Paediatric Emergencies

Paediatric Emergencies 2025:
Conference Report by Dr Linda Dykes

Introduction

I confess I had never heard of paediatricemergencies.com before last week, but now I am a fan! A PEM friend shared a Facebook advert for the (free, virtual) annual Paeds Emergencies one-day conference on 13th November, and I was able to take last minute study leave to dial in. It was fantastic! Really high quality CPD, well presented and perfectly pitched. There are the notes I made during the event, plus a few panels of "extras" where I went off googling related topics - these are indicated by coloured panels and the "down the rabbit hole" logo ↗

An important disclaimer - I am a jobbing Emergency Medicine Consultant and GP, not a paeds Intensivist. I have endeavoured to relay the speakers' messages as accurately as I can, but accept no responsibility for any errors or omissions in my notes (or that the speakers made and I have inadvertently relayed). Remember it is your responsibility to check out any information before changing your clinical practice.

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PS - the conference talks are all now available on-line, free to access - maybe look at this report and watch any session that piques your interest?

Complications of vascular access | Dr Gyula Tövisházi, Paediatric Transport Consultant

Extravasation is a real concern, and whilst some infusions are much higher risk, no infusion fluids are totally risk free: even low-risk solutions like NaCl can cause compartment syndrome if infused under pressure.

NIVAS has an extravasation toolkit - https://vascular-access.files.svdcdn.com/production/images/NIVAS-Infiltration-and-Extravasation-toolkit-version-1-Feb-2024b.pdf?dm=1734439180

IO top tips

- Pink EZIO is too small for most larger babies, regardless of what the manufacturers say: >10% didn't reach medullary cavity in radiology studies. Blue needle more appropriate.
- Speaker suggests pink EZIO need for babies <6/12, blue for those >6/12, and yellow for adults, obese teenagers or any sized child needing humeral access (but not necessarily pushed all the way in)
- Analgesia for awake use of IO access: a German working group issued a statement concerned about LA toxicity from infusion lidocaine (although they had used a more toxic LA than lidocaine and other have queried the dose reported) which resulted in the death of three children. As a result of this, ERC/APLS recently changed their recommendations - they do still allow lidocaine 0.5 mg/kg infused over over 1-2 mins, but no longer *recommend* it, suggesting IN fentanyl/ketamine instead.
- EZ-IO needles (working and well secured) are "MRI conditional" - but not the IO drill.
- You *can* use the same tibia twice with an EZ-IO, but you *must leave the old needle in place* or the fluid you are infusing will fall of the previous hole!
- You can also use the ASIS for IO access if required

Who's heard of NIVAS?

NIVAS is the National Infusion and Vascular Access Society.

They have a really good Extravasation Toolkit that was mentioned in the talk, and their home page currently has a link to new (Spring 2025) guidelines on vascular access device flushing and locking in paediatric patients.

NB: NIVAS appears to be significantly industry-funded.

Intubation in paediatric cardiac arrest |

Dr Chris Flannigan, Paediatric Intensive Care Consultant

This talk was aimed at paediatric airway experts – not occasional intubators - but there was much of interest to me as an EM consultant more likely to be team leading by the foot end of the patient.

Whilst there is no evidence that ETT improves survival, the quality of the available evidence is very poor. The speaker took the position that there is a strong common sense rationale for early-as-practically-possible intubation in paediatric cardiac arrest, as most are caused by hypoxia.

- i-Gel is unlikely to provide a good enough seal to allow uninterrupted chest compressions and BVM certainly won't (if stuck using BVM, pass and NG tube and keep aspirating it)

- **Timing of intubation when expert intubator arrives:**
  - Do *not* wait for a pulse check…. first of all because you are delaying a potentially lifesaving intervention, secondly because people will be reticent to resume chest compressions if you are intubating, and thirdly because you only need the patient still whilst you are passing the tube, not for the laryngoscopy.
  - To do video laryngoscopy with chest compressions going, you need to rest your hand onto the patient's face (or, with direct laryngoscopy, the little finger) - so *you move with the patient* (like when holding otoscopes when examining kids)

- DON'T use a check list in cardiac arrest scenario.

- **Intubation pearls:**
  - DO use stylet in the ETT - especially with video laryngoscopes because they are bigger (use mouth space) you do go round a bend to deliver the tube.
  - Proper positioning (e.g. ear to sternal notch lined up, that helps direct laryngoscopy) is difficult to achieve in a CA, so use se video laryngoscopy as your first line to remove that problem.
  - If you can't pass the tube - check you have optimised your view, and "make space" be pushing blade to the left (more like direct laryngscopy)
  - DON'T forget the role of external laryngeal manipulation to improve the view

- Before running off to a paediatric cardiac arrest, it is better to take half a minute to find a skilled airway assistant (who does it on regular basis) to go with you, rather than heading off to resus by yourself.

- **If you arrive at the cardiac arrest without your own skilled airway assistant:**
  - DO remind the team leader you need an airway assistant.
  - Tell your allocated helper to stay with you (or they tend to disappear to help with something else!)
  - Consider getting your own kit together (assuming effective BVM going on) as it's likely to be quicker than asking them to find unfamiliar kit

- DO instruct your airway assistant to clearly tell the intubator when their kit is ready.

- DON'T want for the team leader to tell you when to intubate - your initial job is solely to secure the airway.

- DON'T try to lead the cardiac arrest team and intubate at the same time – you will do neither well.

- DO have your plan for soiled airways in mind: paediatric cardiac arrest often feature vomit, which is an Achilles' heel for video largynoscopy as the vomit blocks the camera. Suction first, try to keep "high and try", ensure your assistant can see your screen too. But be prepared to revert to direct laryngoscopy if gunk is rendering your VL useless.

- ·DO practice dealing with soiled airways in stressful situations in order to learn how to handle your own stress response – speaker suggested "do something unexpected" with your simulations (e.g. set up the mannequin that "everyone knows isn't used equipped for practicing airway soiling", to *have* a soiled airway and hence surprise the incubator and team).

Physiological Pearls you'll use tomorrow | Dr Peter Cosgrove - PEM Consultant

A really nice format: three scenarios, each with a physiological feature that seems counter-intuitive at first glance. Brilliantly delivered too, with interactive voting, and very practical. Probably my favourite talk of the day, along with the mediastinal masses one!

Case 1 - Cardiac

Scenario: circulatory collapse in a child post-Fontan procedure who has had D&V

- Kids with a completed **Fontan procedure** (used to treat single-ventricle congenital heart defects) are *exquisitely* sensitive to volume loss.
- Post-Fontan surgery, blood flows *passively* into the pulmonary circulation (there's no RV) – so even a tiny loss in pre-load (e.g. 10% dehydration, that most kids would be fine with) can cause a circulatory collapse.

•Give fluids even if CVP is normal. If in doubt - give fluids. On the other hand, positive pressure ventilation is very hazardous to the Fontant circulation.

- You won't get pulsus paradoxus in a Fontan circulation; and CPR doesn't work (as there is no compressible RV chamber)

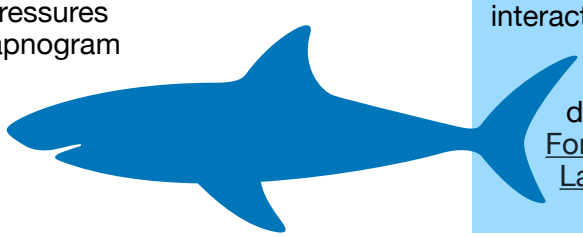
Case 2 - Respiratory

Scenario: intubated asthmatic child. Circulatory collapse.

"Consider Auto-PEEP first, and Tension Pneumothorax second."

What is Auto-PEEP?

- Lungs with severe bronchospasm need a prolonged exhalation time – they may need 4-5 seconds to exhale.
- A ventilator set with a RR of 15 allows on 3s to exhale… but the ventilator doesn't care, and you may get 100ml of air trapped each breath, causing progressive hyperinflation and massive intrathoracic pressure
- This results in impeded venous return, dropping cardiac output
- Characterised by bradycardia, hypotension, and rising peak airway pressures
- Look for shark fin capnogram



- Modified Bohr equation shows how you can be falsely reassured by ABG

To treat:

- Disconnect from the vent (this is diagnostic *and* therapeutic)
- Use BVM slowly - allow up to 10 seconds exhalation time in little kids
- Choose a slower RR on ventilator to allow 6s to exhale
- Accept permissive hypercapnoea
- Don't increase the PEEP

Case 3 - Sepsis

Scenario: severely septic child with sats of 100% but dreadful oxygen delivery and persistently high lactate

- Don't forget the oxygen delivery equation - enough Hb is essential - you can have dreadful oxygen delivery with 100% sats if you don't have enough Hb.
- Consider transfusion if Hb <7 and there is an elevated lactate (don't transfuse if Hb >10) especially if fluids and oxygenation are optimised.

I was busy looking things up during this session, both to remind myself what the heck a Fontan Circulation was (last thought about by me for my Primary FRCA at the turn of the century), and to link to resources for topics that aren't much discussed now.

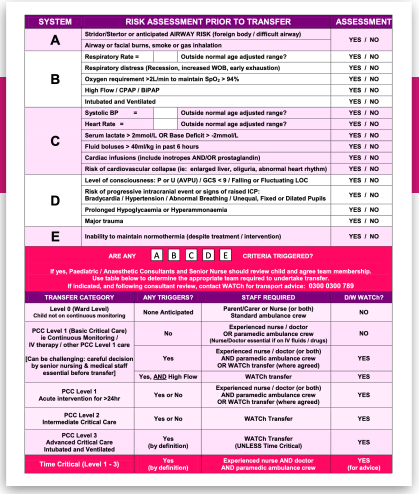
The role of adequate haemoglobin in sepsis patients, for example, was all the rage when we were trying to follow Rivers' Early Goal Directed Therapy in Severe Sepsis, but now most of that has been thrown out and we are left with the noddy "Sepsis Six", it is often overlooked and the Oxygen Delivery Equation too often retreats back to the lair of anaesthetic residents. There's a nice interactive case presention here.

I also found a nice little article discussing the circulatory control of the Fontan circulation, and a Life In The Fast Lane classic on Intrinsic PEEP.

Transport Logistics & Communications

Dr Rorya Sweeney, Paediatric Intensive Care Consultant

I still get jittery when listening to talks about transfers of critically well patients, after some scary experiences as an anaesthetic SHO in the late 1990s! Thankfully the days of stuffing what would now be an ST2 into the back of an ambulance with maybe a local one-day course under their belt have gone, and the widely-used Safe Transfer of Paediatric Patients (STOPP) Tool (right) even specifies what staff should accompany a child on an inter-hospital transfer.



SYSTEM	RISK ASSESSMENT PRIOR TO TRANSFER	ASSESSMENT
A	Stridor/Stertor or anticipated AIRWAY RISK (foreign body / difficult airway)	YES / NO
	Airway or facial burns, smoke or gas inhalation	YES / NO
B	Respiratory Rate = Outside normal age adjusted range?	YES / NO
	Respiratory distress (Recession, increased WOB, early exhaustion)	YES / NO
	Oxygen requirement >2L/min to maintain SpO_2 > 94%	YES / NO
	High Flow / CPAP / BIPAP	YES / NO
	Intubated and Ventilated	YES / NO
C	Systolic BP = Outside normal age adjusted range?	YES / NO
	Heart Rate = Outside normal age adjusted range?	YES / NO
	Serum lactate > 2mmol/L OR Base Deficit > -2mmol/L	YES / NO
	Fluid boluses > 40ml/kg in past 6 hours	YES / NO
	Cardiac infusions (include inotropes AND/OR prostaglandin)	YES / NO
	Risk of cardiovascular collapse (ie: enlarged liver, oliguria, abnormal heart rhythm)	YES / NO
D	Level of consciousness: P or U (AVPU) / GCS < 9 / Falling or Fluctuating LOC	YES / NO
	Risk of progressive intracranial event or signs of raised ICP: Bradycardia / Hypertension / Abnormal Breathing / Unequal, Fixed or Dilated Pupils	YES / NO
	Prolonged Hypoglycaemia or Hyperammonaemia	YES / NO
E	Inability to maintain normothermia (despite treatment / intervention)	YES / NO

ARE ANY A B C D E CRITERIA TRIGGERED?

If yes, Paediatric / Anaesthetic Consultants and Senior Nurse should review child and agree team membership. Use table below to determine the appropriate team required to undertake transfer. If indicated, and following consultant review, contact WATCH for transport advice: 0300 0300 789

TRANSFER CATEGORY	ANY TRIGGERS?	STAFF REQUIRED	D/W WATCH?
Level 0 (Ward Level) Child not on continuous monitoring	None Anticipated	Parent/Carer or Nurse (or both) Standard ambulance crew	NO
PCC Level 1 (Basic Critical Care) ie Continuous Monitoring / IV therapy / other PCC Level 1 care [Can be challenging: careful decision by senior nursing & medical staff essential before transfer]	No	Experienced nurse / doctor OR paramedic ambulance crew (Nurse/Doctor essential if on IV fluids / drugs)	NO
	Yes	Experienced nurse / doctor (or both) AND paramedic ambulance crew OR WATCH transfer (where agreed)	YES
	Yes, AND High Flow	WATCh transfer	YES
PCC Level 1 Acute intervention for >24hr	Yes or No	Experienced nurse / doctor (or both) AND paramedic ambulance crew OR WATCh transfer (where agreed)	YES
PCC Level 2 Intermediate Critical Care	Yes or No	WATCh Transfer	YES
PCC Level 3 Advanced Critical Care Intubated and Ventilated	Yes (by definition)	WATCh Transfer (UNLESS Time Critical)	YES
Time Critical (Level 1 - 3)	Yes (by definition)	Experienced nurse AND doctor AND paramedic ambulance crew	YES (for advice)

STOPP tool has been widely adopted in the UK for risk assessment, deciding which personnel should go, prep and handover - click here to see it.

- Light and sirens are useful for moving through heavy urban traffic, but are *not* justified in order to to drive as fast as possible: the average time saved in a transfer is six minutes, but with a risk to everyone on the ambulance and other road users, as crash risk increases x3. There are also physiological impacts on patients from travelling at extra speed(acceleration, deceleration, cornering, bumps)
- Unrestrained staff in ambulance are at risk - even at 30mph impacts. If your patient needs an intervention needed, can you get your driver to pull over somewhere safe? Also, always wait for vehicle to come to a complete stop!

Septic Shock

Dr Chris Flannigan, Paediatric Intensive Care Consultant

- Adrenaline infusions – it takes 27 minutes in a 3 year old for an adrenaline infusion at a typical start rate to get though the dead space of cannula and infusion set - so either fill them with adrenaline solution first, or use a higher infusion rate until the adrenaline actually reaches the patient's circulation
- Don't forget to look at venous oxygen saturation in resus settings: understand oxygen extraction
- Vasoactive drugs need calcium to work (NB don't use next to bicarb in same line)
- Trauma patients can flip from one kind of shock to another.
- If one drug is causing a problem, (e.g. adrenaline) you can give something else to counteract it - or you can try turning down the drug casing the problem.

Shocked paeds patients will crash on induction - get adrenaline running first - there are some nice blogs on this here and here.

This is a topic where you will find some different emphasis in some US/Aus websites where there is a tradition of intubating critically ill patients with no or minimal sedation, which is regarded here as barbaric.

I had forgotten all about the need for calcium levels to be adequate for inotropes to work, and really liked this 2022 review article and case report by Whelan *et al* that outlines some of the debate and hints that the 2020 paediatric Surviving Sepsis panel members would not commit to writing down what they actually do!

I also found a nice primer/refresher on vasoactive drugs for kids with septic shock at the Don't Forget The Bubbles website.

If you think your vasoactive drugs are not working, systematically work out what may be going wrong:

- o Is the line in the right place?
- o Dead space
- o Dilution error
- o pH
- o Steroids - patient's own adrenal response may just not be enough an supplementation may be required
- o Is there enough calcium for the vasoactive drugs to work?
- o Wrong drug choice
- o Is the diagnosis wrong?

The deteriorating child with a mediastinal mass

Dr Constantine Kanaris

This topic is filed in my brain as "Things that go bump in the night" - the zebra that may creep in amongst many hundreds of kids with wheezy chests and a few with facial swelling.

One for anyone who sees unselected kids to have a flick through just to remember this scenario happens - some of these kids will present to Primary Care, although hopefully not in acute respiratory distress.

The fist presentation of mediastinal masses in kids (mainly tumours, mostly haematological) may be airway compression and SVC obstruction with face swelling. Hence, they can initially present to ED looking like asthma or anaphylaxis.

Pemberton's sign - used to demonstrate increased pressure at thoracic inlet (facial congestion and respiratory distress when arms over head for one minute plus).

75% of mediastinal masses in kids are anterior. This factlet may help you out of trouble for a child with rapidly deteriorating airway compression: flip the child prone (and hope gravity will relieve airway pressure).

Consider:

- NIV
- Shrink the tumour (steroids, chemo/radiotherapy – get early paeds haem/onc consult) and prep for possible **tumour lysis syndrome** (hyperhydration with IV fluids, plus allupurinol or Rasburicase). The fluid requirement is *really* high - 2.5-3 litres per metres square - and ideally started 24-48 hours pre chemotherapy, but sometimes that luxury isn't available.
- Also watch for hyperkalaemia, hypocalcaemia, hypophosphataemia, hyperuriocaemia in tumour lysis syndrome.

Cannulate the legs, not the arms, in SVC obstruction (otherwise drug delivery will be hit and miss)

Do NOT intubate these kids unless you absolutely have to have to: postpone it. Firstly, in most cases the tip of the tube will be *above* the site of compression of the airway. Secondly, loss of thoracic muscle tone with paralytics can worsen severe airway compression.

Cracking CXR image in a Tweet I stumbled upon whilst looking for a photo to illustrate this page!

If there really is no option but to intubate:

- Ideally, CT awake in advance
- Prepare for possible difficult airway and use an armoured/reinforced tube.
- Awake fibreboptic intubation preferred - but only a realistic option for older kids
- Spontaneous breathing, sitting position
- Lower extremity IV access
- Standby ECMO if possible
- Try to avoid any paralysing agent at all if you possibly can - severe airway compression will worsen if chest wall tone decreased. but if you absolutely have to, use rocuronium. *Never* use sux (the potassium surge is risky in context of tumour lysis)

Proning after intubation may be a lifesaver

Hearing this talk inspired me to look up some resources about mediastinal masses in kids - click here for another fantastic DFTB resource - and oncological emergencies in general:

Tumour lysis syndrome from Pediatric EM Morsels and - from Don't Forget the Bubbles yet again - Top Ten Oncological Emergencies in kids .

I even found a case report of spontaneous Tumour Lysis syndrome in a child who hadn't even been diagnosed with their tumour before TLS developed!

The deteriorating paediatric patient with complex needs

Dr Damien Gates, Consultant Paediatric Intensivist

What kinds of problems are "complex needs" kids facing?

- Respiratory failure (chronic and progressive) is common.
- Aspiration risk is high (small asprations oten happen frequently, with risk of bigger ones)
- Increased secretions very common – often on meds for this (or even botox to salivary glands)
- Kyphoscoliosis common
- Often colonised with unhelpful and multi-resistent organisms
- Chronic atelectaosis due to posture
- Low airway tone
- Reduced central respiratory drive
- Reduced nutritional status

Assessment:

- Increased WOB may not be evident (e.g. kids with some forms of muscular dystrophy) – and these kids may breathe less, not more, when very sick.
- Pallor and reduced LOC is suspicious for respiratory academia.
- Ask about seizures or medication changes: LOC reduced may be the primary or a secondary problem.
- Increasing HR and RR, decreased GCS and more respiratory support all spell trouble.
- Parents may be very well informed about what their child does (doesn't tolerate PEEP, for example)
- Get a CXR and compare it with old ones
- Check old notes and results - especially microbiology. Don't automatically reach for standard first line Abx: ring micro/ID.

Managing acute respiratory deterioration:

- Communicate with specialists and parents/ carers
- Posture, positioning, chest physio - they are already effectively HDU patients at home (which may make ward nurses nervous!)
- Maximise lung volumes - escalate respiratory support
- Early anaesthetic review – these kids may be difficulty intubations, it helps is anaethetists have time need to prepare, including looking at old notes
- Hold off on feeds, but don't forget to give critical enteral meds
- Get their own equipment in from home - e.g. their special chairs that optimise their posture
- Watch out for meds being used to reduce secretions - may need to stop to help lower airway secretions clear - d/w resp physio. Stopping anticholinergic meds to allow chest secretions to loosen may make salivary secretions much worse – d/w ENT about botox to salivary glands (eve in acute setting)
- Treat fever - they can look especially poorly with it
- Sudden deterioration is often mucus plugging - try airway clearance measures and chest physio first (and CXR) - can sometimes turn situation around (even if it takes nebulised mucolytics and even bagging briefly with high PEEP)
- Hypertonic saline nebs - can cause bronchospasm, but is mucolytic and the irritation can trigger a good cough.

Thinking of intubating?

- Intubation carries risks - speak to regional PICU first if you possible can.
- Mechanical ventilation injuries lungs – these children often have obstructive *and* restrictive lung disease - will likely need very high ventilation pressures, typically needs sedation and paralysis and they get respiratory muscle deconditioning. You'll likely need to accept worse ABGs than you usually would.
- Plan for difficult intubation - dysmorphia, anatomical distortion due to kyphoscoliosis, and reduced FRC (acute on chronic)
- Is there any congenital cardiac disease? Check!

Escalation planning

- In absence of agreed anticipatory care plan, you may have to just crack on if faced with an emergency situation.
- But, balanced conversations with the child's family are important. They need to know that intubation may kill them, ventilation may not work as well as what the child usually manages, and weaning from ventilator may be impossible.

- *Never* make assumptions about QOL from what you see in emergency setting – concentrate exclusively on whether interventions are likely to work/help - or not.

Questions from the DGH (to PICU)

Dr Phil Ross

Things to that PICU want DGHs to tell them about

- Asthmatics heading towards intubation
- Raised ammonia in neonates - don't put it down as just "sick baby ammonia" - outcomes are worse if ammonia climbs high before treatment starts
- Any myocarditis/cardimoyopathy kids

PICU's top tips for DGH paediatricians treating kids with bronchiolitis

- Don't ring PICU because they're "*at risk* of tiring" - only if they *are* failing on high flow… but don't leave it too late either (80-90% sats is too late)
- Maybe call PICU when a bronchiolitis kid is on about 60% oxygen FiO2 (and you have already have done physio, nebs if older, and suctioning ".. which NICE doesn't like it but it may fend off intubation")
- A bit of hypercapnoea is ok, and sats of 88%-90% sats acceptable if the child is otherwise coping OK
- If interventions have helped improve things, that is reassuring. For example, of putting onto high flow oxygen has resulted in RR and HR falling
- Get hands off these kids when starting on high flow oxygen - let them settle!
- Consider prone position
- Video the kid to demonstrate the WOB (also useful to send to PICU colleagues)

Common avoidable issues in DGH referrals

- Right main bronchus intubation
- Wrong tube size (usually too small) or an uncuffed tube - so can't fix a big leak
- Complex needs kids – remember to suction after intubation
- Don't delay time critical transfers for unnecessary stuff: "get the ambulance as having paramedics standing by the food of the bed waiting will stop you faffing "
- There is a big difference between DGHs in London vs. retrieval by air from remote Scottish islands, and typical DGHs are somewhere in between… "it's almost possible to scoop and run in London where the nearest NICU is less than 15-20 minutes away"
- Dopamine has gone out of fashion - no longer on any guidelines.
- Adrenaline is generally first line and noradrenaline second line – if they aren't

There was also a thought-provoking session on "When your baby needs ICU: a personal reflection" that can be watched on catch-up (available at this link) - it don't lend itself to taking bullet points to share.

The session concerned a surrogate baby who became ill in Bogotá, Colombia, before being brought home to the UK. A throw-away session by the speaker about managing conditions causing hypoxaemia whilst at high altitude (Bogotá is 2640m above sea level; AMS risk begins from 2500m) led me down a pretty wide-ranging rabbit hole of googling stuff and ended up with me looking at resources on **Assessing Fitness to Fly in patients with conditions where pre-existing hypoxia (e.g. COPD) may cause problems**.

Firstly, I found a 2021 BTS statement on air travel in patients with respiratory disease - https://thorax.bmj.com/content/77/4/329.long that is well with a read.

Meanwhile, *The Civil Aviation Authority information* still has with the nice and simple "… *the single, most practical, fitness to fly test, which has stood the test of time, is to assess whether the patient can walk 50 yards/metres at a normal pace or climb one flight of stairs without severe dyspnoea. If this can be accomplished, it is likely that the patient will tolerate the normal aircraft environment*" - which looks lovely and clear, but note that the BTS disagree with this.

Hypoxia fit-to-fly tests are widely available privately for £250-400, and whilst finding *that* out, I also found there are online services offering a plethora of medical letter types for things like travel insurance claims.

Whilst I found the "dial a letter saying what you want" somewhat alarming, it is probably worth knowing such services exist, because we don't generally issue letters from UK EDs, and whilst patients can get letters from their GP (privately, and charged for), it probably isn't the best use of scarce GP consultations (even if the patient is able to secure an appointment in the timescale their travel insurance company requires).