PICU.

Make a note if there were concerns with patients under our care and bring them to the attention of the consultant when appropriate.

4.0.4 Consultant handover and ward rounds

The ward consultants change over on a weekly basis. However, some consultants elect to be on-call for two weeks at a time.

> **Consultant handover**
>
> Consultant handover occurs on **Thursdays, 9-10 am**. The unit will provide you with the current video link or you can attend in person.

Both incoming and outgoing consultant take part in handover. Depending on the ward workload only one of the team's JMS may be able to join. At times, other staff members may also join, such as an ANUM or physiotherapist.

The unit's resident or ATR presents the patients under our care. This is an excellent opportunity for you to practice presenting patients in a clear and concise way. The aim of handover is to enable both to update the incoming consultant on the clinical course of the unit's patients as well as enabling a constructive review of the management plan.

Usually, the structure of the handover will include:

- *Inpatients*
  While there is no fixed order, presenting the most complex or sickest patients first enables the team to devote more time to discussing these patients.
- *Patients under shared bedcard / in NICU*

- *Active consults*
  Consults where our our team is currently involved should be presented and discussed. New consults who have not yet been seen can be discussed with the incoming consultant after the handover.
- *HITH patients*
- *Patient expects*

4.0.5 Patients referred to us

Other teams will approach you for advice or a formal consult regarding one of their patients. We aim to see referred patients on the day of the referral or within 24 hours. Monash Health guidelines stipulate the following time-periods for review of referred patients:

- *Urgent:* within 4 hours
- *Non-urgent:* within 24 hours
- *Elective:* within 48 hours

The ATR should be made aware of referrals straight away so they can be triaged according to urgency. Ensure the referring team is clear in what they want us to do. The clearer the request, the better we can advise.

- Is the request for an ATR or a consultant review? Reviews by the ATR will always need to be discussed with the consultant on the same day.
- How urgently does the patient need to be reviewed? Some urgent reviews can't even wait for 4 hours.
- Would the referring team like an answer to a clinical question, do they need us to perform a procedure or are they asking us to take over care?

- If the request relates to bronchoscopy see that you can get an overall picture of what else is happening with the patient:
  - Are there other procedures planned for the patient during the same general anaesthetic?
  - If so, where is the procedure taking place?
  - Are there other teams involved and which other procedures are planned?
  - Who is coordinating the procedure, who is doing the bookings?
- If the patient is already known to one of the Respiratory Physicians make sure the on-call consultant is aware of this. There may be long-term plans in place.
- We are usually very happy to agree to requests to take over a patient's bedcard unless a different team would be better suited to care for this child. *Requests for change of bed card under Respiratory always require approval by the Respiratory consultant on-call.*

4.0.6 Asking another team for a patient consult

Our referrals to other teams should be concise and ask a clear clinical question. Avoid vague referrals such as "Fever. Renal cause?". Think about which specific problem we want the referred team to address. Give a brief synopsis of the patient's background, previous investigations relevant to the clinical question and our working diagnosis.

"Thank you for non-urgent review of this 6 year old boy with spastic quadriplegia, GMFCS level V. Multiple admissions for LRTI in setting of aspiration from above and below. Currently inpatient for confirmed pneumococcal LRTI, improving on BenPen. Unexpected fever spikes over past 48 hours, growth of Proteus mirabilis on CSU and rising creatinine (35□150). Need for further renal tract imaging and renal FU?"

Let the other team know how urgently out patient requires their review. If very urgent, make clear why and determine when our patient is likely to be seen by the other team. Apart from communicating your referral to the other team verbally, make sure you also refer through the EMR.

Chapter 5

Investigations

Pulmonary Function Lab

The Pulmonary Function Laboratory at Monash Health offers the whole breadth of pulmonary function tests:

- Spirometry
- Diffusion capacity measurement
- Body plethysmography (lung volume measurement)
- Oxygen assessments
- Altitude simulation tests
- Cardiopulmonary exercise testing (CPET)

The lab is also your go to address for organising oxygen equipment to be delivered to family's homes.

Keeping track of things

Particularly for CF patients lung function results are an important marker of overall health and a key factor to direct treatment. Try to keep track of current, recent and previous (6 months) results of your patients. Your consultant is likely to enquire about these during ward rounds. You can also print off graphical representations of a patient's key parameters over time (such as FEV_1, FVC, weight etc.) via *Respiro*, the lung function database software available on the G-drive. Visual representation of data, if done right, is much better digested by our brains than a row of plain numbers. In addition, time-series of data gives a better indication of what is happening with your patient than a single data point.

Consider a single reading of an oxygen saturation of 94% in a patient you're looking after. That's no too bad - certainly nothing to worry about for the moment, you'd think. So let's add a bit of clinical context.

You're looking after a 4 week old baby corrected age, born at 28 weeks. She's only been home for three weeks and presented to MCH ED a day ago with wheeze and crackles,

in keeping with a diagnosis of early bronchiolitis. She also wasn't feedings as well and pulse oximetry showed her to be hypoxaemic. She has since been doing well in subnasal O2 of 0.25 L/min, with her oxygen saturations reliably sitting above 95%.

Given the history of this baby, you'll probably feel your Spider Sense[1] going off by now. This is a vulnerable baby for a number of reasons, including extreme prematurity, early requirement of supplemental oxygen and - given the timeline of being early in this illness - a high likelihood for further deterioration. The fact that the oxygen flow that previously led to complete resolution of hypoxaemia is no longer enough should act as a strong trigger to suspect that things are currently going in the wrong direction for this baby.

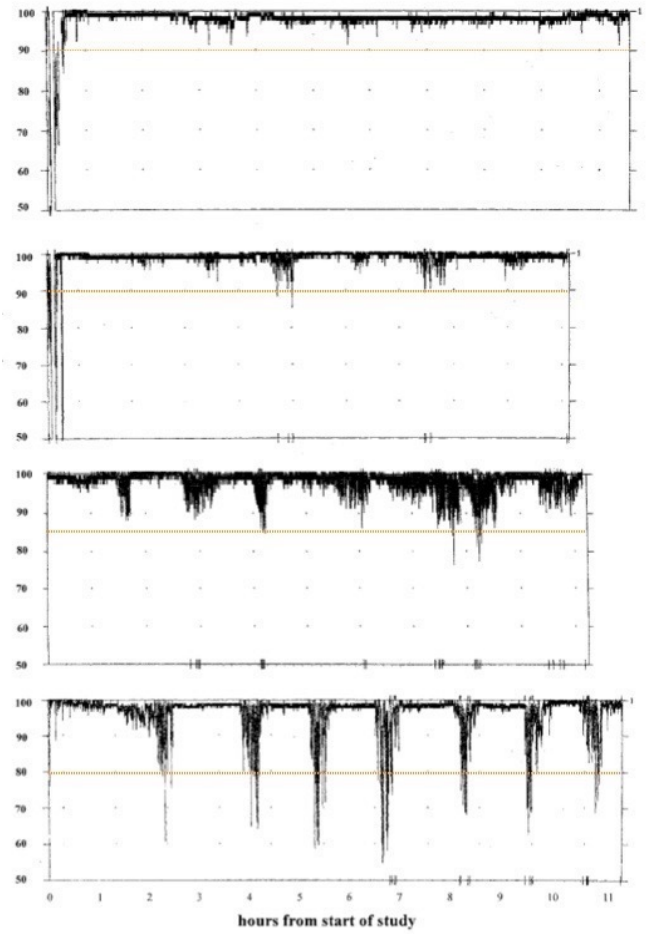
Think about what your next steps would be to manage this baby (in addition to notifying your ATR).

Access to the respiratory database is organised by Paul Finlay in the lab - he'll be happy to arrange access for you.

Oximetry has long become the 5th vital sign, standing proudly in a line with temperature, blood pressure, pulse and respiratory rate (though still competing with pain for this position).

Like with so many parameters there is added value in evaluating oxygen saturation and its evolution over time ("trend"). Recorded oximetry is often used in overnight recordings. Added pressures come into play in the sleeping child. Respiratory rate and tidal volume are reduced during sleep, potentially unmasking underlying respiratory insufficiency. Nocturnal changes in muscle tone can give rise to obstructive sleep apnoea which might be diagnosed using oximetry. Identifying multiple clusters of oxygen desaturation to levels below 90% is consistent with obstructive sleep apnoea in a patient whose history and clinical examination also fit the diagnosis. Unfortunately, the sensitivity of this test is only 50% when compared to a sleep study so a negative overnight oximetry is unable to rule out this condition.

[1] . Spider-Man is a fictional superhero created by writer-editor Stan Lee and writer-artist Steve Ditko. He first appeared in the anthology comic book Amazing Fantasy #15 (Aug. 1962) in the Silver Age of Comic Books. His origin story has him acquiring spider-related abilities after a bite from a radioactive spider; these include clinging to surfaces, superhuman strength and agility, and detecting danger with his "spider-sense." (From: Wikipedia, https://en.wikipedia.org/wiki/Spider-Man). If you don't yet have a Spider Sense, you're sure to develop one as you advance in your training.



Organising an oximetry

In order to interpret overnight oximetry you will need an recording oximeter whose data can be downloaded into a computer for analysis. The oximeters on our wards are not equipped with this functionality and you will require one of the specialised recording oximeters from the Sleep Unit.

There's more: not all oximeters are built equal. The signal quality that oximeters return is greatly impaired by subject movement. Manufacturers use proprietary algorithms to reduce the impairment in signal-quality arising from this. Despite what the oximeters make it look like, you do not actually see a live SaO2-reading on the display. Rather, oximeters display a mean of samples over a time-period (averaging time) so that the displayed numbers don't jump around so much during periods of difficult signal acquisition. In many oximeters this averaging time is set to a default of 12 seconds. This is a useful setting to evaluate the trend of a patient presenting with an acute problem of cardiac output or oxygenation.

When diagnosing obstructive sleep apnoea we have more specific needs: we are looking for potentially very short-lived oxygen desaturations caused by airway obstruction. An

ideal device would obtain a "beat-to-beat" analysis of arterial oxygen saturations. No oximeter currently on the market offers an averaging time this short.

We have found that Masimo brand oximeters work best for our purposes. Their artefact suppressing technology is effective while preserving valuable signal data. And: the averaging-time can be set as low as two seconds.

In short: not every oximeter will do and the choice of machine might differ based on the clinical question you want answered. Keep these limitations in mind when presented with oximetries performed outside of our Sleep Unit.

Inpatient oximetry

Monash Children's Hospital paediatric wards

When organising an overnight oximetry for an inpatient get in touch with the Children's Sleep Centre:

- Nina Lyons, x23593
- Bella Cortes, x23592
- Rebecca Mihai, x23589
- Nicole Verginis, x23589

Most of the Children's Sleep Centre's recording oximeters are booked out in advance for outpatient studies. Planning ahead and letting the unit know early is key to securing a device. Occasionally, a unit might be available on the same day but this will be a rare event. You will need to fill out an oximetry request form (available at the Sleep Centre or from mcsu.org.au → Referrals). Discuss the request with the ATR or on-call consultant and document specifics on the request form.

Discharge process for infants with chronic neonatal lung disease on home oxygen therapy

---

Neonatal Intensive Care Unit (NICU)

For babies in the NICU you should liaise with the Monash Newborn registrar responsible. Newborn Services are structured by campus (Monash, Dandenong, Casey). With the Monash unit being so big (65 beds), it is further structured into NICU and Special Care Nursery services, each sub-divided into teams.

Newborn services at the Monash Campus have their own recording oximeters and can usually organise oximetry to happen the very same night. They will also print off the recording for you.

This is not usually the case for babies at the Casey and Dandenong campuses. In order to obtain an overnight oximetry for babies at these campuses, the Casey and Dandenong services will usually need to request an oximeter from Monash Children's @ Home.

What to request

As always, be specific in how you want the study to be performed:

- Position of baby - prone or supine?
- Room air or supplemental oxygen? If you would like supplemental O2, specify the flow required.
- At times it may be helpful to "split" the night. You might order an oxygen flow of 0.125 l/min from 7pm to midnight and 0.25 l/min from midnight to 7am. This might save the need for another night's recording.
- It is rarely helpful to record overnight oximetry in oxygen flows < 0.125 l/min as the oxygen equipment used in the family's home can not reliably deliver flows less than 0.125 l/min. That said, the flow meters in the NICU cannot be set to 0.125 l/min and we will use a satisfactory oximetry in 0.1 l/min as an indicator for a flow of 0.125 l/min at home.

After the oximetry

If you used an oximeter from the Children's Sleep Centre, please collect it first thing after morning handover and return it to the unit. It will be downloaded and cleaned so that it can go back into service in the early afternoon. The unit will print off the recording for you and have it ready for you to collect later in the day. Should you require the recording urgently discuss with one of the scientists but be mindful of the fact that they may have other things to do first.

Make sure the ATR/consultant know that the study took place and inform them about any problem that occurred during the recording. Once you have the study printout discuss it with the ATR or on call consultant. An easy way of ensuring the consultant has a copy of the report is to scan and email it. The sleep unit can do this for you, if you ask them.

Oximetries and medical records

Recorded oximetries are often a central part of deciding on the requirement for supplemental oxygen or respiratory support for a patient.

Sleep lab staff will upload all oximetries and sleep studies to SMR – but not into our EMR. For inpatients having oximetry or sleep study enter a note into the EMR to direct other teams caring for this patient to look up results in SMR.

Oximetry requests from non-network hospitals

From time to time, the ATR will receive requests to interpret oximetries obtained at and sent in from non-network hospitals. Make sure that the oximetry fulfils some basic criteria:

- Averaging time of oximeter was set to lowest setting (ideally 2s).
- A bedside chart accompanies the recording that details times when the baby was crying, nappy was changed, position of baby in cot, O2 flow used (if any), etc. This greatly improves interpretation of the data.

Referrers should download a request form from https://bit.ly/mchoximetry

Monash Children's Hospital

Interpretation of External Overnight Oximetry

Referral Guidelines

- We will not be able to interpret oximetry without an observation sheet showing the tim oximetry started and finished, the amount of any oxygen, and as many observations possible about awake/asleep state, position (prone/supine), feeding, crying, alarm so probe changes etc.

- Outpatient overnight oximetry can help to titrate oxygen therapy, confirm the diagnos Obstructive Sleep Apnoea, and suggest appropriate perioperative monitoring for adenotonsillectomy – it is NOT an effective screening tool for OSA

- Please familiarize yourself with how to determine and change the averaging time of y oximeter – we cannot exclude desaturations unless it is set to 2-4 seconds

Patient Demographics

Name:_____ DOB: _____ Monash UR:_____
Phone: _____ Address: _____

Oximetry

Why was the Oximetry done?

_____

Brief medical history:

_____

Date of study: _____ Dates of any previous studies sent: _____
Check that an observation sheet is included □ Is the oxygen flow noted, if used? □
What is the brand and model of the oximeter? _____
What is the oximeter averaging time? _____
Please circle: Hospital Inpatient study / Outpatient study

Referrer Information

Referring Doctor Name: _____ Provider No: _____ Phone: _____
Location: _____ Email: _____
Details of Consultant Name & Contact: _____

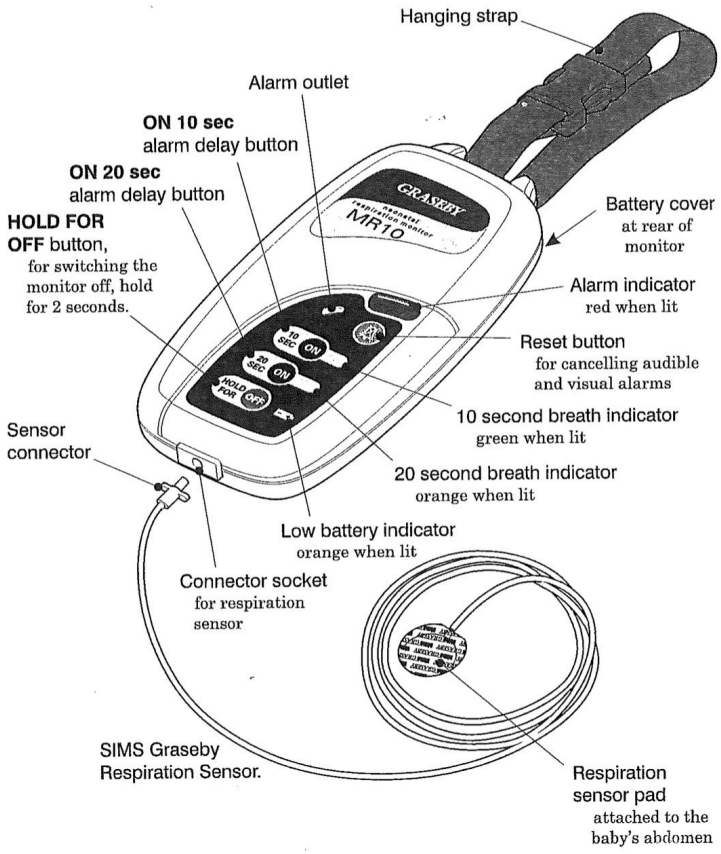
Opinion – we will reply via email, and scan to Monash SMR

D/w Resp Cons _

Please ensure the oximetry and relevant attachments are forwarded to the sleep centre. Once reported, the ATR will scan the report to Monash SMR and forward the results to the requesting consultant.

In selected patients, the we might decide to use a device to monitor an infant for the occurrence of central apnoeas. You know these as apnoea monitors or "Graseby-monitors", named after a manufacturer of these devices. Unfortunately, they are now out of production. As there is no replacement on the market that meets our requirements, we still have a number of these older monitors in use.

Parts of the Monitor



A small sensor with an air-cushion is attached to the baby's abdomen with adhesive tape. Abdominal excursions during the baby's breathing cause small pressure fluctuations in the sensor's air cushion. The apnoea-monitor detects these pressure fluctuations and expects at least one such fluctuation every 10 or 20 seconds (depending on the chosen setting). If there is no fluctuation within the set time-period the monitor will take this as cessation of breathing and alarm.

Which baby needs an apnoea monitor?

The users of apnoea alarms within Monash Children's mostly fall into one of two groups:

- Infants following life threatening events
- Infants with documented central apnoeas (respiratory drive disorders)

There will be the occasional baby outside of these groups we will consider an apnoea monitor for (e.g. sibling of infant with *SUDO* (Sudden Unexplained Death in Infancy) or a young infant required to be slept prone. The consultant in charge will decide on the appropriateness of using an apnoea monitor for a given child.

Apnoea monitors are not useful in babies presenting with obstructive apnoeas. These babies will show ongoing respiratory effort (thus not triggering the monitor) but markedly impaired ventilation and potentially significant hypoxaemia.

□

How to arrange for an apnoea monitor

1. An apnoea-monitor needs to be requested by a **Respiratory or Sleep** consultant. Requests from other units need to be discussed with the Respiratory consultant on call before you can progress along this list.
2. Obtain approval for monitor loan from Drs Davey (x23586) or Nixon (x23587) who oversee the NIV/monitoring-program.
3. Ensure monitor availability with the administrative assistants (x23592/23593) in the paediatric sleep lab. The lab will require the following information:
    - Name of requesting consultant
    - Details of patient and parents - ideally patient sticker
    - Whether consultant will pick up the monitor or to send monitor to consultant's office
4. Organise resuscitation training for all relevant care-givers. For ward patients, this should be facilitated through ward staff. Outpatients can be directed to St. John's Ambulance Service[2] (Phone 8588 8590).
5. Inform the consultant about the outcome. The requesting consultant needs to personally handover the monitor to the family to ensure the family know how to operate it correctly. This can be done in clinic or on the ward. The consultant may ask you to organise a time.

[2] . https://www.stjohnvic.com.au/training/course-cpr.asp

Things to know

- The Sleep Centre only has a limited number of apnoea-monitors available. Accordingly, we need to make sure use of a monitor is indeed required (→approval from Drs Davey or Nixon).
- There is no Medicare reimbursement to the unit for the cost of maintaining these devices. In order for us to continue offering this service, parents are required to rent these monitors. Monthly cost to the family is $50. There is also an upfront $100 deposit payable (reimbursed following return of the monitor). Sensors cost $12 each (they age with frequent re-taping and need regular replacing). Total cost for the first month will be $186 (Deposit $100 + 1st month's rent $50 + 3 sensors $36).
- Apnoea monitors can help indicate a baby that requires intervention or review by the caregiver. *They are in no way a guarantee that an infant will not come to harm*. Be mindful of your wording of what these monitors can achieve.
- The unit gives out a family booklet on the use of apnoea-monitors and which also contains a resuscitation algorithm. Have a browse through - it is always helpful to know which information families receive so you can answer questions if required.
- Alternatively, a monitor can be rented directly by the family from Smiths Medical in Sydney for comparable cost. www.smiths-medical.com, □ (02) 9634 9200.

Background

We frequently discharge infants who still require supplemental oxygen. Supplying families with domiciliary oxygen is a standard procedure nowadays but is actually one of the more recent approaches to out of hospital care for neonates and infants.

The original use of home oxygen was in adults with COPD following studies in the 1960s showing reduced mortality in this group, when treated with supplemental oxygen. In 1976, Pinney and Cotton[3] published a paper on the home use of oxygen for children with bronchopulmonary dysplasia, facilitating earlier discharge from hospital. Children's Hospitals all over the world followed the example, building their own home oxygen programs. Today, the requirement for supplemental oxygen is no longer a reason for a child to be stuck in hospital.

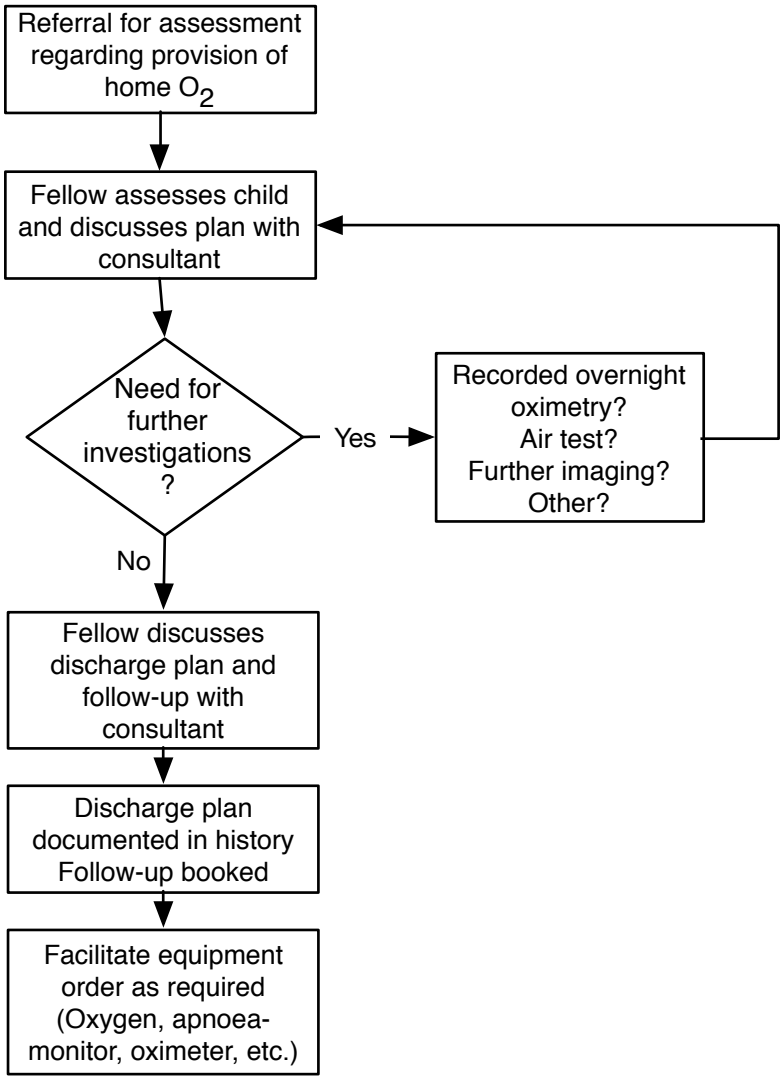
The majority of home oxygen requests flow through our department. The most common indication for the use of home oxygen is in preterm children with oxygen dependant

[3] . Pinney MA, Cotton EK. Home management of bronchopulmonary dysplasia. Pediatrics 1976; 58: 856-859.

chronic neonatal lung disease (CLD). Definitions for CLD vary but a good working definition is 'the requirement for supplemental oxygen beyond 36 weeks post-conceptional age'.

Referral process

Children will mostly be referred from Monash NICU or network SCNs (Dandenong Hospital, Casey Hospital). Referrals may also come from other specialty teams. In general, the pathway to setting up a child on home oxygen is as follows:



Introduction

Monash Children's Sleep Centre is the biggest paediatric sleep lab in the state. We conduct four diagnostic and an additional research polysomnography (PSG) five nights a week when not actually hampered by pandemic limitations. In addition, the centre offers Multiple Sleep Latency Tests (MSLTs) - a labour-intensive diagnostic test used in

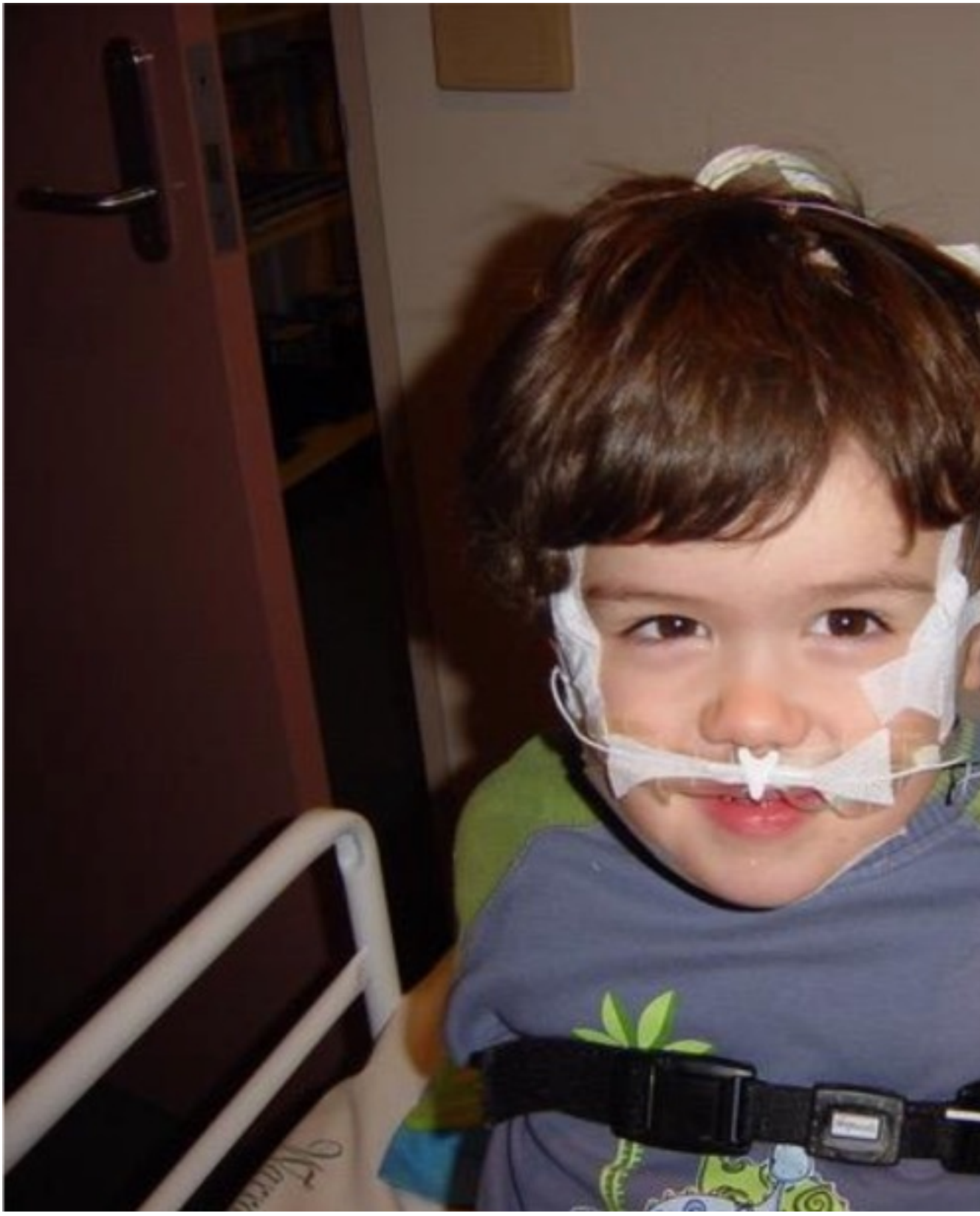
the workup for some conditions presenting with excessive daytime sleepiness (EDS), such as narcolepsy.

A portable sleep study unit is available for patients who are too unstable to be studied in the sleep lab. Please discuss with Drs Davey / Nixon regarding staffing and availability.

PSG captures neurological, cardiovascular and respiratory parameters during sleep that can be assessed by non-invasive means. Standard recordings include:

- Limited channel electroencephalogram (EEG)
- Electrooculogram (EOG)
- Electromyogram (EMG, chin and leg)
- Electrocardiogram (ECG)
- Chest and abdominal excursion using respiratory inductance plethysmographic (RIP) belts
- Pulse oximetry
- Oro-nasal airflow via pressure transducer and thermistor
- Capnography via transcutaneous and end-expiratory CO2
- Continuous audio and video recording
- Automatic position monitor, to record body position (B/L/R/F)

The setup-up process is quite involved. Experienced paediatric sleep technicians take about 45 minutes to place the sensors on an older child. In younger children or those who feel more anxious, have more difficulty adjusting to new environments or unfamiliar sensations to their skin this process can take much longer. The unit is always happy to show around a family prior to a study to ease the feeling of "the big unknown". Call the unit's administrative assistants to arrange a suitable time.



more details you should know about

Some more details you should know about

- Families are asked to arrive at the lab at 7.30 pm. Studies run until 6 am when the families are woken.
- Each child has their own study room. A parent stays with them overnight in a separate bed.
- Night staff consists of a mixture of sleep scientists and nursing staff. Complex or potentially medically unstable patients booked for PSG require prior discussion with Drs Nixon or Davey to allocate appropriate staff.

What is assessed

When you look at the parameters recorded during a PSG you can somewhat delineate the role PSG plays in the diagnostic process of sleep disorders.

EEG in conjunction with OMG is used to identify the child's sleep stage. Sleep is divided into two broad categories: REM-sleep (active sleep in infants) and NREM-sleep (quiet sleep in infants), which is further sub-divided into NREM-1, NREM-2 and NREM-3 based on EEG characteristics).

REM (*rapid eye movements*) sleep is a sleep phase characterised by rapid eye-movements, low-muscle tone and often vivid dreams. It has essential homeostatic functions and is often preserved even in severely sleep deprived individuals. Newborns spend around 50% of sleep in REM. Once the brain is fully matured, 20% of total sleep time is spent in REM.

NREM-1 sleep marks the transition between wakefulness and sleep. Brain waves transition from alpha-waves (8-13 Hz) to theta waves (4-7 Hz). Myoclonic jerks are often observed during NREM-1 sleep. Only small amounts of sleep (about 10%) are spent in NREM-1.

NREM-2 sleep is characterised by the occurrence of sleep spindles and K-complexes in the EEG. About 50% of sleep in adults is spent in NREM-2.

NREM-3 (formerly divided into NREM-3 and NREM-4) is also known as slow-wave or deep sleep. In the EEG large delta-waves dominate. Parasomnias such as night terrors and sleep-walking occur during NREM-3. About 20% of sleep is spent in NREM-3.

Respiration is assessed via abdominal and thoracic RIP belts. Together with flow signals obtained from oro-nasal sensors we can assess respiratory effort (positive readings from RIP belts). Absent airflow through nose or mouth with persisting respiratory effort (often paradoxical) is indicative of airway obstruction while absent RIP-belt signals reflect absence of respiratory effort (central apnoea).

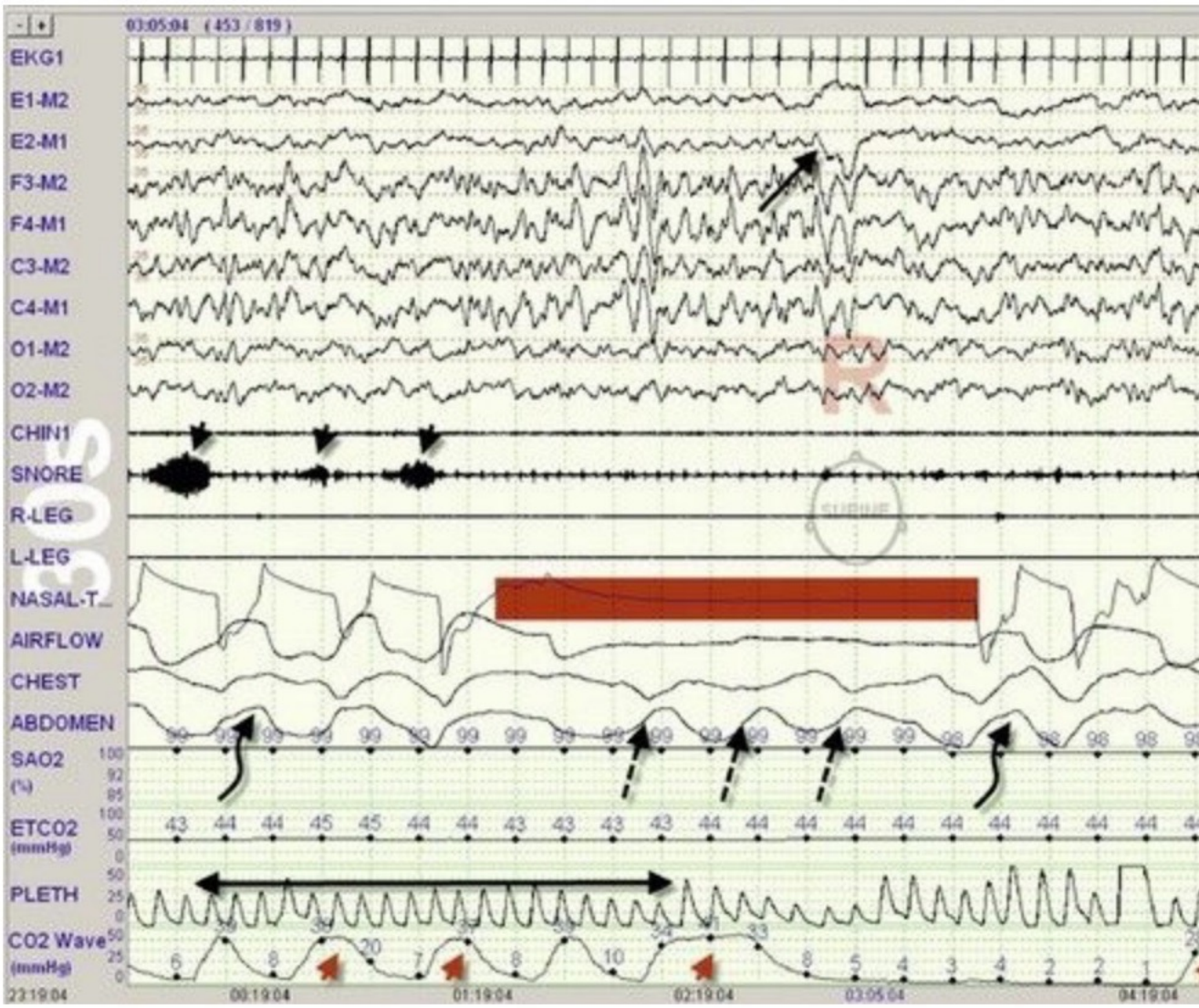
Pulse oximetry helps assess the efficacy of the respiratory system and severity of potential impairment.

Reporting of sleep studies

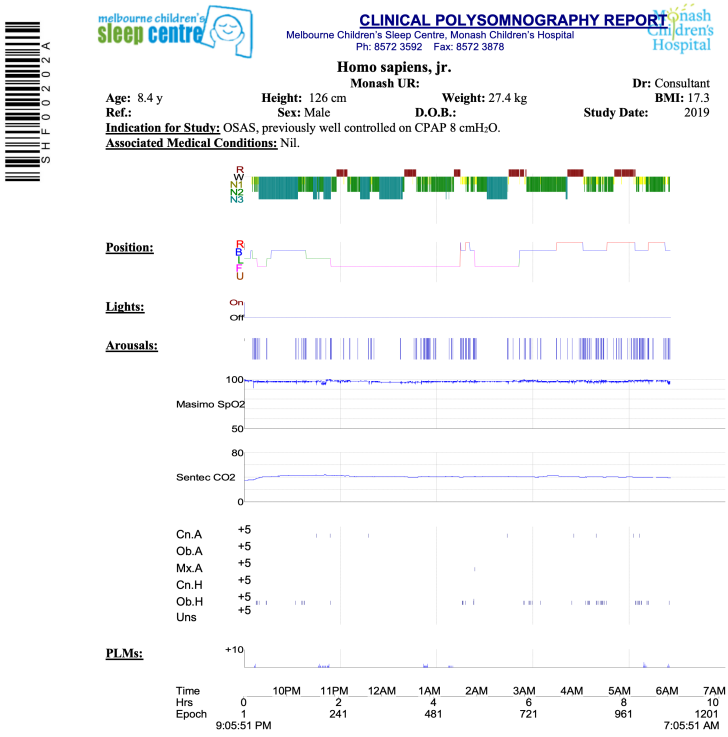
All data is recorded in real-time and stored as a computer recording. Once a PSG is recorded, the recorded data has to be assessed. This involves staging of sleep and evaluation of respiratory parameters.

Respiratory events during sleep are scored according to strict criteria. Be aware that PSGs scored according to paediatric criteria can differ markedly in their assessment from those scored according to adult criteria. Obstructive episodes are assessed as hypopnoeas (>50% airflow reduction compared to previous breaths) or obstructive apnoeas (>90% reduction), with duration being two breaths.

Assessment takes place in specialised PSG-software that displays recorded data in segments called *epochs* (30 seconds for sleep, two minutes for respiratory parameters). And, in case you wonder: yes, sleep scientists go through all this data epoch by epoch to score sleep stage and respiratory events. This is reviewed by the sleep physician writing the report.



Epoch showing the occurrence of an obstructive apnoea with paradoxical abdominal/thoracic excursions (broken arrows) and loss of oro-nasal airflow (bar). Snoring (arrowheads) ceases with loss of airflow.



RDI =	7.5/hr	**SpO_2 nadir =**	94%	**Arousal I =**	19.0 /hr
OAHI =	6.5/hr	**Avg SpO2 drop =**	3%	**% Resp Ar =**	36%
CAHI =	0.9/hr	**SpO_2 < 90% =**	0.0/hr	**PLMI (TST) =**	6.3 /hr
REM RDI =	2.4/hr	**SpO_2 ≥3% drop =**	1.2/hr	**% PLM Ar =**	13%
CnPauseI =	1.9/hr	**Avg $TcCO_2$ ↑ REM =**	<3mmHg	**Avg $TcCO_2$ TST =**	41 mmHg

Summary: Diagnostic study performed noting had been off CPAP for preceding 3 nights. Typical night regarding breathing effort and sleep pattern but louder breathing sounds as compared to normal. Just under 8 and ½ hours sleep available for analysis with excellent sleep efficiency. Normal sleep architecture with one supine REM sleep period recorded. Sleep fragmentation was in association with obstructive events. The arousal index was moderately elevated at 19/hr with 36% due to respiratory arousals and 44% due to spontaneous arousals and 13% related to periodic limb movements. Nasal airflow with breathing sounds ranging from quiet to audible breathing to snoring. Mild to moderate increased work of breathing during supine sleep position. The obstructive apnoea hypopnoea index (OAHI) was elevated at 6.5/hr with obstructive events predominantly during supine sleep position. Obstructive events were associated with mild SpO2 desaturation and an arousal from sleep. The central apnoea hypopnoea index (CAHI) was within normal limits. SpO2 levels were well maintained throughout the night. There was no CO2 retention during REM sleep. Mildly increased frequency of periodic limb movements with the periodic limb movement index elevated at 6.3/hr (normal PLM < 5/hr).

Conclusion: Persisting moderate obstructive sleep apnoea which is most marked in supine sleep position. Suggest attention to increasing dietary iron intake.

A/Prof Margot Davey / A.Vlahandonis.

Legend

1. Hypnogram indicating sleep phase plotted over time on x-axis. Red areas indicate REM-sleep, grey areas periods of wakefulness, blue deep or NREM3 sleep.
2. Child's body position
3. Arousals
4. Pulse oximetry. Note scale: 100% at top, 50% at bottom
5. Capnography
6. Respiratory events:
    1. **Cn.A: Central apnoea**
    2. **Ob. A:** Obstructive apnoea
    3. **Mx. A:** Mixed apnoea

    4. **Hyp:** Hypopnoea
    5. **Uns:** Unsure (event does not fit criteria to be classified into any of above but is associated with desaturation or arousal)
    6. **RERA:** Respiratory event related arousal (<50% reduction in airflow with associated desaturation or arousal)
7. Period limb movements (PLMs, >5/hr considered pathological)
8. Time-line (also indicates epochs)
9. Indices and physiological data
10. **RDI:** Respiratory Disturbance Index (all scored respiratory events Index ie. Obstructive Apnoea, Mixed Apnoea, Obstructive Hypopnoea, Central Apnoea, Central Hypopnoea, unsure)
    1. **OAHI:** Obstructive Apnoea, Mixed Apnoea, Obstructive Hypopnoea Index CAHI: Central Apnoea & Central Hypopnoea Index
    2. **REM RDI:** REM Respiratory Disturbance Index
    3. **CnPauseI:** Central Pause Index
    4. **Avg SpO2 drop:** Average SpO2 desaturation drops with scored respiratory events SpO2 <90%: SpO2 desaturation Index to <90%
    5. **SpO2 3% drop:** SpO2 desaturation Index with desaturation 3%
    6. **PLMI (TST):** Periodic Leg Movement Index (based on events scored in sleep)
    7. **Arousal I**: Arousal Index (cortical arousals, sub-cortical activations) including those scored at end of sleep/beginning wake epoch
    8. **% Resp Ar:** % Arousals following scored respiratory event
    9. **% PLM Ar:** % Arousals following scored PLM
11. Physician's report

Ordering a sleep study

Indications for PSG:

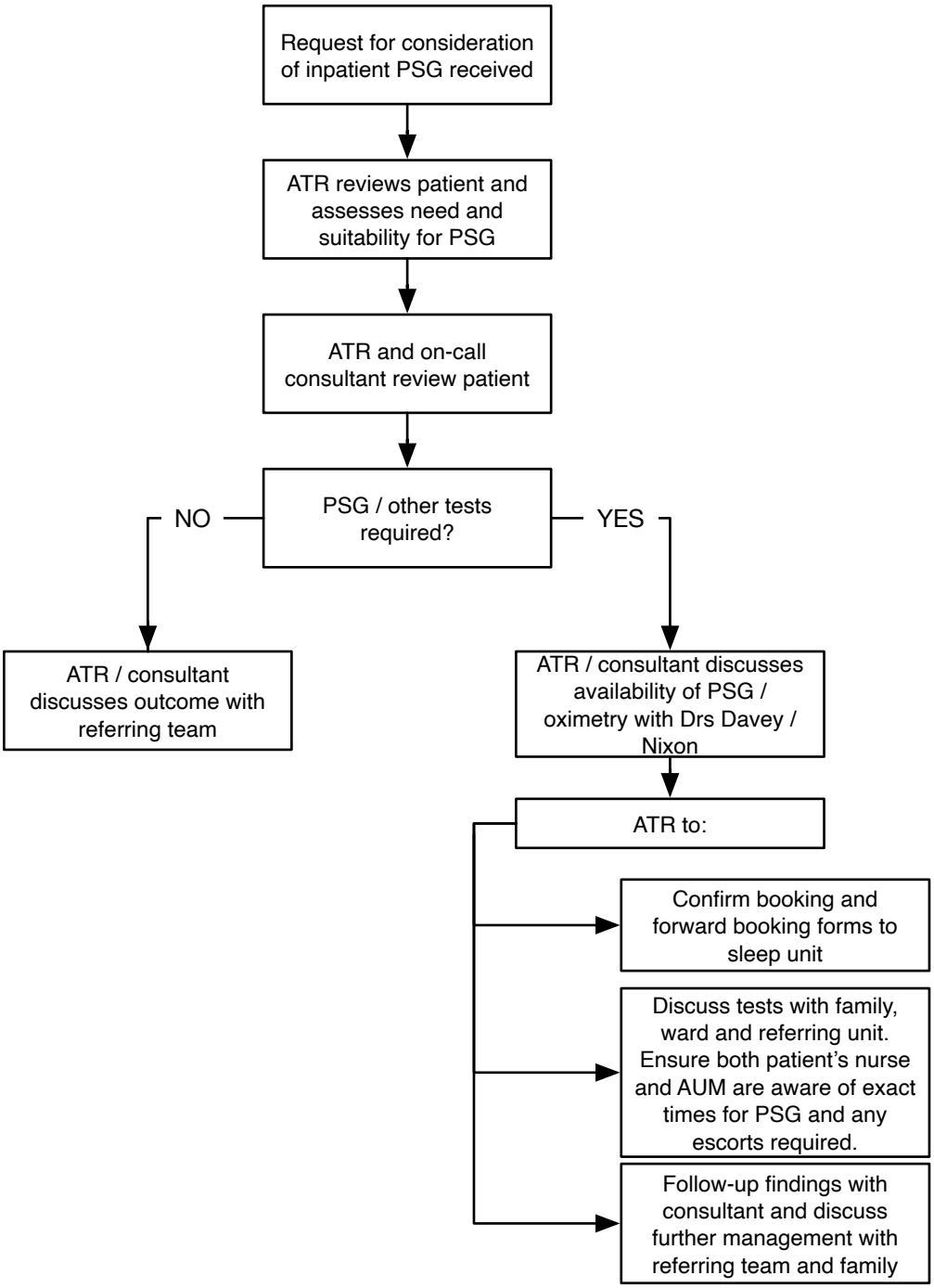
1. OSAS (obstructive sleep apnoea syndrome).
2. Suspected central sleep apnoea in children with developmental issues, or history of cerebral trauma or tumour.

3. Assessment of sleep-related respiratory reserve in children with neuromuscular disorders.
4. Initiation and monitoring of respiratory support including CPAP and BiPAP.
5. Frequent or violent parasomnias.
6. Periodic limb movements.
7. Assessment of sleep architecture in patients with EDS (excessive daytime sleepiness), usually in conjunction with an MSLT (multiple sleep latency test).

Requests for PSG from other inpatient teams

Follow this algorithm when assessing the need for PSG when requested by another inpatient team:

□



The sleep unit is also home to Monash Children's Hospital Non-invasive Ventilation Service. The unit provides full support to families with a child on CPAP or BiPAP. This includes fitting the appropriate mask for a child, teaching of the device and intervention to the child and family and act as a central hub where families turn to with questions around their child's respiratory support setup.

The unit employs a variety of machines with different functionalities. Certain machines may be more appropriate for a particular child and the unit will usually advise on the

best device to choose. Some of our newer models feature built in modems and can send back detailed usage reports to the unit as well as have their settings change remotely.

It may be useful to familiarise yourself with the unit's introductory video on the use of bilevel (BiPAP) ventilators on the wards: https://www.youtube.com/watch?v=I1uiXd185eM

A variety of documents are available on Prompt, detailing the use of certain non-invasive ventilators and for decision support on questions surrounding non-invasive ventilation.

Patient selection for Continuous Positive Airway (CPAP) and BiLevel non-Invasive ventilation in MCH wards
Continuous Positive Airway Pressure CPAP (Paediatric) Management

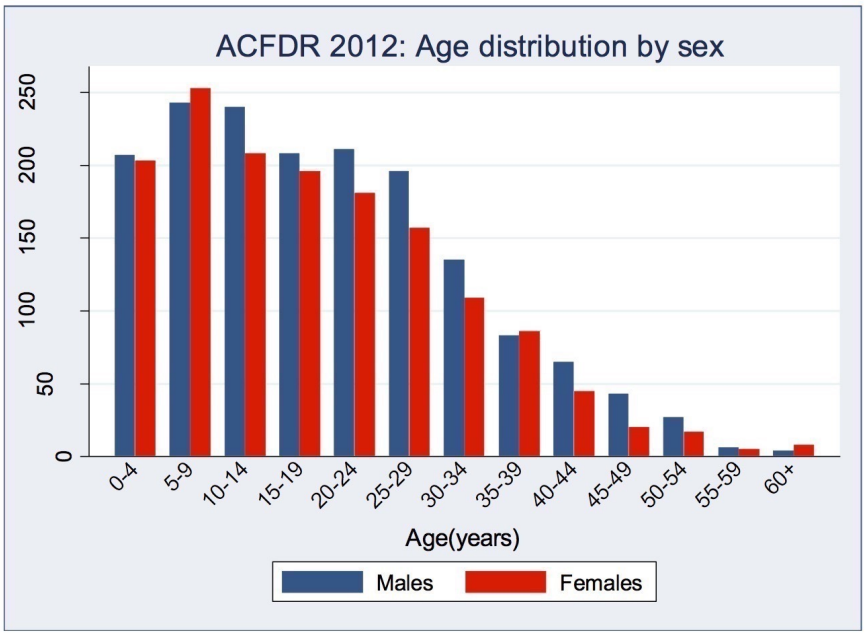
Cystic fibrosis is the most common life-limiting genetic disease in the Western world. Incidence is ≈1/2,700 births and has decreased somewhat after the introduction of antenatal screening for families at risk.

In 2013, there were just over 3,000 people with CF living in Australia. CF used to be a disease with devastating consequences to very young children. First described by American physician, Dorothy Hansine Andersen, in 1938 CF was long thought to be a disorder limited to the gastrointestinal tract. Children died in infancy from severe malnutrition secondary to exocrine pancreatic failure. Contrary to popular belief the name "cystic fibrosis" is not derived from cystic lesions forming in the lung - none of these children ever lived long enough to develop severe pulmonary sequelae of CF. It was the pancreas that showed cystic and fibrotic changes and gave the illness its name.

We have come a long way since the first description of CF by Anderson. Major milestones include the introduction of pancreatic enzyme replacement therapy, aggressive treatment of respiratory exacerbations with systemic antibiotics and physiotherapy, and inhaled therapies. More recently, the introduction of CFTR modulators have brought about a further significant improvement in CF care.

Assessing medical progress can be a bit nebulous at times, but we can very much see the impact it continues to have in improving the lives of CF patients and their families. Children with CF started to live well beyond infancy through their teenage years into adulthood. During 2013 the number of adults with CF in Australia exceeded the number

of children with CF for the first time ever. Our centre now has two CF physicians taking care exclusively of *adults* living with CF - something virtually unheard of only 15 years ago.



CF modulators

In 2012 Ivacaftor (*Kalydeco*) become available to patients with at least one copy of the CFTR-mutation G551D. Ivacaftor modifies the gating of the altered CFTR-protein in affected persons, leading to increased ion-channel activity. This has marked beneficial effects on lung function, weight and pulmonary exacerbations in CF. While the total number of CF patients with this specific mutation world-wide is <5%, to many in the CF- community this drug is a "game-changer". The first of what is now a group of CFTR-modifying drugs with a potential outlook of full correction of the disease.

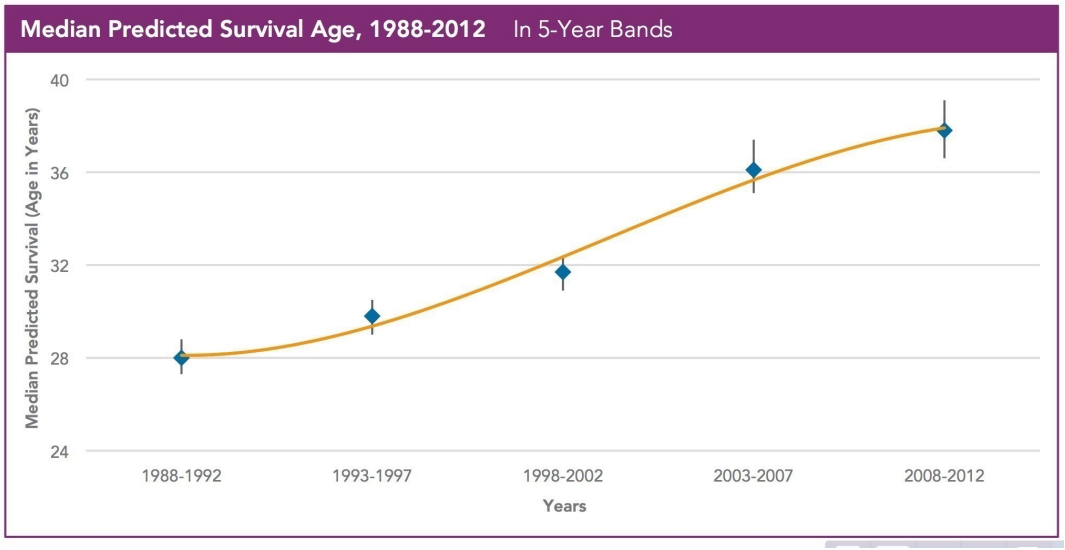
Other drugs that act in a similar fashion for patients with other genotypes are actively being developed and introduced into the market, more recently the combination of Lumacaftor/Ivacaftor (*Orkambi*) for those homozygous for the dF508 mutation and the incoming triple combination of Elexacaftor/Ivacaftor/Tezacaftor (*Trikafta*) for those with a single copy of the dF508 mutation and a non-medication responsive second mutation.[4]

Life expectancy

[4] . While both ivacaftor and the combination lumacaftor/ivacaftor are covered under Medicare, the funding application for elexacaftor/tezacaftor/ivacaftor is currently being considered by the PBAC (2021) and the drug is not yet regularly available to Australian patients.

Life expectancy in CF is directly related to the decade the child was born[5], reflecting the partnership between CF-Centre, the patient and their family as well as the continuing improvements in therapies and management.

These are truly exciting times to work in cystic fibrosis.



Cystic Fibrosis is a chronic condition. Sure, you know that.

Did you also know it takes about 15 minutes for the average inhalation ("neb") to go through a standard nebuliser? So, what's 15 minutes? Well, that depends...

Quite a few teenagers with CF will look at the following daily regime:

- Take 10-20 capsules of pancreatic enzymes
- Take anywhere between 2-10 vitamin supplement tablets
- Do two sets of physiotherapy, 15-30 minutes each
- Inhale 4 mls of hypertonic saline BD (15 minutes each)
- Inhale 2.5 mls of *Dornase Alfa* (10 minutes)
- Inhale 5 mls of *Tobramycin* BD (15 minutes each)
- Drink 2x 200 mls of *Sustagen* supplements
- Spend a considerable amount of time coughing, potentially keeping you awake or waking you up overnight

[5] . CFF Patient Registry Report 2012, http://www.cff.org/UploadedFiles/research/ClinicalResearch/PatientRegistryReport/2012-CFF-Patient-Registry.pdf

We apply the term *treatment burden* to a daily regime like this and are done with it. Our patients have to live it every day. We see 14 days of hospital stay. For them it never stops. Try to keep that in mind when you observe the seven year old throwing a tantrum over "just a bit of inhalation therapy". Or when you see an adolescent who decides she's no longer going to follow any treatment advice because *"it's not making my CF go away anyway!"*.

Organising your work - keeping things flowing

CF tune-ups usually happen in a fairly standardised way. The fundamentals of treatment are

- Intravenous antibiotics
- Physiotherapy
- Additional treatments and investigations

Take a moment and think about how we are going to obtain venous access for this child.

Is there a port-a-cath? If so, speak to the child and family to find out how it is usually accessed. Families will have their own routine for most things, including port access. A particular nurse, local anaesthetic etc. might be part of the family's preferred routine. As always, the paediatric CF co-ordinator will be an excellent first port of call.

For most line insertions you will want to discuss the most suitable line with one of our friendly anaesthetists - they're always happy to help out with their expertise.

Chapter 6

Cystic Fibrosis

6.1 Line types

Peripheral catheters are typically geared for use for a few days and will then need replacement. They are rarely a first choice for a child requiring a CF tune-up.

"Mid-lines" - the Monash term for a venous catheter of about 12 cm length inserted into a peripheral vein. These lines terminate in veins of a bigger calibre and are less prone to cause obstruction or phlebitis than pure peripheral catheters.

They are often considered when we know we will require venous access for more than just a few days up to two weeks. While they can be inserted under vision only in an awake child on the ward, in reality many younger (and older!) patients will require at least some sedation and the use of ultrasound to guide placement.

PICCs - peripherally inserted central catheters. PICCs are the line of choice for children likely to require longer-term intravenous treatment. PICCs can typically remain in place for six weeks and in many children are appropriate remain in the home and even school environment. Because they are long and thin resistence can be an issue.[1]

Which drugs are we likely to use and where is the child going to receive treatment?

Choice of venous access does not only depend on the duration of treatment but to a large degree on which treatment the child is going to receive and where the child is going to be treated.

Will we get by with peripheral venous access?

This might be an option in an older child with good veins who tolerates this procedure well. Or is this a younger child that suffers unduly with intravenous access? Speak to play-therapy as they can make a tremendous difference to how the child will experience the procedure.

[1] . Remember that resistence to flow is directly proprotional to length and diameter. R=þL/A, where R is resistance, L length of catheter, A diameter of catheter in m^2, þ resistence of material. The longer a line or the smaller its diameter the higher its resistence to flow will be, That's why PICCs are not a good option should a patient require urgent fluid resuscitation.

If peripheral access does not seem a feasible option a PICC or "mid-line" inserted under GA with the help of anaesthetics might be the way to go.

Do we need any blood tests? Send a path slip detailing the tests and the right tubes with the child and make sure the anaesthetist knows about our request.

Organising line insertion of PICC and central lines by anaesthetics

PICC and conventional central lines placed via anaesthetics are requested via the following procedure:

□

- Call the anaesthetist in charge at MMC on x3051 to discuss your line plan and fasting instructions for the patient.
- Once you've agreed on a plan with anaesthetics enter your request into EMR:
  - In the orders section type *CVAD*, then select *ANAES Central Venous Access Device (CVAD) Insertion PAEDIATRIC*
  - Complete all fields, including all details of the referral **and** a *Request for Emergency Surgery*. This is required to obtain access to an operating theatre. Only if your patient already has a procedure booked in theatre during which the line can be placed (for instance a bronchoscopy) and no additional theatre space is required can you omit the *Request for Emergency Surgery*.
- **Both** a verbal as well as an EMR referral need to be done before anaesthetics will proceed to insertion of a line.
- Please note that anaesthetics are unable to accept **any** referrals for above lines out of hours (ie after 5 pm Monday-Friday and during weekends or public holidays).

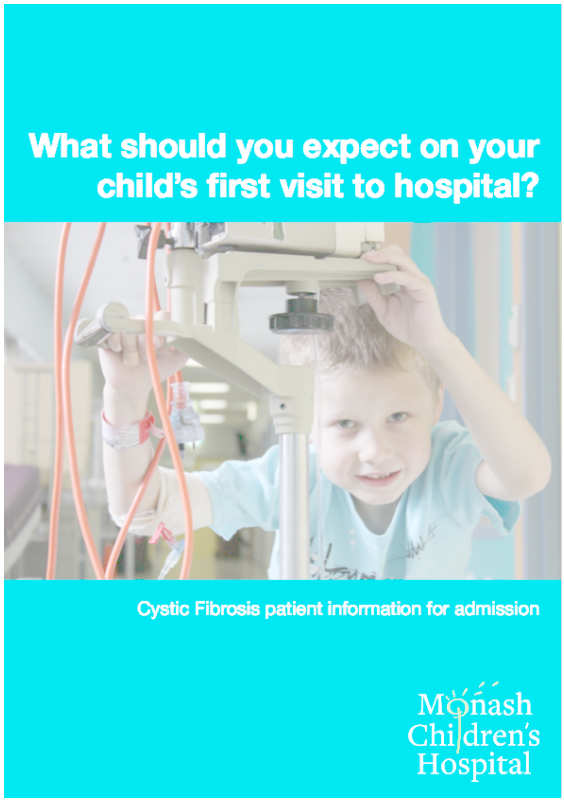
A child with cystic fibrosis will most frequently be admitted under the Respiratory bed card. If the admission is for a non-CF related issue, such as appendectomy, we will usually share a bed card with the primary admitting team. General anaesthesia and subsequent inability to adhere to the patient's regular physiotherapy regimen can lead to significant deterioration. Advance planning of procedures in conjunction with the CF-team can often reduce procedure-related impairments in the child's health.

The majority of CF-related admissions are semi-elective for a *tune-up.* Typical clinical scenarios leading to a *tune-up* include:

- Significant deterioration in lung function

- Eradication-therapy for *Pseudomonas aeruginosa* — now mostly done at home with *TOBI* (Tobramycin for inhalation) — or other significant pathogens (*Burkholderia cepacia, Mycobacterium abscessus*).
- Persistent moist cough.
- "Prophylactic" - before travelling overseas, exam periods, etc.

Frequently the child will have had treatment at home with oral and inhaled antibiotics before being admitted to hospital. If this is the child's first hospital admission, make sure the family have received a copy of our brochure "What should you expect on your child's first visit to hospital". The CF-coordinator can supply you with copies. Give it a read yourself if you haven't yet.

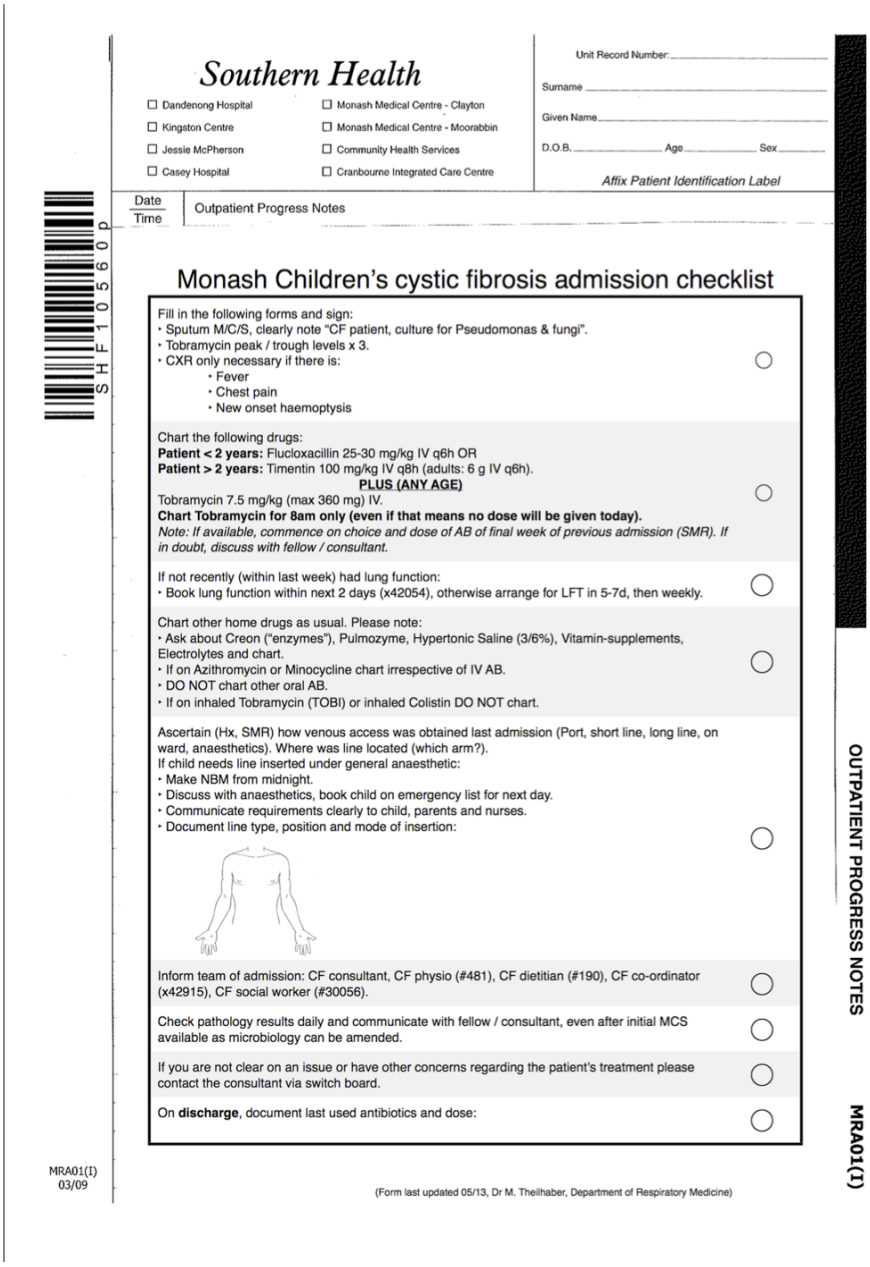


Admission logistics

Print two documents off the Intranet:

- Cystic Fibrosis Admission Checklist from http://cfadmit.notlong.com
- myCF Inpatient Care Plan from http://is.gd/cfplan

Both links will open a PDF document that prints on a blank sheet of A4 paper on any hospital printer.



Southern Health

☐ Dandenong Hospital ☐ Monash Medical Centre - Clayton
☐ Kingston Centre ☐ Monash Medical Centre - Moorabbin
☐ Jessie McPherson ☐ Community Health Services
☐ Casey Hospital ☐ Cranbourne Integrated Care Centre

Unit Record Number:
Surname
Given Name
D.O.B. Age Sex
Affix Patient Identification Label

SHF100560p

Date / Time | Outpatient Progress Notes

Monash Children's cystic fibrosis admission checklist

Fill in the following forms and sign:
- Sputum M/C/S, clearly note "CF patient, culture for Pseudomonas & fungi".
- Tobramycin peak / trough levels x 3.
- CXR only necessary if there is:
  - Fever
  - Chest pain
  - New onset haemoptysis

Chart the following drugs:
Patient < 2 years: Flucloxacillin 25-30 mg/kg IV q6h OR
Patient > 2 years: Timentin 100 mg/kg IV q8h (adults: 6 g IV q6h).
PLUS (ANY AGE)
Tobramycin 7.5 mg/kg (max 360 mg) IV.
Chart Tobramycin for 8am only (even if that means no dose will be given today).
Note: If available, commence on choice and dose of AB of final week of previous admission (SMR). If in doubt, discuss with fellow / consultant.

If not recently (within last week) had lung function:
- Book lung function within next 2 days (x42054), otherwise arrange for LFT in 5-7d, then weekly.

Chart other home drugs as usual. Please note:
- Ask about Creon ("enzymes"), Pulmozyme, Hypertonic Saline (3/6%), Vitamin-supplements, Electrolytes and chart.
- If on Azithromycin or Minocycline chart irrespective of IV AB.
- DO NOT chart other oral AB.
- If on inhaled Tobramycin (TOBI) or inhaled Colistin DO NOT chart.

Ascertain (Hx, SMR) how venous access was obtained last admission (Port, short line, long line, on ward, anaesthetics). Where was line located (which arm?).
If child needs line inserted under general anaesthetic:
- Make NBM from midnight.
- Discuss with anaesthetics, book child on emergency list for next day.
- Communicate requirements clearly to child, parents and nurses.
- Document line type, position and mode of insertion:

Inform team of admission: CF consultant, CF physio (#481), CF dietitian (#190), CF co-ordinator (x42915), CF social worker (#30056).

Check pathology results daily and communicate with fellow / consultant, even after initial MCS available as microbiology can be amended.

If you are not clear on an issue or have other concerns regarding the patient's treatment please contact the consultant via switch board.

On **discharge**, document last used antibiotics and dose:

MRA01(I) 03/09

(Form last updated 05/13, Dr M. Theilhaber, Department of Respiratory Medicine)

OUTPATIENT PROGRESS NOTES MRA01(I)

□

The CF-checklist will guide you along the admission of a patient with CF. Tick the list off to ensure you've covered all areas and *file it into the patient's history*. You still need to document the admission in the patient's history in your usual concise way, outlining the reason for admission, current and past issues, your clinical examination findings and patient assessment and treatment plan.

CF "colours"

Avoiding airway colonisation with aggressive bacteria is a significant factor in achieving long-term health in CF. While none of these bacteria pose a risk to immunocompetent

persons with normal airways, other people with CF can become colonised by contact to an affected patient. Immuno-suppressed patients may also be at risk.

To avoid cross-infection many CF-centres assigned patients to groups according to the type of bacterial airway-colonisation. We have also used this approach by assigning colour codes to groups of bacteria and segregated all clinics, lung-function appointments and gym-sessions based on these categories.

However, the rise of non-tuberculous mycobacteria as a new threat to the health of people with cystic fibrosis has led to a rethinking about cross-infection in the hospital. We'll talk more about this in the next segment.

We have changed the way our clinics run, bringing them in line with international best practice. Upon arrival to clinic the patients enter their individually assigned clinic rooms and remain there for the duration of the appointment. This reduces the risk of cross-infection by confining the patient (and their potentially pathogenic airway bacteria) to a well supervised area. In addition, we use portable HEPA-devices in our clinic rooms that filter out >99.9% of all bacteria. Medical, allied health and social work staff rotate through the patient's room rather than the patient going to see these providers. Lung function testing also occurs in the patient's room using a calibrated portable device.

As the adult CF clinics still follow the colour system we continue assigning patients into colour groups based on their latest airway cultures. Once grouped into a specific (non-blue) pathogen cohort, return to the blue cohort (standard precautions) requires at least 6 month and 3 negative cultures. In case of a positive airway culture for *M. abscessus* a minimum of 12 months since positive culture and 4 airway cultures negative for *M abscessus* are required before return to the blue cohort can occur.

Cohort Colour	**Any sputum culture positive**	**Action**
Blue	No *Pseudomonas or NTM*	Standard precautions
Green	*Pseudomonas*	Isolate from CF patients who do not have *Pseudomonas*
Yellow	Melbourne strain (M16) clonal *Pseudomonas*	Isolate from all M16 negative patients with CF, other chronic lung disease or immunocompromise
Purple	*Burkholderia cepacia*, *MRSA or non-tuberculous mycobacteria* (*NTM*)	Isolate from patients with CF, other chronic lung disease or immunocompromise, including those who are already in the purple cohort (many strains).

□

CF outpatient management

When we reviewed the overall clinical exposure junior medical staff had to CF care we found that the majority of contactd occured in inpatient care.

Inpatient care has traditionally been the area where paediatric JMS spend most of their working time and received the most clinical exposure. Paradoxically, it is also the area of clinical care where the majority of paediatricians spend the *least* amount of time. The majority of clinical contacts for paediatricians typically occurs in outpatient encounters - an area we found clinical JMS training to been lacking. To improve this imbalance we made significant changes to the training opportunities for the ATR.

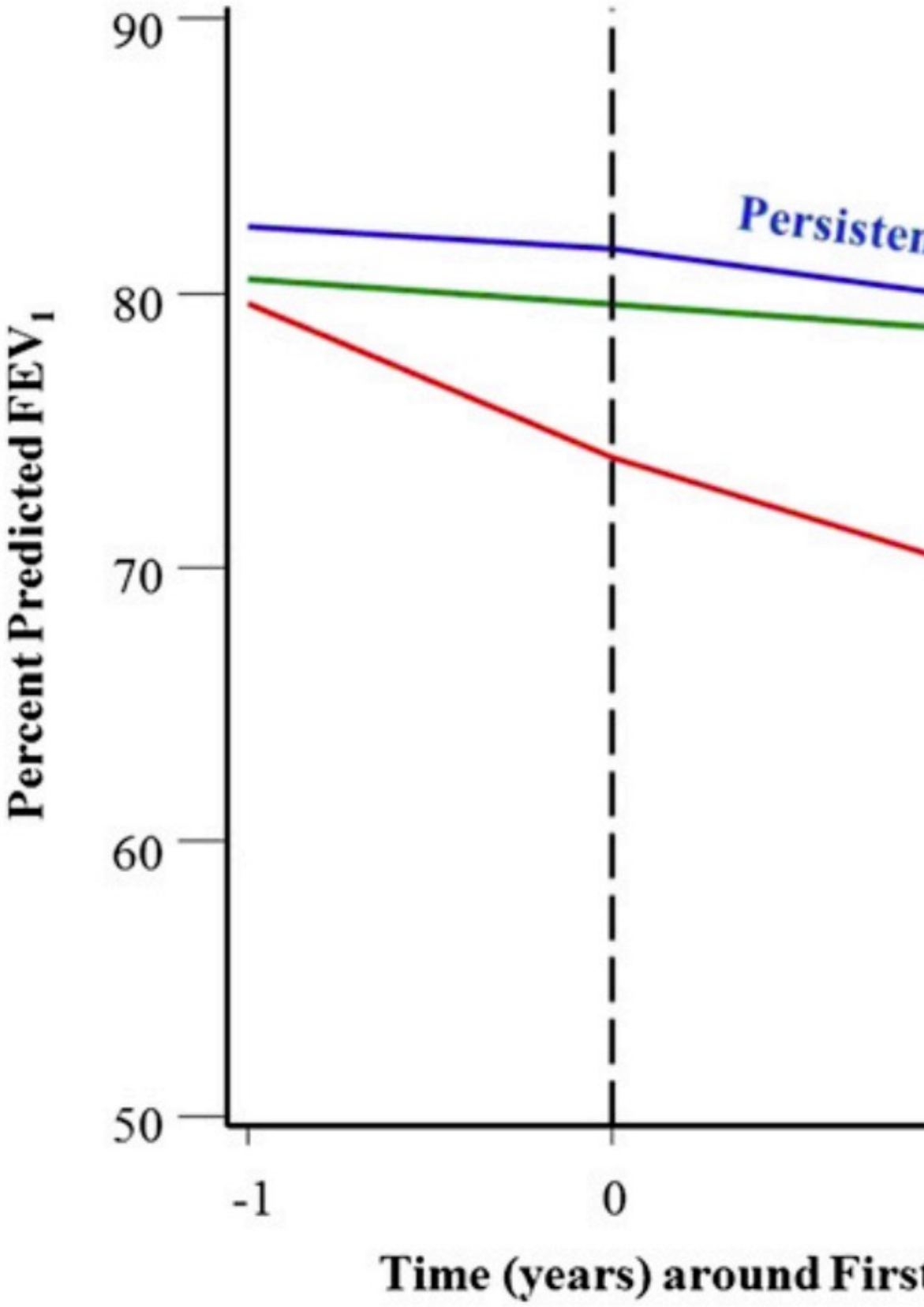
The centrepiece of the redesigned training is the ATR's participation in the weekly CF outpatient clinic. This opens up the range of CF outpatient care with its distinct challenges and rewards. The ATR has the opportunity to build long-term relationships with patients and families, monitor progress, and experience the significant benefits of multi-disciplinary CF care as an integral member of a long-term partnership between patients, families and the Monash CF-team.

The ATR acts as first port of call for outpatient queries and requests during business hours. This includes clinical scenarios such as deciding whether to commence an outpatient on antibiotics, reviewing and acting on pathology reports for outpatients and helping families who requesting scripts.

Queries from outpatients go through the CF-coordinators and they are usually able to sort out most of the questions. They will seek the ATR's input when medical decision making is required. As with all clinical matters, please discuss or escalate to the on-call consultant if you are uncertain on how best to proceed.

Emerging pathogens

Cystic fibrosis is a dynamic field. Unfortunately, this is not only true for new therapies but also for emerging pathogens. Beginning in the early 1990s, centres around the world have seen a marked increase in the number of CF patients presenting with pulmonary infection with non-tuberculous mycobacteria (NTM). These bacteria pose a major challenge to those affected by CF and health services world-wide as they are extremely difficult to treat and can lead to severe, sometimes precipitous deterioration.


90
80
70
60
50
Percent Predicted FEV1
Persisten
-1
0
Time (years) around First

Two particular NTM organisms most commonly affect people with CF:

- *Mycobacterium avium complex* (*MAC*): a group of closely related slow-growing mycobacteria. Well over 2/3 of NTM cultured from airway secretions of CF patients belong to this group. There have been no reports of patient to patient transmission.
- *Mycobacterium abscessus*: a rapid growing mycobacterium. Patient to patient transmission has been reported.

Culturing NTM from a CF-patient's airway does not equate to clinically relevant NTM-infection. NTM are ubiquitous and sporadic airway occurrence is to be expected. There is a wide clinical spectrum from those without any symptoms to those severely affected. Accordingly, a positive culture for NTM is only one piece of the puzzle. Of those with a first positive NTM-culture about 40% will go on to clinical NTM-disease requiring treatment.

Why not just treat at first signs of NTM?

Good question. It has a fairly straight forward, somewhat depressing answer: NTM are notoriously difficult to treat. Treatment is time-consuming, requires long-term complex iv therapy and severe side-effects often make the treatment very difficult to tolerate for patients. To add insult to injury chances of successfully eradicating *M abscessus* are very low (*MAC* are usually easier to treat). More often than not we think of suppressing NTM in this setting rather than eradicating.

So, if we're deciding to embark on this treatment path we need to make sure the substantial burden of treatment does in fact outweigh the detrimental effects caused by the disease.

Differentiating between NTM-infection and NTM-disease

Research is occurring internationally to generate best practice guidelines to address the question on how best to select patients for treatment of NTM, which treatment combination to use and for how long to treat.

Keeping in mind that NTM-disease should present with significant clinical deterioration we look at the problem along 3 axis:

1. ***Microbiological evidence***
    - Positive NTM culture x2 (sputum) or x1 (BAL) over 12 month period
2. ***Clinical / radiological evidence***
    - Unexplained loss in LFTs

- Increased respiratory symptoms
- Constitutional symptoms
- Progression of radiographic features c/w NTM-infection

3. ***Absence of co-morbidities that could explain the patient's clinical state*** (***treat aggressively and re-evaluate***)
    - Co-infections
    - Sputum clearance
    - Reactive airways disease
    - Nutritional deficits
    - Cystic Fibrosis Related Diabetes (CFRD)
    - ABPA (Allergic Bronchopulmonary Aspergillosis)
    - Sinus disease

Organising lung function tests

The majority of lung function tests you request will be for patients with CF. We usually check lung function in patients with CF when they come in for a tune-up and then monitor progress on a weekly basis. Your ATR or consultant will let you know if lung-function assessments are required at other times.

Because of the risk of cross infection between patients we have completely changed the way we see *paediatric* CF patients in clinic.

Make sure you understand the colour coding of CF-patients according to their colonisation with certain bacteria (see previous chapter). We work hard to avoid crossover of patients of different colours in the Respiratory Department. This applies even more so to the Lung Function Lab.

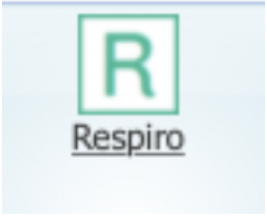
To book in your patient for lung function tests, call **ext 42278** and let them know:

- UR number, patient name and age
- CF patient? If yes: which colour cohort does the patient belong to
- Any other precautions the lab needs to be aware of (such as immuno-suppression)
- Which tests you want and how urgent they are

Make sure you communicate any special requirements. If you require a physiotherapist to be present during a test (such as for a Mannitol trial), make sure both the lab and the physiotherapist know about it. Similarly, if you want Salbutamol given to test for reversibility of bronchoconstriction, say so.

Respiro - the pulmonary lab results database

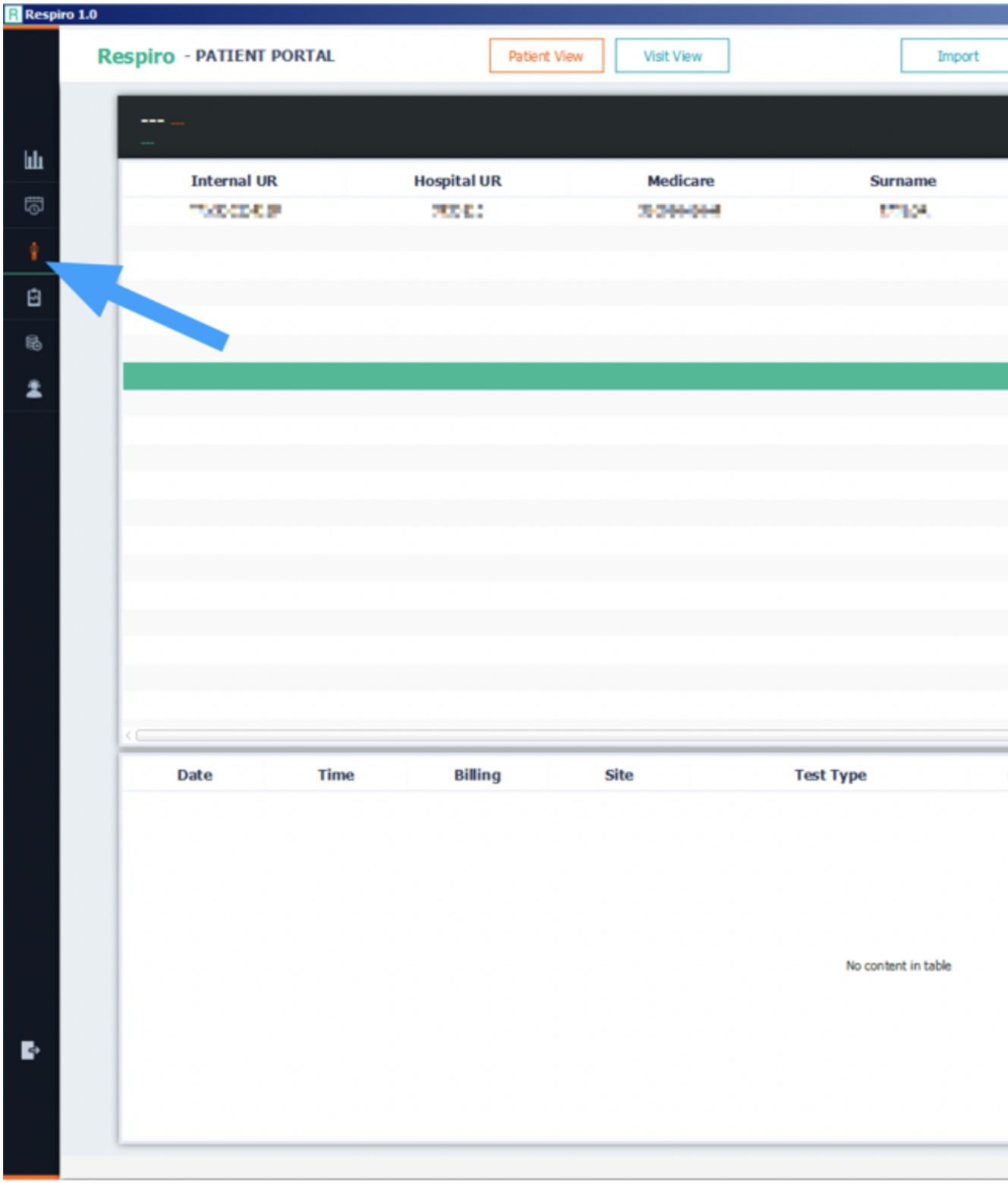
All tests performed in our pulmonary lab are documented in the department's database. The latest iteration of the software is called *Respiro*. Look out for the Respiro icon on your computer desktop:



If you can't locate the icon you might not yet have access to this resource. Please speak to Paul Finlay in the lab who will organise access for you.

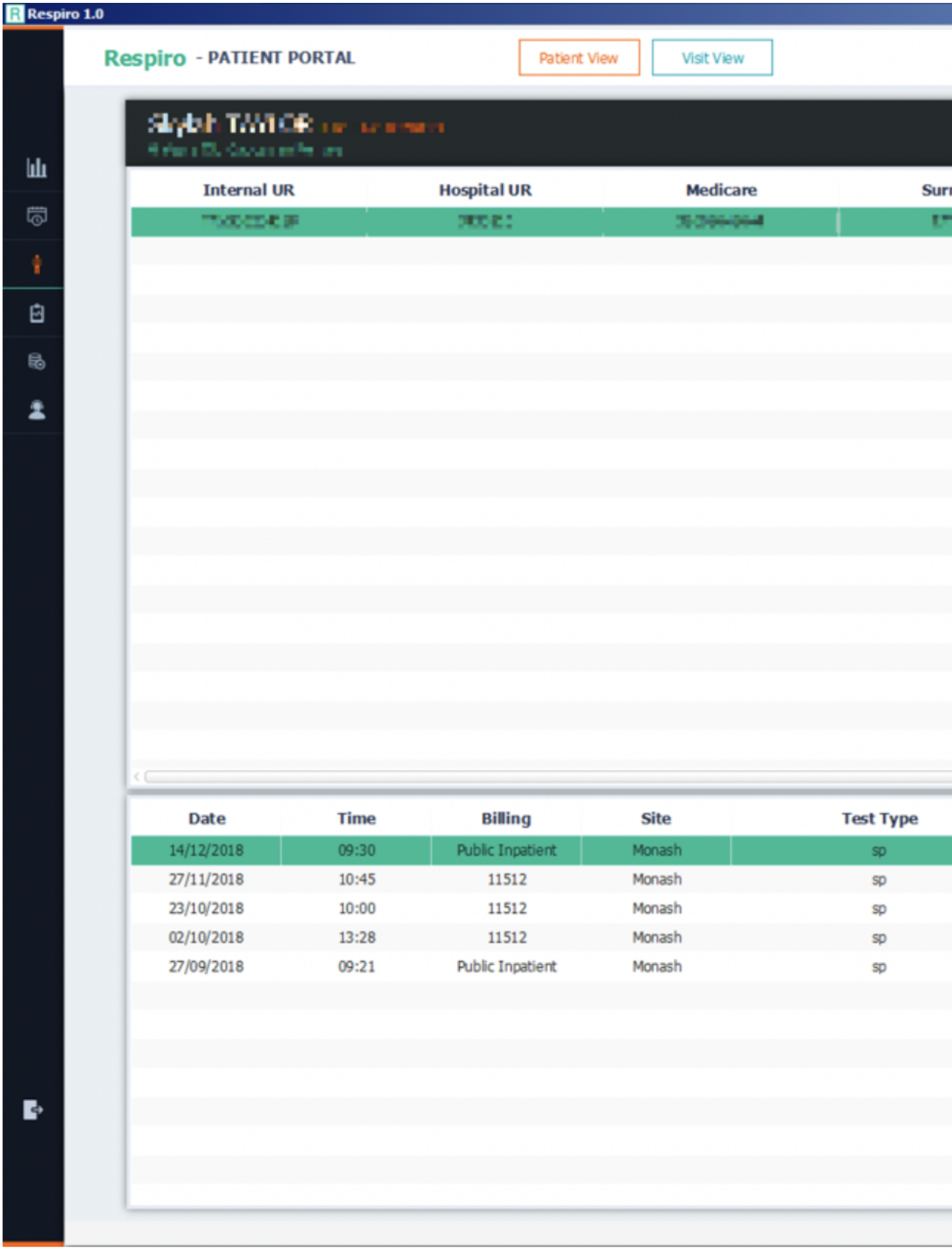
Once you've run Respiro, you need to login. Use 'physician' for both id and password and you will be greeted by Respiro's main screen.

Click on 'I' on the left, then enter the name of the patient you're looking for on the right. Make sure you separate last and first name by using a dash ('-') rather than a comma (',').

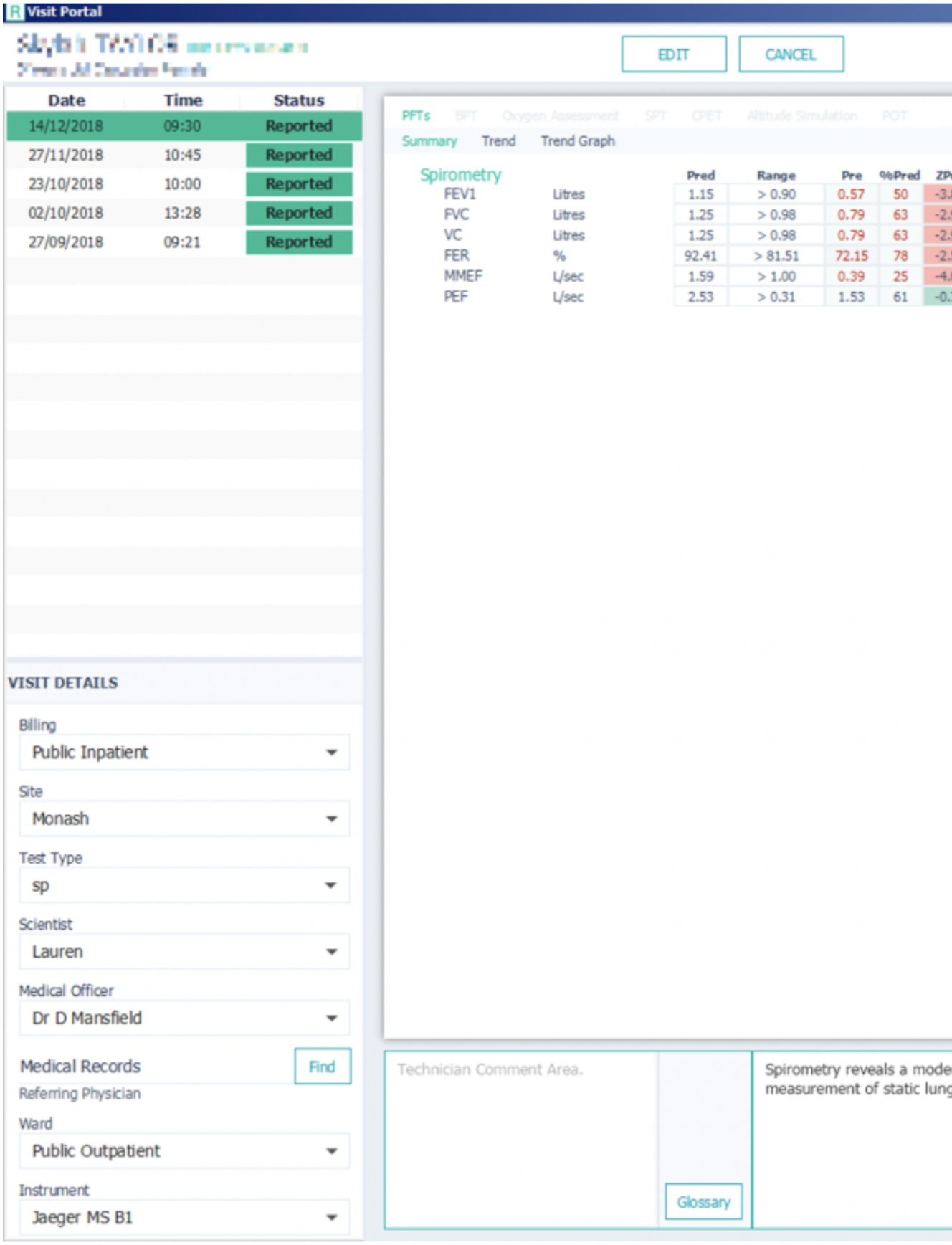


Click on 'Search DB' to find patients.

Patients fitting this name will be listed in the top table, their corresponding tests can be found in the bottom table.


Respiro 1.0
Respiro - PATIENT PORTAL
Patient View
Visit View
Internal UR
Hospital UR
Medicare
Date
Time
Billing
Site
Test Type
14/12/2018
09:30
Public Inpatient
Monash
sp
27/11/2018
10:45
11512
Monash
sp
23/10/2018
10:00
11512
Monash
sp
02/10/2018
13:28
11512
Monash
sp
27/09/2018
09:21
Public Inpatient
Monash
sp

Double click a test entry to the results of that test.


Visit Portal
EDIT
CANCEL
Date
Time
Status
14/12/2018
09:30
Reported
27/11/2018
10:45
Reported
23/10/2018
10:00
Reported
02/10/2018
13:28
Reported
27/09/2018
09:21
Reported
PFTs
Summary
Trend
Trend Graph
Spirometry
Pred
Range
Pre
%Pred
FEV1
Litres
1.15
> 0.90
0.57
50
FVC
Litres
1.25
> 0.98
0.79
63
VC
Litres
1.25
> 0.98
0.79
63
FER
%
92.41
> 81.51
72.15
78
MMEF
L/sec
1.59
> 1.00
0.39
25
PEF
L/sec
2.53
> 0.31
1.53
61
VISIT DETAILS
Billing
Public Inpatient
Site
Monash
Test Type
sp
Scientist
Lauren
Medical Officer
Dr D Mansfield
Medical Records
Find
Referring Physician
Ward
Public Outpatient
Instrument
Jaeger MS B1
Technician Comment Area.
Glossary
Spirometry reveals a mode
measurement of static lung

You can also plot trends over time. Click on 'Trend Graph' to chose the parameters you would like Respiro to plot for you.

Other functionality will be added to Respiro over time. Speak to the lab staff for particular functionality you may be interested in.

The CF team-meeting

CF is a complex multi-system disease that significantly affects the lives of patients, their care-givers and their social networks. Contemporary CF-care is embedded within multi-disciplinary teams which provides superior care over a single provider approach.

In any organisation, keeping up communication pathways becomes a challenge as the number of people involved increases. This topic has recently re-surfaced in other areas of medicine such as the renewed focus on medical handover of patients and the impact its quality has on subsequent patient care.

The main multi-disciplinary CF-meeting occurs weekly on Tuesday afternoons for 90 minutes, 45 minutes each are allocated for discussion of paediatric and adult patients. All CF-team members attend: medical (CF physicians, registrars and residents) and allied health (physiotherapy, dietetics, social work, nursing, CF-coordinator).

The objective of the meeting is to inform all team-members on patient progress, identify patients who require a more intense focus and establish management plans that benefit from collaborative team input. To help optimise patient care the meeting structure may change from time to time to give preference to areas that require more urgent attention or increased discussion time.

The meeting offers an excellent opportunity to hear and learn from a multitude of patient presentations, at times very complex clinical problems and the way the team addresses these. As a team member you will contribute your observations and knowledge about the clinical path of current inpatients.

Team members document treatment decisions made during the meeting for each inpatient. The responsible consultant or registrar might ask you to action items as required.

Chapter 7

Admissions and Common Presentations

Some background on admitting a child to hospital

Not everyone will be as versed in the hospital system as you are. Particularly families who have never had a child admitted to hospital will often be very anxious about the process. You will likely have seen many children with pneumonia. In your mind you can already picture the little 3 year old before you a few days down the track, running around the ward, being chased by a parent. The parent's vision of the imminent future for their child might not be quite as rosy.

Fear plays a central part in the mindset of most people seeing a doctor for an acute health issue. This is magnified for parents of a sick child, even more so if this child requires admission to hospital. Be mindful of the fact that emotions are often high in these situations. Use a level of language appropriate for the family you are seeing. Remember that much of what you explain is likely to fall by the wayside as families grapple with their anxieties.

If you admit a patient from the ED outline what is going to happen next, such as when the family can expect to be transferred to the ward, any further tests that might be required, or other team members that will be reviewing the child. If you have already discussed a treatment plan with your ATR or consultant make sure the family understand what is going to happen.

Give the family space to ask questions. If you can not answer a question or feel you are not in the best place to answer (for instance because you do not feel it appropriate to talk about possible deterioration and the need for invasive ventilation) let the family know that you will arrange for a senior doctor to discuss these questions with the family.

Try not to fall into the trap to promise good outcomes if you can't be sure. On the other hand, don't be too guarded if the child is likely to be fine in a few days. Talking to families is a skill and an essential part of you growing into a more senior role. We have all started off with little experience and all been in a situation where we wished we could have addressed a certain issue in a different way. Listen to the way other

team members talk to patients and families and see which techniques you would like to incorporate into your bedside manner.[1]

General principals for admissions

Like all other tasks that you add to your to-do list on a continuing basis, there will be competing interests. Time management is the magic word whispered on every corridor - no matter the field of work you're in. Prioritise the requests you receive. Patients who have already been sorted out in ED, are stable and simply waiting to go to the ward are likely in less urgent need of your input than a 7 months old boy with respiratory distress being commenced on high-flow cannula oxygen support without a clear diagnosis.

Of course, your list will also include numerous requests for charting drugs, scripts, fluid orders, inpatient reviews and many more. You might be carrying an additional pager because you're cross-covering for a colleague's afternoon off. It's because you will be busy that you need to take the time to sort out what to concentrate on.

In the end, it will always come down to basic principles:

1. Communicate frequently with others in your team. Make sure they're doing ok.
2. Review tasks
3. Prioritise
4. Allocate tasks
5. Attend to your tasks
6. Go back to 1, rinse, repeat.

There's nothing wrong with needing help. Speak to the ATR or contact the on-call consultant.

Like any other sub-specialty, we have our "bread and butter" presentations that we see very frequently. That said: be wary of the "typical" child with whatever frequent presentation you have been seeing over the last week. Not every baby with crackles has bronchiolitis, not every tachypnoeic child with hypoxaemia has pneumonia. Ask yourself: "what else could this be?" with every patient you see.

You will find a selection of frequent presentations to our service over the following pages with some guidance on how to best initiate these patients's workup and treatment.

Respiratory conditions are the most common illnesses responsible for children's hospital admissions over all age groups. If your rotation with us falls into the summer, you

[1] . Communicating effectively is a core skill in medicine but addressing this goes beyond the scope of this guide. For a start, see Jennifer Ha et al, "Doctor-Patient Communication: A Review", The Ochsner Journal 10:38-43, 2010.

might only see the occasional child with bronchiolitis. Conversely, if you are with us during a winter rotation you might come to think Respiratory Medicine was mostly about bronchiolitis and severe, complicated pneumonia.

Bronchiolitis is an interesting disease. Infants make up about 1% of the population but 10% of all hospital admissions. A proportion of these admissions occurs for conditions such as prematurity and jaundice but the majority of the rest is for respiratory illnesses. It is estimated that 2-3% of all infants will be hospitalised for bronchiolitis at some point. As bronchiolitis affects mostly young infants up to 6 months of age, it is frequently the cause for a child's first hospital admission.

It may seem to you that being admitted to hospital was a common thing for a child but it is actually not. The lifetime risk for hospitalisation for a child up to the age of 17 is somewhere around 1:15. What is an everyday event for you – such as admitting a child with bronchiolitis – is very likely an extraordinary (and highly stressful) event for the family in front of you.

The majority of admissions of babies with bronchiolitis will come in under the General Paediatric team. Babies with bronchiolitis admitted under our bed card are usually the ones who are very sick and require admission straight to ICU or patients who are already known to our unit.

What to look out for

Even in our selected group of very sick babies with bronchiolitis the vast majority will have an excellent outcome.

Be aware of underlying conditions that pose an increased risk of morbidity and mortality:

- Down Syndrome
- Structural cardiac abnormality, particularly large left to right shunt (e.g. VSD)
- Underlying lung disease (e.g. chronic lung disease in ex premature infants)

□

Also, very young infants (< 6 weeks) are at high risk of becoming very sick with bronchiolitis and frequently require intensive care admission.

General principles

Though bronchiolitis has an enormous impact on health care systems all over the world in terms of cost and health care utilisation, no illness modifying treatments have emerged in the last 50 years. You will likely have read a bit about the use of steroids, inhaled adrenaline / β-agonists or hypertonic saline for bronchiolitis. Unfortunately,

none of these interventions make a discernible difference to length of stay or illness severity. The hallmarks of hospital treatment remain unchanged:

- Oxygen
- Fluids
- Respiratory support

You will assess children along these lines accordingly. Does the child need supplemental oxygen? What is their respiratory rate and work of breathing? Is their breathing compatible with feeding orally? Remember that feeding is hard work for small infants and increases in their work of breathing and respiratory rate are not only going to make them more tired but also more prone to aspiration.

If supplemental oxygen is needed on the ward we use dry or humidified oxygen (to saturation vapour pressure) up to a flow of 2 l/min, heated to body temperature (370C). High flow oxygen (>2 l/min) via nasal cannula will always be humidified.

If the child can feed orally, consider whether decreasing the volume per feed and increasing the feed frequency might be beneficial. If you want to avoid oral feeds consider nasogastric feeds before you decide on intravenous fluids. The sickest infants with marked tachydyspnoea will usually not be candidates for enteral feeding and require intravenous fluids.

In general we aim for a reduced amount of daily fluids during the acute phase of moderate or severe bronchiolitis. Aim for 2/3 of the baby's calculated fluid maintenance to keep the likelihood of dilutional hyponatraemia low (2nd to inappropriate ADH secretion, SIADH). This intervention might also reduce the likelihood of pulmonary oedema.

Respiratory support

If work of breathing becomes too much the baby will require help. The mode of respiratory support for a wide range of conditions has seen a significant shift over the past few years. Almost overnight humidified high flow nasal cannula oxygen (HFNCO2) has become first-line treatment for many infants and children requiring respiratory support.

Getting ready for discharge

Assess how well the child it is going throughout the day. Are there still problems following a prolonged ICU stay? How is the baby sleeping, how much rest is the mother (still mostly the primary care giver) getting? Is the child back to its pre-admission feeding regime and oxygen requirements? Make sure you check oxygen requirements

over night as oxygen saturations tend to dip during deep sleep. How are the parents coping?

Not everything has to be back to normal for a child to return home. Often infants will continue to cough for quite a few weeks following a severe LRTI. Feeding might still not be fully at pre-illness levels – but it should be close. The odd child might even go home on a defined period of supplemental oxygen if there are no other concerns keeping the child in hospital.

Children who had a severe episode of bronchiolitis might benefit from follow up visits by the Monash Children's @ Home team as a post-acute care follow-up. This way you can make sure the family copes with the anxieties of returning home, the baby is feeding well and gaining weight and is indeed continuing to improve.

Pneumonia occurs frequently in children. In affluent countries almost all children with pneumonia – be they of viral or of bacterial cause – will have complete recovery. In fact, most children with pneumonia in Australia don't even require admission to hospital.[2]

Of those children with pneumonia admitted to Monash Children's only see a small proportion are admitted under our bedcard. Children with uncomplicated lobar pneumonia requiring hospital care are usually admitted under the General Paediatric bed card, unless special circumstances warrant admission under our team's care (for instance, if the child is known to our team).

Children with pneumonia requiring admission under Paediatric Respiratory

Children with the following diagnosis at presentation require admission under the Paediatric Respiratory bed card:

- Pneumonia with large effusion / empyema (complicated pneumonia)
- Pneumonia requiring ICU treatment at admission
- Patients with cystic fibrosis

Which tests to order for a child with suspected pneumonia

Which tests to order for a child with suspected pneumonia

In any infectious disease we would like positive confirmation of the pathogen causing the disease. In children with pneumonia we are rarely in the lucky situation to achieve this. This has a variety of reasons.

Most children are unable to provide a sputum sample to send for culture, which usually has the highest yield of positive confirmation. Urinary antigen tests (mostly for *S*

[2] . Have a look at the 2011 BTS guideline on the management of community acquired pneumonia in childhood, https://www.brit-thoracic.org.uk/guidelines-and-quality-standards/community-acquired-pneumonia-in-children-guideline/, accessed 01/2021

pneumoniae) are in wide use in adult medicine. Unfortunately they are of little use in paediatrics because of their high rate of false-positives and false-negatives in this age-group, making it impossible to reliably interpret the result.

Blood cultures in childhood pneumonia are also a notoriously frustrating enterprise. Occasionally (≈5%), your efforts will be rewarded with a true-positive blood culture in a child with bacterial pneumonia (most often invasive *S pneumoniae*). More often though your efforts to improve your management by taking a blood culture will be complicated by *Staphylococcus* contamination from a poorly obtained blood-culture specimen. Try to avoid taking blood cultures for these patients - they rarely help with management for above reasons. To top it all off, it's a costly practice that rarely changes management.[3]

If you do decide to obtain a blood-culture make sure you adhere to a strict aseptic technique. Touching the skin of the insertion site just before inserting the needle to confirm position of the vein is likely to contaminate your blood-culture sample.

The child with empyema

Pleural empyema in children most often occurs as a complication of bacterial pneumonia. Often the child will initially be sick enough to warrant a chest X-ray. In the early stages of the illness there might not yet be much evidence of pleural effusion. In hindsight, subtle changes such as dulling of the costophrenal angle can often be seen even on early X-rays. Keep a close eye on a child with these early findings.

Frequently the suspicion of empyema is raised when a child fails to show clinical improvement despite adequate treatment with empirically appropriate antibiotics.

Indicators of treatment failure

Children with bacterial pneumonia usually improve within 24 hours after initiating appropriate antibiotic therapy. Failure of clinical improvement within 48 hours or clinical deterioration at any point requires re-evaluation of diagnosis and management.

Indicators of treatment failure:

- Ongoing fevers
- Respiratory deterioration
  - Increasing oxygen requirement
  - Increasing respiratory rate
  - Increasing work of breathing

[3] . See Lintzenich Andrews A et al. A cost-effectiveness analysis of obtaining blood cultures in children hospitalized for community-acquired pneumonia. J Pediatr 2015 Oct 8; [e-pub].

  - Worsening clinical appearance

- Lack of improvement in oral intake

You will primarily be guided by clinical features. Observing trends of laboratory parameters (acute phase proteins, WCC) has its role when in doubt about the clinical course of the patient. Avoid second guessing yourself by routinely ordering inflammatory labs on a patient that is clearly improving.

Workup / management of suspected pleural empyema

Routine investigations to investigate potential pleural empyema include:

- AP chest film (a lateral will only be necessary in few select cases). Some institutions find that a lateral decubitus increases the sensitivity of this test. It is rarely, if ever, done at Monash Children's.
- Chest ultrasound to determine amount of fluid, presence of fibrinous strands / loculations (thought to make success of conservative treatment less likely)
- At least daily electrolytes while on iv-fluids, keeping a close eye on serum-Na (increased risk of → SIADH)

On chest xray look for signs of pleural effusion, i.e.:

- Blunting of costophrenic angle
- Fluid within the horizontal / oblique fissure
- Fluid meniscus at basal aspect of lung
- Mediastinal shift away from effusion (look for position of cardiac shadow, outlines of trachea)

Ultrasound of the chest is highly sensitive in detecting the presence and amount of fluid. The report will also comment on the presence of fibrinous strands and the formation of loculations within the pleural space.

Discuss the ultrasound findings with the Respiratory ATR or on-call consultant to decide on further management of the patient. In some cases ongoing conservative management of the condition may be appropriate even in the presence of a small to midsized pleural effusion. Larger effusions, particularly those with formation of loculations within the pleural space, are unlikely to improve with conservative therapy alone and will frequently require surgical intervention.

Referring the patient to Paediatric surgery

If the decision has been made to refer the patient to Paediatric Surgery you may be asked to contact the Paediatric Surgical Resident or Registrar asking the team whether VATS (Video-assisted thorascopic surgery) would be appropriate for this patient. VATS is not the only way to address this condition. Many units will use intrapleural proteinases as first line treatment with excellent outcomes. Monash Children's has traditionally used a more surgery forward approach but this may well change over time.

Make sure the family is aware of the referral to surgery and that their child might need an operation.

The referral should include brief history, positive and negative findings relevant to the current presentation, management so far and relevant past medical history. The surgeons at Monash Children's are well versed with thorascopic techniques. Should the surgical team suggest a different approach or require further information these discussions will take place between the surgical team and the ATR or on-call consultant.

Monash Children's @ Home

Monash Children's @ Home looks after patients in their home environment in a variety of constellations:

- **HITH** (Hospital in the Home) services
  Patients formally remain hospital inpatients but are actually off-site.
- **PAC** (Post Acute Care) visits that follow the child after a hospital admission or long- term care.
- **Complex Care Program**. Support for highly vulnerable children, typically mid to long-term.

Chapter 8

Contact Details

Contact details

		Office hours	After hours
SENIOR MEDICAL STAFF			
Paediatric Respiratory/Sleep			
Paediatric Sleep			

-
-
-
-
-

JUNIOR MEDICAL STAFF	Paediatric		Pager/mobile
Respiratory Registrar			
Sleep Registrar			Pager 4104
SLEEP CENTRE	Jaynne McKeown	45656	
Secretaries	Nicole Verginis /	45705	
Sleep laboratory	Rebecca Mihai		
CYSTIC FIBROSIS			
CF Co-ordinators			

-

Physiotherapist

-

Dietitians	Kate Johnson/Sarah Gliddon
Social Worker	Nikki Sher / Amanda Nichols
	Caitlin Miles/Erin Carr
	Stephanie Chen

RESPIRATORY LABORATORY	Marilyn Wilkinson	42278
Reception	Paul Findlay (Head)	42278/9
Scientists		

CLINICAL TRIALS CO-ORDINATOR

MONASH CHILDREN'S AT HOME