AQUA 2020

Annual Queenstown Update in Anaesthesia

Programme and Abstracts

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Welcome to Queenstown

Dear Colleague,

Welcome to AQUA 2020!

This year the effects of COVID-19 and closed borders have impacted AQUA like no other year. However, we welcome you to Queenstown in December for the first time and hope you will enjoy what should be a unique and memorable AQUA.

As usual, the scientific programme contains a broad range of clinically focused updates on topics from cardiology and regional anaesthesia to the COVID pandemic. We are also offering Airway (CICO) and TEG workshops.

We have made some changes to the social programme to reflect the shift from winter to summer, our AQUA BBQ on Friday evening will now be held at Jack's Point and there'll be mountain biking, golf activities and walks on the resort trails to enjoy. The AQUA conference dinner will still be held on Saturday night at Walter Peak and features the TSS Earnslaw boat trip across Lake Wakatipu, dinner and farm demonstration.

Lastly, we'd like to thank our sponsors for their continued support of our meeting this year.

Neil MacLennan
Kerry Gunn
&
Karen Patching

AQUA Organising Committee

Social Programme

THURSDAY, 10 DECEMBER 2020

17:00 – 19:00

Registration & Welcome Function
Exhibitor Area, Pounamu Room, Heritage, Queenstown

FRIDAY, 11 DECEMBER 2020

16:30 – 21:00 approx.

AQUA BBQ Function
Jack's Point

SATURDAY, 12 DECEMBER 2020

18:00 – 22:10 (you need to be at Steamer Wharf, 88 Beach Street, Queenstown, no later than 17:30)

AQUA Conference Dinner (pre-purchase)
TSS Earnslaw & Walter Peak

Faculty

Dr Fiona Stewart	Consultant Cardiologist, ADHB
Dr Kerry Gunn	Consultant Anaesthetist, Auckland
Dr Aruntha Moorthy	Specialist Anaesthetist, CCDHB
Dr Morgan Edwards	Specialist Anaesthetist, Obstetric Lead, WDHB
Dr Sheila Hart	Specialist Anaesthetist, CCDHB / President, NZSA
Dr Kerry Benson-Cooper	Intensive Care Medicine Specialist, ADHB
Dr Gemma Malpas	Specialist Anaesthetist, ADHB
Dr Vanessa Beavis	Specialist Anaesthetist, ADHB / President, ANZCA
Dr James Lai	Specialist Anaesthetist, ADHB
Dr Indu Kapoor	Specialist Anaesthetist, CCDHB
Dr Matt Taylor	Specialist Anaesthetist, CMDHB
Dr Sally Roberts	Clinical Head of Microbiology, ADHB
Dr Tony Smith	Intensive Care Medicine Specialist, ADHB

Airway Workshop [Teleflex]

Dr Helen Lindsay	Specialist Anaesthetist, ADHB
Dr Gemma Malpas	Specialist Anaesthetist, ADHB
Dr Nola Ng	Specialist Anaesthetist, ADHB

TEG6 and Major Haemorrhage Workshop [Haemonetics]

Dr Kerry Gunn	Consultant Anaesthetist, Auckland
Chris Finlay	Technical Specialist, Point of Care Testing, Christchurch

POCUS demonstrations [FUJIFILM SONOSITE]

Dr James Lai	Specialist Anaesthetist, ADHB

Scientific Programme

Friday, 11 December 2020

Session 1 – Chair: TBA		Icon Conference Room
07:55	Welcome and Introduction	Sheila Hart, President NZSA
08:00	Cardiology Update	Fiona Stewart
08:30	New Zealand Critical Bleeding Bundle	Kerry Gunn
09:00	Perioperative Medicine	Aruntha Moorthy
09:30	Update in Obstetric Anaesthesia in New Zealand	Morgan Edwards
10:00	Morning Break	Pounamu Room – Exhibitor Area
Session 2 – Chair: TBA		Icon Conference Room
10:30	ALS Update	Sheila Hart
11:00	ICU Update	Kerry Benson-Cooper
11:30	Airway Update	Gemma Malpas
12:00	Close – Lunch packs and fresh fruit available for pick-up	Mackenzies Restaurant
12:15	POCUS Demonstration - Lung and Cardiac Ultrasound	James Lai [Icon Foyer]

AQUA Workshops [Friday afternoon] *(please ensure you attend the session you registered for)*

13:00	■ Airway [AW1] 90 mins	Icon Conference Room
14:30	Afternoon Break	Icon Foyer
14:40	■ Airway [AW2] 90 mins - concludes at 16:10	Icon Conference Room

Saturday, 12 December 2020

Session 3 – Chair: TBA		Icon Conference Room
08:00	The College	Vanessa Beavis
08:30	The Erector Spinae Plane Block	James Lai
09:00	Update in Paediatric Anaesthesia	Indu Kapoor
09:30	White Island Eruption – the Middlemore experience	Matt Taylor
10:00	Morning Break	Pounamu Room – Exhibitor Area
Session 4 – Chair: TBA		Icon Conference Room
10:30	Covid-19 and Beyond	Sally Roberts
11:15	White Island Eruption – Disaster Management	Tony Smith
12:00	Close – Lunch packs and fresh fruit available for pick-up	Mackenzies Restaurant
12:15	POCUS Demonstration - Erector Spinae Block & blocks used for Breast/Thoracic Surgery	James Lai [[Icon Foyer]

AQUA Workshops [Saturday afternoon] *(please ensure you attend the session you registered for)*

13:00	■ TEG6 & Major Haemorrhage Workshop [TEG1] 90 mins	Pounamu Room – Exhibitor Area
14:30	Afternoon Break	Pounamu Room – Exhibitor Area
15:00	■ TEG6 & Major Haemorrhage Workshop [TEG2] 90 mins	Pounamu Room – Exhibitor Area

The AQUA Conference 2020 can be claimed under the ANZCA CPD Knowledge and Skills category under the following activities: Lectures 1 credit/hour. Small group discussions 2 credits/hour.

Cardiology Update

Dr Fiona Stewart

Consultant Cardiologist, ADHB

For all of us, 2020 has been dominated by COVID although we in New Zealand have fortunately, so far, had little experience with it. Cardiovascular concerns emerged early in the discussion around COVID. The virus binds in the lungs via ACE2 receptors. There were initial concerns that patients taking ACE inhibitors or ARBs would be more susceptible to the virus. Subsequent studies have not confirmed any risk from these agents. COVID causes multiple cardiovascular complications particularly myocarditis, a propensity to thrombosis and in children a Kawasaki-like inflammatory condition. Hydroxychloroquine promoted early for treatment of COVID but not now seen to be effective raised concerns about long QT and the risk of VT especially when given with azithromycin.

Heart Failure

ACE inhibitors, Beta blockers and spironolactone have been the mainstay of medical therapy for heart failure with reduced ejection fraction. Device therapy with CRT pacing and implantable defibrillators have improved outcome in selected groups of patients. Two new classes of medication have led to further significant improvements in survival – neprilysin inhibitors (Entresto – a combination of valsartan with sacubitril) and the SGLT2 (sodium-glucose cotransporter-2) inhibitors (Dapagliflozin).

To date, no effective treatment has been found for patients with heart failure and preserved ejection fraction other than treating any underlying cause.

Infiltrative Cardiac Diseases

With improved imaging cardiac sarcoidosis and amyloidosis is easier to diagnose. Survival in patients with transthyretin cardiac amyloidosis (TTR-CA), the most common form of amyloidosis in the elderly, has improved significantly with TTR stabilisers. Trials are continuing to find effective and affordable medication.

Ischaemic Heart Disease

The ISCHEMIA trial which looked at optimal management for patients with stable coronary disease and moderate to severe inducible ischaemia on stress testing compared an invasive vs noninvasive approach to management after a LMS or proximal LAD severe stenosis was ruled out by CT Coronary Angiography. No overall benefit in reducing cardiovascular events was seen with an invasive approach.

Optimal anticoagulation and antiplatelet therapy for patients with atrial fibrillation following PCI has been studied in a number of trials. The choice of agent and duration of therapy depends on the individual risk of ischaemia and bleeding. NOACs are preferred over warfarin except for mechanical valves and moderate to severe MS. Triple therapy with aspirin, clopidogrel or ticagrelor and the NOAC is continued for 7 days to 3 months depending on patient risk (usually 1/12) and then clopidogrel or ticagrelor with the NOAC for a maximum of 1 year. A NOAC alone is effective long term.

Atrial Fibrillation

NOACs are the preferred anticoagulants except for patients with moderate to severe MS and mechanical valves. Rivaroxaban is now indicated for patients with creatinine clearance >15ml/min. Bridging anticoagulation is rarely indicated preoperatively but it is important that the NOACs are not stopped too early before surgery.

Left atrial appendage occlusion with a Watchman or similar device is as effective as an anticoagulant in prevention thromboembolism for patients who cannot tolerate an anticoagulant.

For younger patients or patients with left ventricular impairment, maintenance of sinus rhythm with PVI gives the best results.
In the elderly, attention to heart rate control is important. If rate control is inadequate and increased medication is not tolerated, insertion of a pacemaker and AV node ablation usually leads to improved quality of life.

Supraventricular arrhythmias
Catheter ablation is the preferred first line treatment for most supraventricular arrhythmias rather than antiarrhythmic therapy.

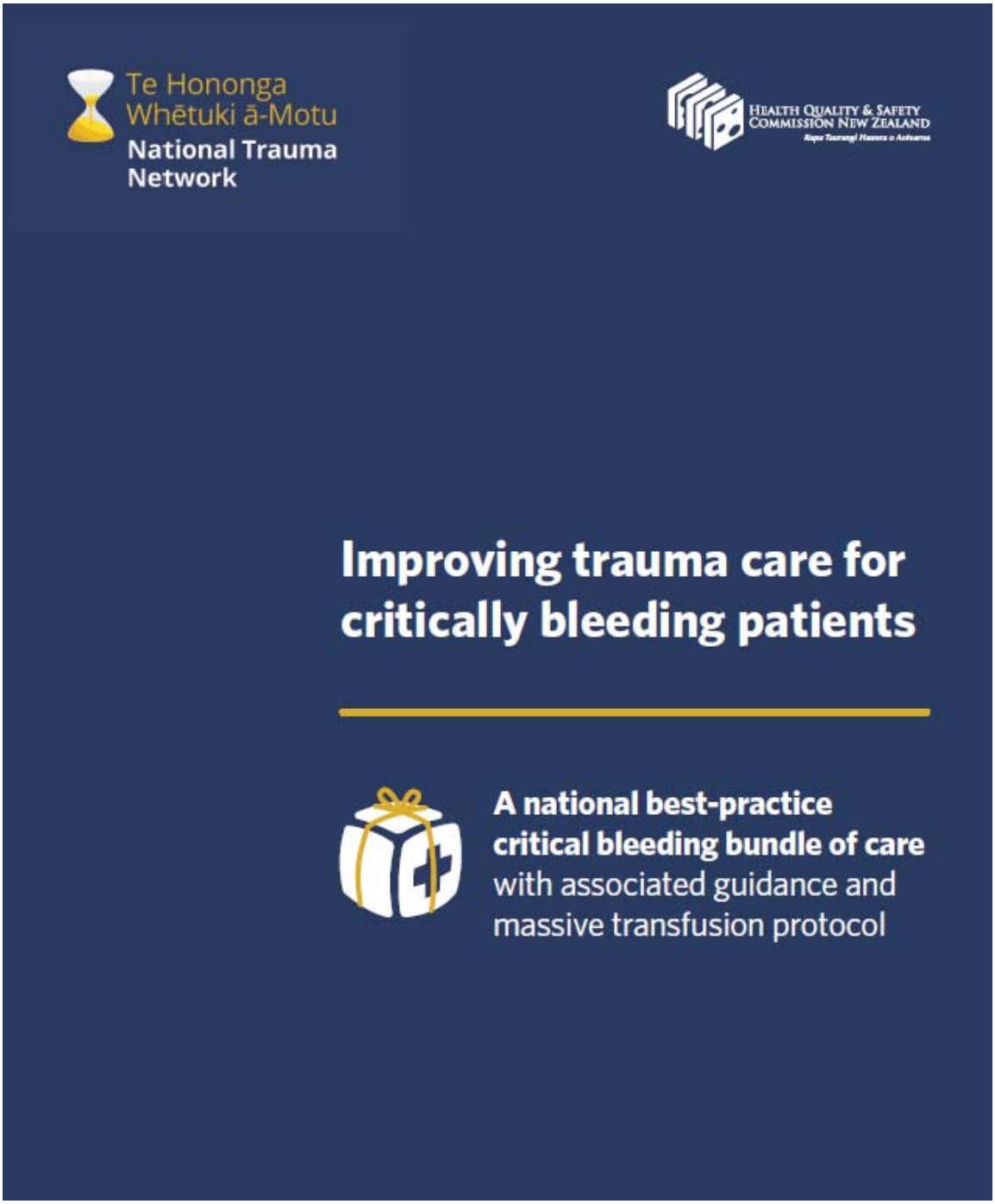
Ventricular Tachycardia and VPBs
For patients with impaired LV function ablation of the VT or ectopic focus will usually lead to improved cardiac function and improve exercise tolerance.

Valvular Heart Disease
TAVI is now the preferred approach for most patients whether low, intermediate or high risk for surgery.

Wearable Devices
There is an explosion of wearable devices to monitor cardiac function now available on the market. Some, such as the Alive Cor or Kardia device now built into the I-Watch V will produce high quality ECG rhythm strips. Oxygen saturation monitoring will be available with the next model. Blood pressure monitoring is also available in a watch format. Patients are increasingly engaged with these health technologies which, when used well can significantly improve our diagnostic potential. They however increase cardiac anxiety and cardiac hypervigilance in many patients.

New Zealand Critical Bleeding Bundle

Dr Kerry Gunn
Consultant Anaesthetist, Auckland



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Perioperative Medicine

Dr Aruntha Moorthy

Specialist Anaesthetist, CCDHB

Perioperative medicine is an evolving specialty where a multidisciplinary team formulate an integrated, pathway that begins from the time surgery is contemplated through to recovery and return to the community. The overarching principle is that it should be patient centred to address their needs and values. This is an evolution of the traditional pre, intra and postoperative care model which has served many patients well.

However, we are aware that there is a particular group of high risk patients who are not served well by this system which can be fragmented and disjointed. This small group has the highest mortality and morbidity (1,2) and include older patients (3), the frail (4,5) and those with multiple comorbidities. These poorer than anticipated outcomes can result from: Not recognising this subgroup, not planning for their specific needs, and failure to identify and rescue early complications. The developing specialty of Perioperative Medicine attempts to create a bespoke patient-centric model of care as a possible solution to these problems (6) and minimise avoidable harm(9).

What are these poor outcomes?

Traditionally, we monitor: mortality, length of hospital stay and ICU admissions as outcome measures probably because they are easy to trace and are finite end points. These may be useful to hospital accountants and planners however, these end points may be of little meaningful value to a patient consenting for high risk surgery. They are more likely to be interested as to when they can return to their normal life.

Perioperative medicine is trying to address this by looking at different end points, for example quality of recovery score, morbidity scales, days alive at home after surgery (7,8) which patients can relate to. Both sets of outcomes are valuable to different groups for different reasons.

Principles of a Perioperative Pathway

1. Tools to identify high risk surgery.
2. Tools to identify high risk patients (most important).
3. Establishing a team who will know the patient and be involved in their care from pre-assessment to discharge.
4. Getting patients to engage in their care: EPOA, advanced care planning, discussing wishes and needs, (10). Remember to address cultural needs.
5. Medical, anaesthestic and geriatric evaluation. This will include cognitive screening, frailty assessment cardiovascular screening and a risk evaluation e.g. with NZrisk, NSQIP.

   To try and compare this patient to a general population undergoing similar surgery.
6. An MDT with the patient and discussion utilising the principles of the difficult conversation. The team needs to include the surgeon here to outline the options, what life might look like and non-surgical options. Consideration should be given to other specialty providers at this point (11) and areas worthy of optimisation before embarking on the pathway.
7. Once intent is established i.e. goals of care, it needs to be documented, relayed to patient and family again for review, and commenced. This pathway should have the capacity for flexibility if the needs or wishes of the patient change.

The perioperative physician/team will follow patient progress and help to smooth the perioperative journey all the way home and for some time after.

What are we doing in Wellington?

CHRISP (Complex High Risk Surgical Patient) pathway
We managed to get together various components of the ideal pathway, some funding for a 1/10 geriatrician and we commenced a pilot study.

Our Perioperative registrar looked at some of our data from the pilot study over a year and compared them to a matched group and showed a trend of less ICU time, less unplanned ICU admissions and fewer total days in hospital. Interestingly of the CHRISP group initially assessed just under a half did not proceed with initial planned procedure. Some had less invasive surgery and at least one declined surgery, preferring to take the extra home help offered in place of high risk surgery. The pilot study showed some promising results which we hoped would be supportive CHRISP becoming established practice in Wellington Hospital. We are in a queue for permanent funding. With on-going requests from our surgical colleagues and good will we are still continuing to provide this service in a contracted form.

Summary

There is a group of patients whose numbers are increasing and they carry a higher burden of postoperative complications than most. Prolonged morbidity after surgery is associated with a higher risk of premature death for up to two years post-surgery (12). By altering our model of care to anticipate the needs of this group and rescuing them from prolonged harm in the early perioperative period we should improve outcomes for the patient and look after our health resources, and so improve the risk benefit profile.

With regards to the CHRISP pathway we concentrated our efforts on elective high risk patients, in the hope that once we had an established pathway we could quickly put this into action for our acute very high risk patients where the timeframe is hours rather than days.

Of interest

Top med talks
Centre for Perioperative Care

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Update in Obstetric Anaesthesia in New Zealand

Dr Morgan Edwards
Specialist Anaesthetist, Obstetric Lead, WDHB

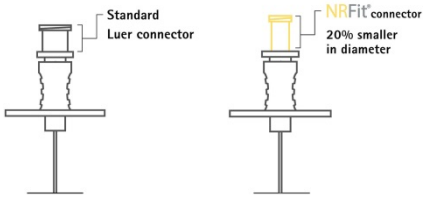
What is new in Obstetric Anaesthesia in New Zealand 2020?
Like with most subspecialties, our year has been dominated by COVID-19. However, several other key developments have occurred, or are in progress.

NRFit
Following a myriad of reports of wrong route administration errors, the International Organization for Standardization (ISO) developed the ISO 80369 engineering standards to specify the design of small-bore connectors for various clinical applications that are dissimilar.

Non-epidural medications (e.g., potassium chloride, antibiotics, vinca alkaloids) have inadvertently been administered into the epidural or intrathecal space. Some of these errors can result in permanent neurological and cardiac deficits, and death.

Medical device connectors for neuraxial applications are changing from Luer connectors to ISO 80369-6-compliant connectors. Compared with Leur system, NRFit syringes have

- 20% smaller connector diameters
- Smaller collar and tip (but same inner diameter)
- A tip that is flush with the collar (Leur tip extends beyond).



Rollout of this new system hasn't yet been given a date for completion by ANZCA, however trials are occurring across Australia and NZ. ADHB is leading the way in NZ, with others to follow. Currently there are no NRFit-Leur adapters available, which mandates a complete changeover of all equipment at once.

Patient education - Breastfeeding and Anaesthesia
There are now three NZ Based Patient education sites available for directing women to. The newest addition is www.breastfeeding-anaesthesia.info, which is hosted by Dr Caroline Ariaens – SMO at Waikato DHB. This site provides information for both women and healthcare professionals on how to approach anaesthesia with a breastfeeding woman.

NOA in conjunction with the NZSA is in the process of establishing a central patient information page which will host a link to this site as well as www.yourlabouryourway.co.nz and www.yourcsection.co.nz. This page will be available to access via a QR code, with plans for NOA to provide a business card template to any interested DHB.

Obstetrics + COVID
Most recently, RANZCOG has released an update (August 7) with the following key statements.

- N95 masks are required for healthcare workers caring for women with suspected or proven COVID-19 infection in labour, birth and caesarean section
- The patient who has proven or is suspected to be at high-risk for COVID-19 infection should be encouraged to wear an appropriate mask, recognizing that this may not be tolerable.

- During the third stage, retain protective equipment and follow usual practice, including, where appropriate delayed cord clamping, controlled cord traction, skin to skin contact and initiation of breastfeeding.

The Ministry of Health is yet to amend its stance on PPE requirements for care of known or suspected COVID-19 positive women in labour. Regional policy currently differs.

Gastric acid prophylaxis

Obstetric patients are considered at increased risk of aspiration of gastric contents during general anaesthesia when laryngeal reflexes are reduced. This is associated with significant morbidity and mortality. Obstetric patients are at a higher risk compared to the non-pregnant population because high levels of progesterone cause relaxation of the musculature at the gastro-oesophageal junction and increased gastric residual volume. In addition, there is higher intra-gastric pressure due to the gravid uterus, which causes gastric contents to be forced upwards. Studies have shown that the administration of parenteral opioids in labour is associated with delayed gastric emptying.

Since the removal of Ranitidine from use there has been a universal switch to Omeprazole use across all DHBs, although there is variation in practice. Some are using Omeprazole routinely whereas others reserve it for high risk women only.

Tramadol

The AAGBI (now AoA) has released guidance on the use of Tramadol in breastfeeding.

- Limited to inpatient use only
- Monitoring for respiratory depression in the neonate

This raises the question regarding appropriate drugs for discharge for those women requiring additional analgesia beyond NSAIDs and Paracetamol.

- Continue Tramadol (many DHBs doing this)
- Sevredol (also associated with Neonatal depression)

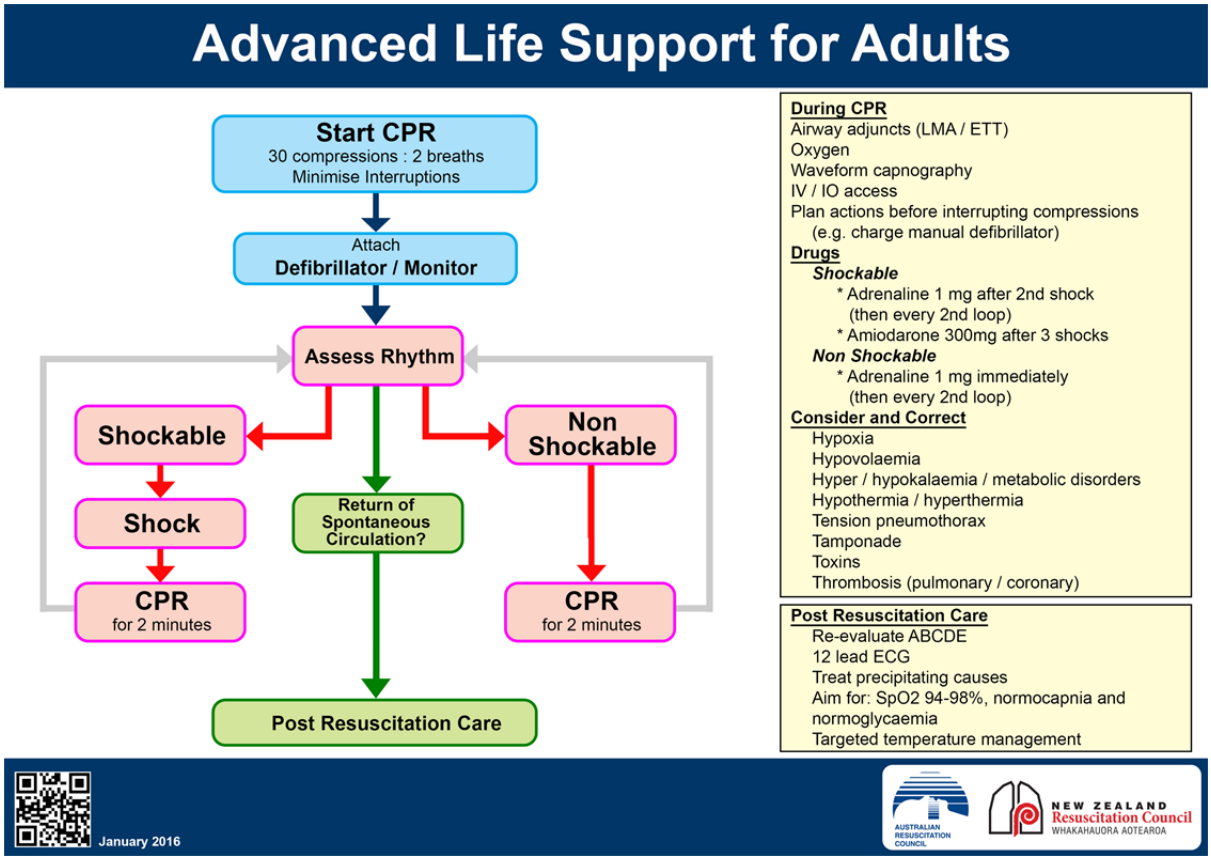
Dr Morgan Edwards
Specialist Anaesthetist – Obstetric Lead Waitematā DHB
NZSA – Obstetric Portfolio
ANZCA Obstetric SIG – NZ Representative
NOA Committee Member

ALS Update

Dr Sheila Hart

Specialist Anaesthetist, CCDHB

The last update for ALS guidelines was in 2016 and there have been no changes since then. 2 large RCTs have been published – Airways 2 and Paramedic 2 which have generated some discussion relating to current recommendations.



Epidemiology

Out-of-hospital cardiac arrest (OHCA) is a leading cause of mortality in the world. Due to low survival rates and to the high risk for irreversible neurological damage and disability in survivors, it is a significant public, and global, health issue.

Overall survival to hospital discharge of around 10% internationally (6-22%) [Dyson 2019]
We have a 14% 30-day survival in New Zealand.

Global Resuscitation alliance 10 steps to improving outcome:

1. Establish a Cardiac Arrest Registry – Utstein comparators*
2. Begin Telephone-CPR with ongoing training and Quality improvement
3. Begin High-Performance EMS CPR with ongoing training and Quality improvement
4. Begin Rapid dispatch
5. Measure professional Resuscitation using the defibrillator recording
6. Begin and AED program for first responders, including police, security guards

7. Use Smart technologies to extend CPR and Public Access Defibrillation and use programs to notify volunteer bystanders to respond to nearby arrests
8. Make CPR and AED training mandatory in school and the community
9. Work toward accountability - submit annual reports to the community
10. Work towards a culture of excellence

*Utstein Comparators: Adults (>15yrs), all cause, resuscitation attempted, shockable presenting rhythm and bystander witnessed. Excludes children, EMS witnessed and no resuscitation attempt.

Community response: Early effective CPR and defibrillation

Community response remains a critical step in the Chain of Survival and the only aspect that is readily modifiable.

If you weighted intervention based on ability to improve outcome the chain of survival would look more like this for OHCA [Deakin 2018]:

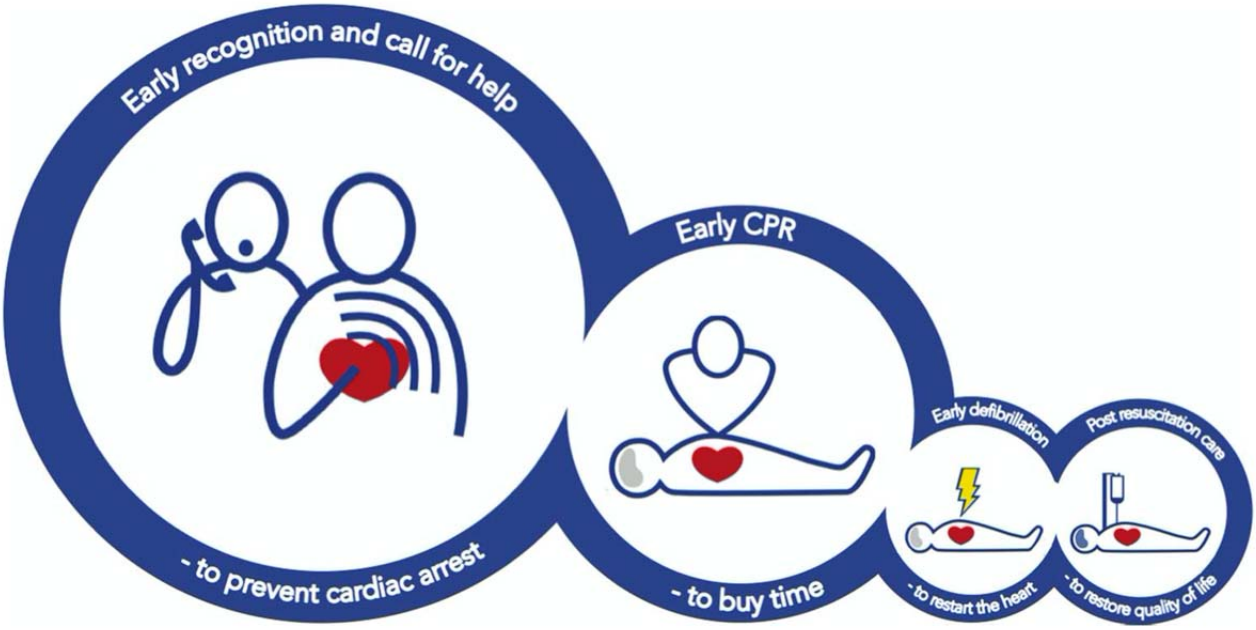


Fig. 1. Chain of survival for out-of-hospital cardiac arrest (Area ratios 1.0, 0.47, 0.12, 0.12).

Even in communities with mature infrastructure only about half of cardiac arrest victims receive CPR prior to EMS arrival and < 5% received defibrillation prior to EMS arrival [Blackwood 2020]
Cardiac arrest rates are higher, and bystander CPR lower in areas of socioeconomic deprivation [Van Nieuwenhuizen 2019] and usually there are less public access defibrillators [Dicker 2019]

Public access defibrillation programmes are consistently associated with better outcomes from OHCA

Good SAM is an international App, used in NZ, aiming to improve bystander CPR rates by calling on registered volunteers in the neighbourhood (alert sent at time of EMS dispatch). Studies are not showing a convincing benefit of such systems, but in NZ annual report into OHCA showed an improvement in survival if a Good SAM volunteer was present.

For in hospital cardiac arrest, the importance of early warning systems allowing intervention before arrest occurs is highlighted, and post resuscitation care plays more of a role:

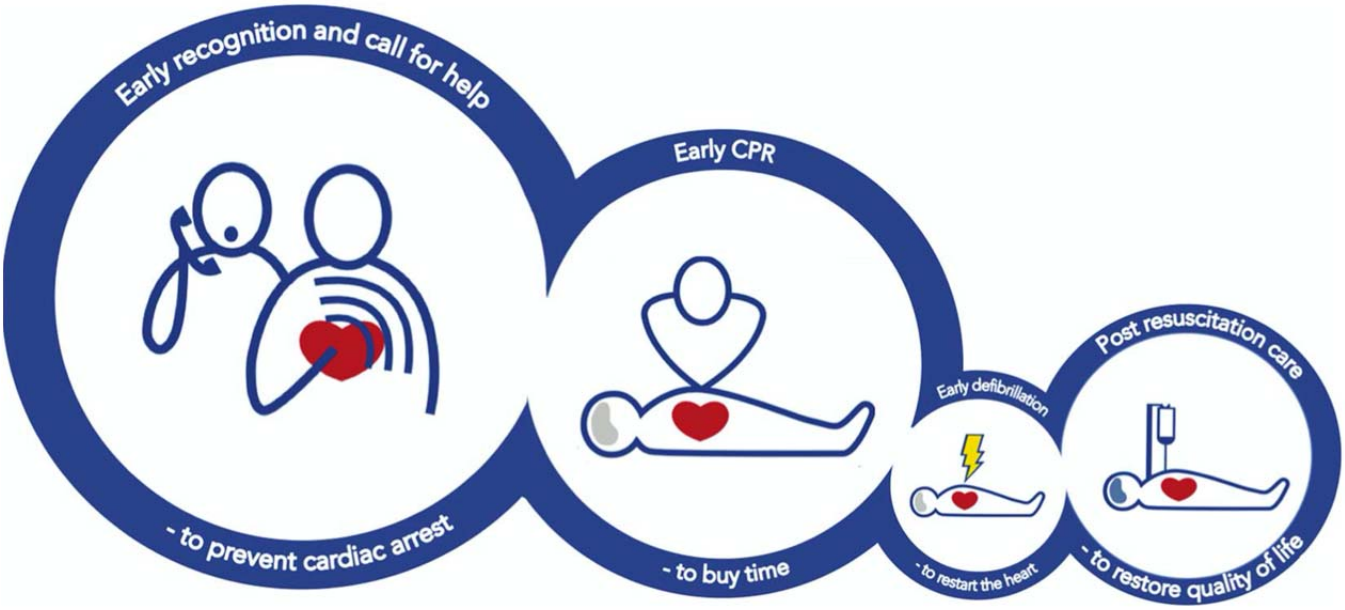
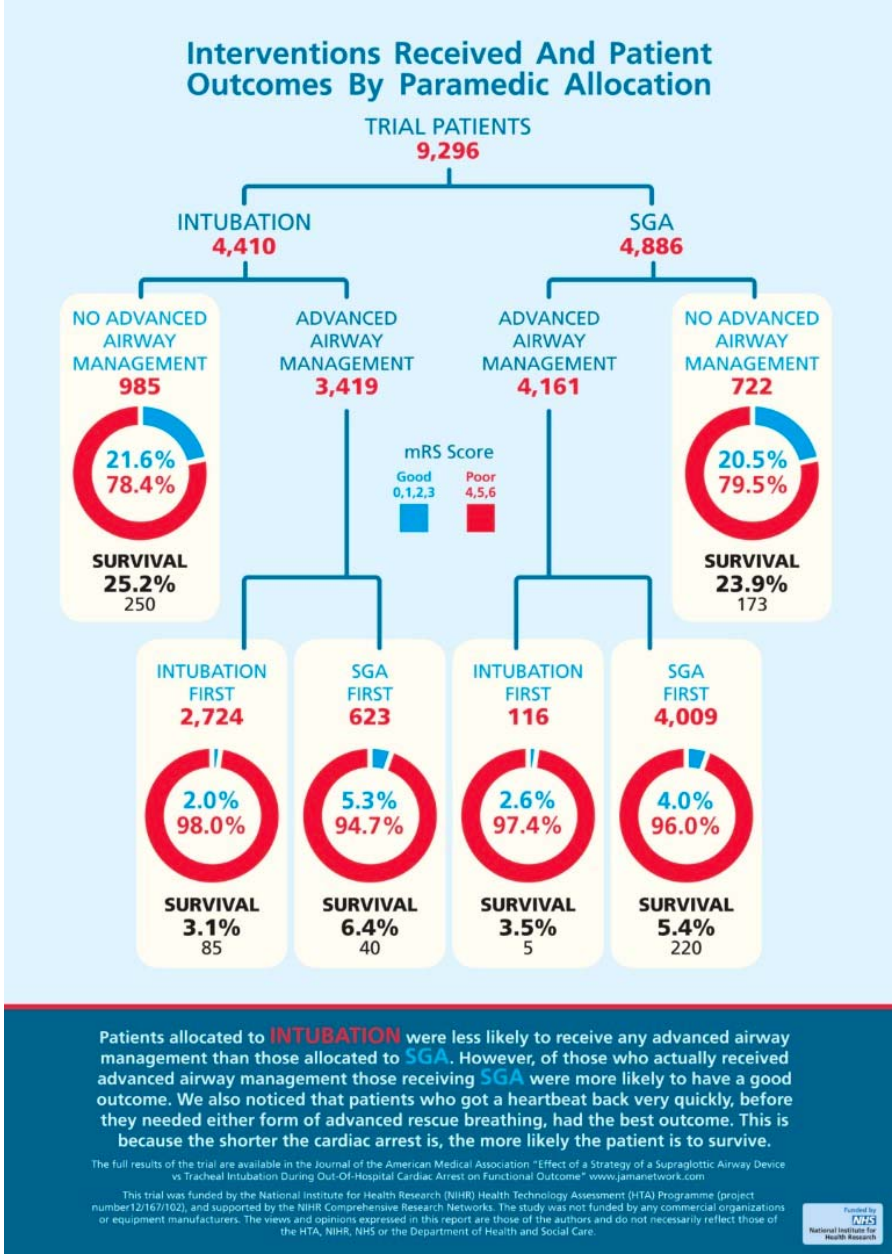


Fig. 2. Chain of survival for in-hospital cardiac arrest (Area ratios 1.0, 0.95, 0.17, 0.38).

Defibrillation
Early is key. Start at 200J, then escalate to maximum the machine can go to (360J biphasic).

Evidence for Double sequential external defibrillation (DSED) and vector change defibrillation for refractory VF so far does not suggest improvement over current strategy [Cheskes 2019, Delorenzo 2019]. An RCT is currently underway in Canada attempting to find a robust answer as to whether there is benefit or not (DOSEVF).

Airway
Airways 2 trial published in 2018 [Benger 2018]. Showed that early ROSC was key to survival! And that SGA was easier to insert with similar outcomes.



Drugs

Adrenaline

- Paramedic 2: the Adrenaline trial [Perkins 2018] published after last guidelines formulated
    - Showed current bolus regime of adrenaline resulted in improved survival but with worse neurological outcomes
- Is adrenaline bad, or is it the way we give it that is bad?

Amiodarone vs Lignocaine

No difference between the 2 in arrest, but lignocaine better than placebo. [Kudenchuk 2016] Although note lignocaine not currently part of ALS recommended therapy.

COVID 19 and CPR

Is CPR aerosol generating and what is the risk to a rescuer? This has generated much discussion over the last few months. Evidence is low, although cadaveric and simulation studies have been published demonstrating aerosol generation with chest compressions. So, how should we tailor our strategy to CPR in the presence of COVID given that some organisations classify as aerosol generating and some do not?

NZRC published a revised algorithm – key being have a plan and intervene early in an attempt to reduce the need for CPR. In the event of an arrest, anyone entering room needs to be in droplet PPE, and then airborne PPE for chest compressions/airway interventions. However, this recommendation is not universal.

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ICU Update

Dr Kerry Benson-Cooper

Intensive Care Medicine Specialist, ADHB

The COVID-19 Pandemic has kidnapped attention over 2020. No more so than in the Intensive Care Units of the world. This presentation will briefly address the implications of this disease on organ systems in its most severe form. We will also look at the non-medical resource implications of COVID-19 on the Intensive Care within Australasia.

Airway Update

Dr Gemma Malpas

Specialist Anaesthetist, ADHB

WAMM 2019 through COVID-19" My thoughts on Emergency Airway Management - **OPTIMISATION"**

I was fortunate to attend the World Airway Management Meeting in Amsterdam in November 2019. (I recommend if anyone wants to view this see twitter @WAMM_2019) This was the second World Airway Management Meeting to be held. The inaugural WAMM was held in Dublin in 2015. The Difficult Airway Society (DAS), the Society for Airway Management (SAM) and the European Airway Management Society (EAMS), combine their annual scientific meetings to producing a highly successful world class congress. These are some of my thoughts following this meeting.

In the broadest sense what I came away thinking was that "We need to try and simplify airway management". We need a common language and a shared mental model in emergency airway management. This has to be across the three main specialties that management emergency airways (Emergency medicine, Intensive care and Anesthesia).

Thoughts from the VORTEX work shop

Likes - the terms and concepts I came away with were - **Upper Airway Life Lines**, **Green Zone**, **Best effort** and **Optimisations**.

Upper Airway Lifelines *- the three upper airway lifelines of*
Face mask (FMV),
Supraglottic airway (SGA)
Endotracheal tube (ETT)

They are equally able to fulfil the goal of alveolar oxygen delivery but differ in their ability to fulfil secondary goals such as airway protection, airway security, and carbon dioxide elimination. Whilst important, these secondary goals become inconsequential if alveolar oxygen delivery cannot be achieved.

Green Zone *refers to any situation in which adequate alveolar oxygen delivery can be confirmed and the patient is no longer at imminent risk of critical hypoxia. The essential question to be answered to identify entry into the Green Zone is "Can adequate alveolar oxygen delivery be confirmed?".*

<u>Confirmation</u>: this will typically involve ensuring that ventilation with oxygen is occurring by the presence of an $ETCO_2$ waveform and/or rising SpO_2 reading.

<u>Adequacy:</u> the adequacy of alveolar oxygen delivery is not defined numerically but is instead assessed by asking "Is the patient likely to suffer harm from hypoxia if this level of SpO_2 persists for the next 15 minutes?". The absolute SpO_2 value satisfying this criterion will vary according to the context.

So for me this highlighted the importance of Waveform Capnography in determining Alveolar Oxygenation. This made me think how we tend to concentrating of SpO_2 values in difficult airway situations. Maybe we need to refocus the attention on whether we have a $ETCO_2$ trace. The green zone really is a time to take a breath yourself and plan.

In regards to capnography it reminded me of The Royal College of Anaesthetists (RCoA) and the Difficult Airway Society (DAS) collaboration in 2019 re **Capnography: No Trace = Wrong Place**. The important message that during

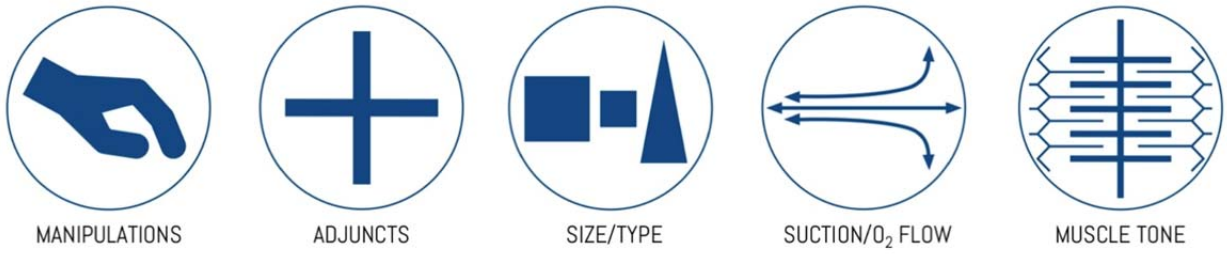
cardiac arrest, if a capnography trace is completely flat, oesophageal intubation should be assumed until proven otherwise (https://rcoa.ac.uk/safety-standards-quality/guidance-resources/capnography-no-trace-wrong-place)

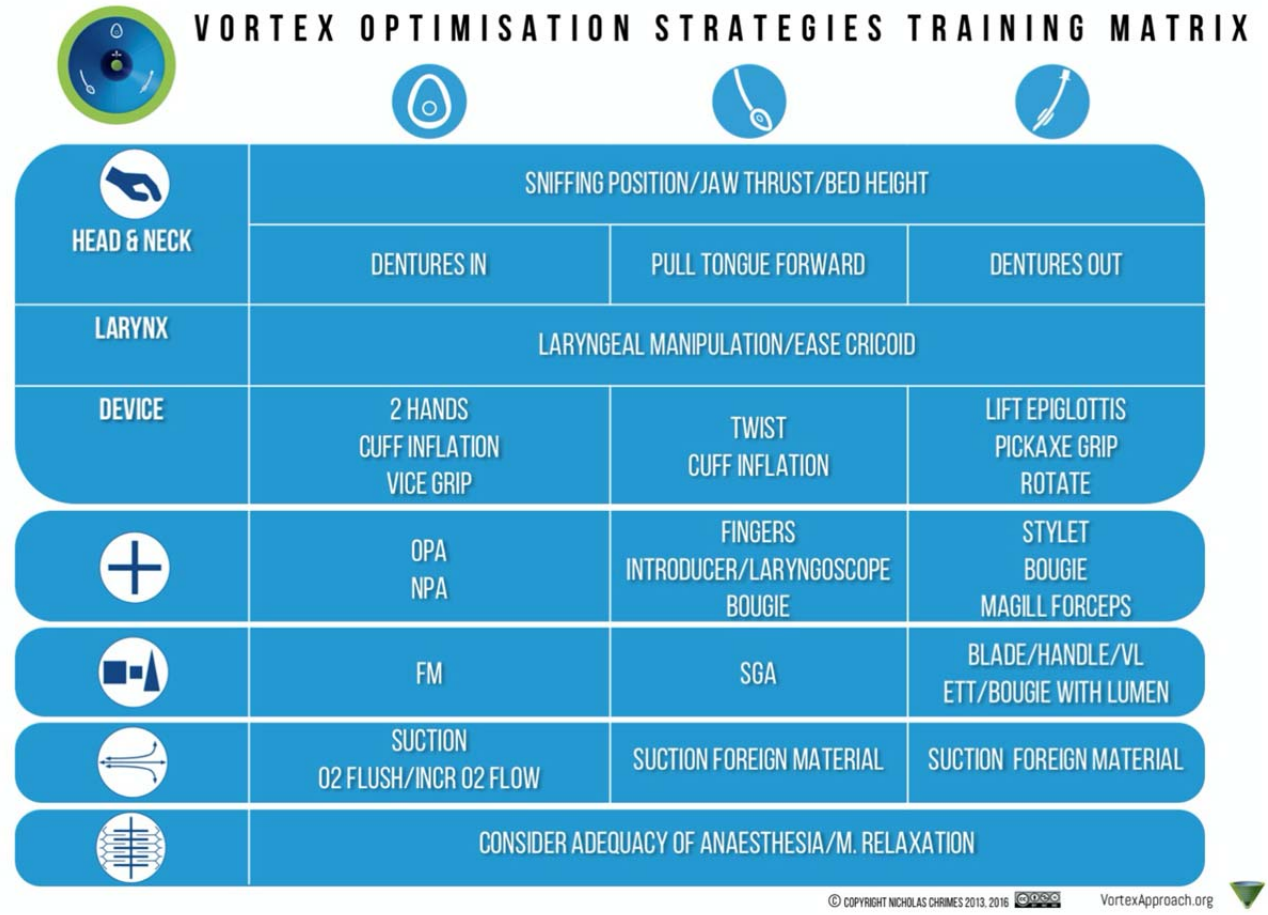
*The term '**best effort**' is used by the Vortex Approach to describe the circumstance in which all viable strategies to facilitate success at entering the Green Zone via a given lifeline have been implemented. The Vortex model prompts five categories of **optimisation** that may be applied to improve success entering the Green Zone via any of the lifelines.*

I like the term **optimisations.** The ones which are consistent across all three upper airway life lines are

Positioning - sniffing, 'flextension', bed height.
Easing (removing!) cricoid
Muscle relaxation - "a best effort at any lifeline must include full muscle relaxation"

For **FMV** my take home was Oral / Nasal airways and the **V-E grip**





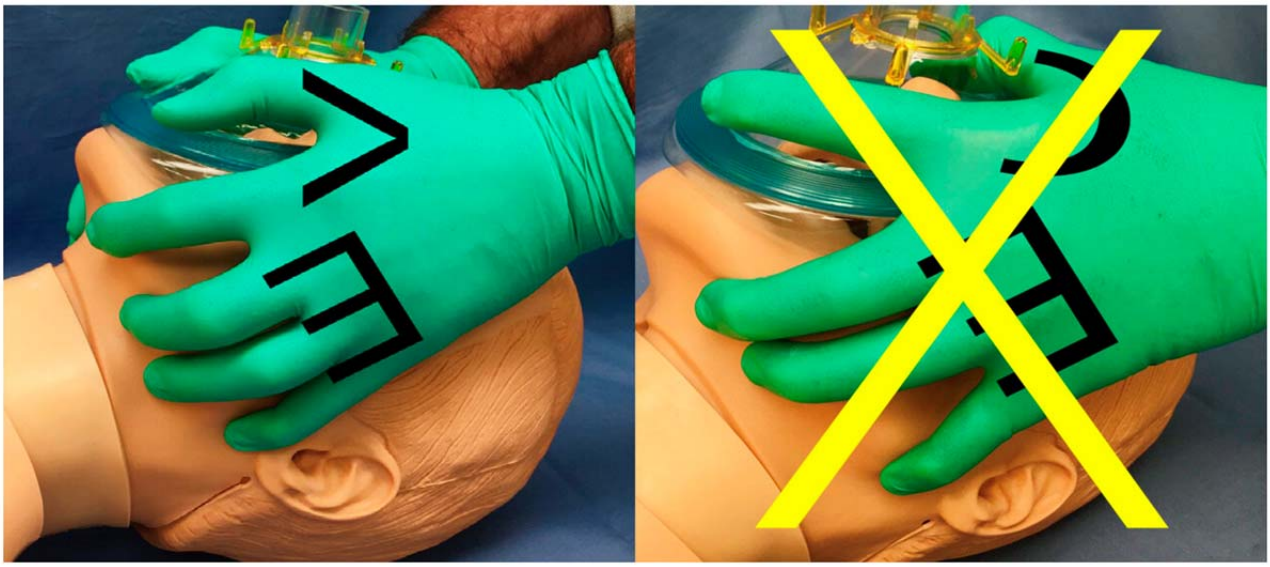
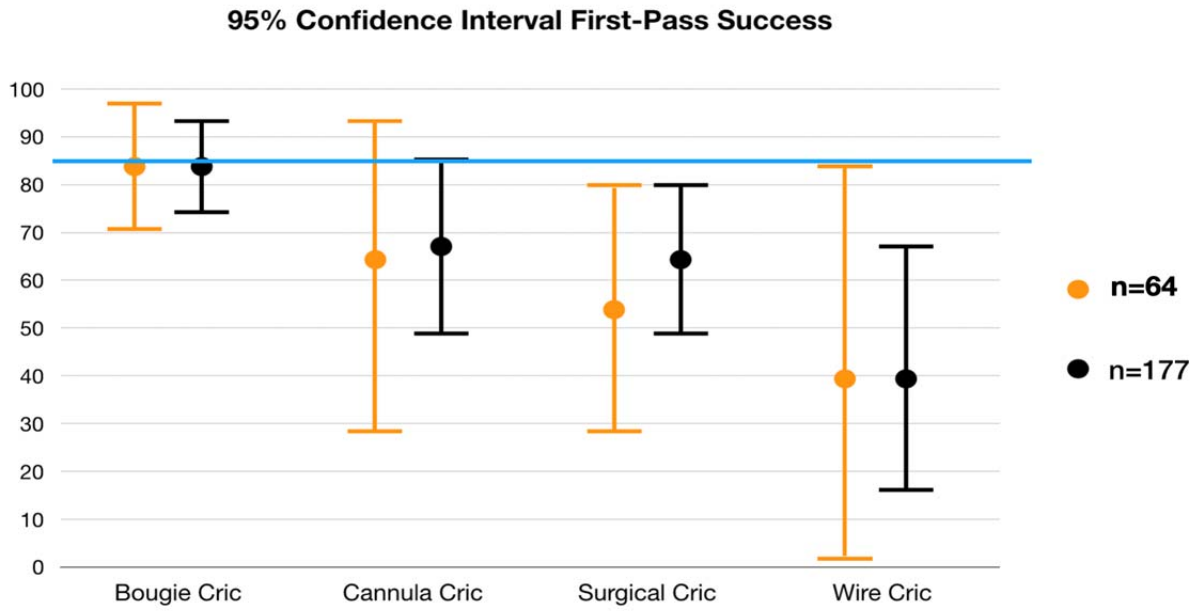


Figure 4 2-handed 2-person BMV technique with the 'VE hand position', the second person squeezes the bag. Figure a shows what to do ('V hand position') and figure b what not to do ('C hand position')

Dislikes- CICO ("ky-koh"). I struggle after hearing all the different pronunciations to think this is the correct term to use in an emergency situation. Also this seems a very anaesthesia driven term and certainly wasn't familiar to other specialties and regions outside Australasia in the workshop .I personally think **Front of neck Airway (eFONA)** is a better term.

Emergency front of neck airway WAMM-19 - Laura Duggan presented the ongoing data from the AIRWAY APP (http://www.airwaycollaboration.org) There was then 37 months of input data from 39 countries. 177 reported CICO events. Male 76%, BMI <40 72%, Obstructing Airway Pathology 41%, Non-surgeons 92%



So the only reported technique from this data that has approximately 85% first pass success is Bougie Scalpel Cricothyroidotomy. Some may argue about the relevance of this self-reporting study and its associated biases. However I do think this provides support for the move to a scalpel bougie technique for rescue of the CICO patient. It doesn't obviously state which Scalpel technique to use! I think the slightly more interesting story from

this data is that in the reported CICO cases - 35% of the times a SGA had not been tried and 42% of the time a muscle relaxant hadn't been given.

Intubation in Emergency Airways - ETT placement - Optimisation
Taken from Redirecting the Laryngoscopy Debate and
Optimizing Emergency Airway Management George Kovacs and Richard Levitan

We would all agree that videolaryngoscopy (VL) can be very useful in cases of difficult laryngoscopy. It is certainly beneficial in teaching and supervision of juniors. The visualization of the glottis is almost always improved however this doesn't always equate to passing a tube in to the glottis. Interpreting the growing literature comparing VL to Direct laryngoscopy (DL) is complicated for many reasons foremost of which relates the heterogeneity VL devices on the market. There are two major classes of commonly used VL devices, defined by the shape of the blade.

- Macintosh shaped ("standard geometry") VL blades (SG-VL) allow both video (indirect) and direct visualization,
- "Hyperangulated" (HA-VL) devices provide visualization only through the video camera and monitor.

Macintosh Shaped

In the highly quoted Driver et al. study, where a SG-VL device was used in 98% of cases, they reported using the screen in approximately half of cases. Most impressively, this study set a potentially new benchmark for rapid sequence intubation (RSI) in the ED with a 98% FPS when a bougie was used routinely with a SG-VL device. Similarly, in a recently reported prehospital RSI study Angerman et al. documented FPS of 98% when a bougie was used in combination with a SG-VL device. These studies, with signals from meta-analyses of other studies, show growing evidence that "optimized" SG-VL laryngoscopy may provide superior outcomes (FPS) compared to conventional DL. Compared to DL, putting a video camera element near the end of a conventional Macintosh, SG-VL blade provides an undistracted, larger, and wider view of the larynx in isolation. Using a bougie "optimizes" SG-VL (with or without video augmentation) by improving tracheal tube (TT) delivery and FPS.3,4 In the study by Driver et al., when operators encountered the common Cormack-Lehane (C-L) Grade 2 view, there was a significant benefit of a bougie for first-pass successful tube placement (97% bougie vs. 66% stylet).

Routine first-attempt optimization maneuvers with a standard geometry blade device (VL or DL)

- **proper positioning** with head elevation with ear-to-sternum alignment
- **bimanual laryngoscopy** (by the operator using their right hand) to provide manipulation of the larynx externally
- **use of a bougie**

Video example of "Optimized SG-VL (Mac VL)"for patients including those with suspected COVID-19: https://vimeo.com/404041551

Hyperangulated Shaped

The components of optimised hyperangulated VL are less well defined. It is dependent on navigating two opposing curves (primary and secondary curves)

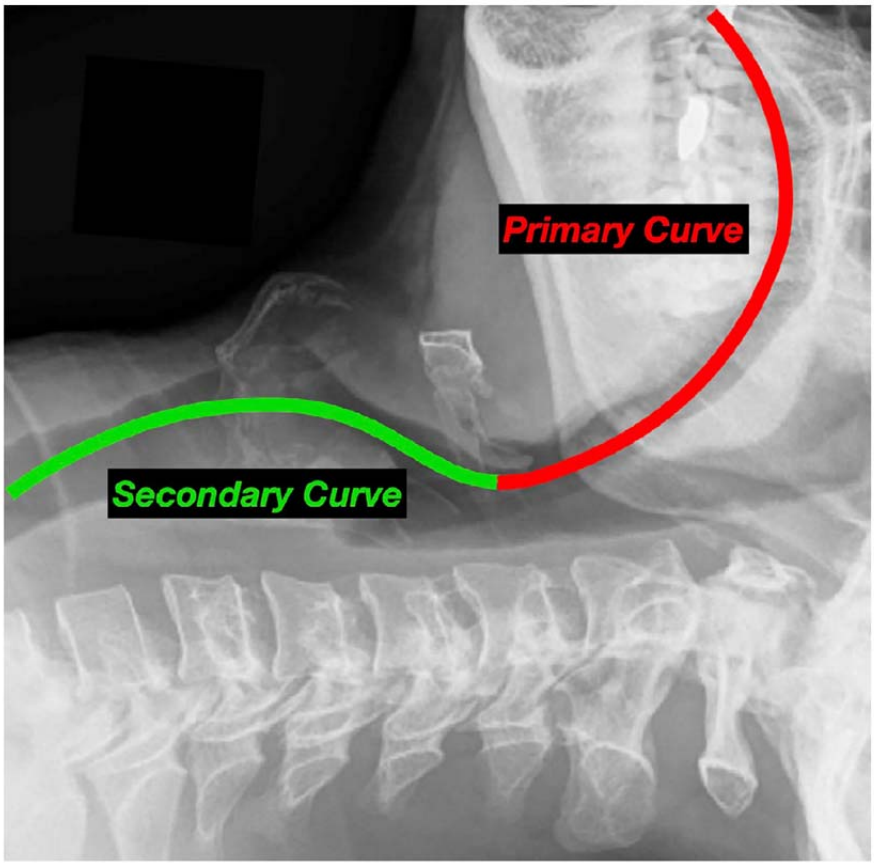


Figure 1. The primary curve (*red*) transitions into an opposing secondary curve (*green*).

Maximizing laryngeal exposure (seeking a C-L Grade 1 view) when using a hyperangulated blade can increase TT placement problems by **decreasing** the viewable space between the camera and the vocal cords as the tube is navigated to and through the laryngeal inlet. With HA-VL, a C-L Grade 1 view on the screen represents an "around-the-corner" target where the TT must be navigated around a minimally displaced tongue (primary curve), up (anterior) to the laryngeal inlet, and then transition acutely down the trachea (secondary curve) as it descends posterior into the chest. A limited literature and a growing experience suggests that success using HA-VL may improve by seeking deliberately restricting (C-L Grade 2) view (i.e., keeping the glottis < 50% of screen real estate and percentage glottic opening < 50%; see Figures 2B and 2C).

Using a **styletted tube** with a modest **60–70 degree** distal bend will help an operator navigate the tube around the hyperangulated blade and enter the larynx. Once the tube enters the larynx, the **stylet can be partially withdrawn** (3–5 cm) to minimize distal impact and hold-up of the TT bevel on the anterior tracheal wall (cricoid or tracheal rings; Figure 3A). The tip of a standard left facing bevel TT may still catch the anterior tracheal rings as it is rotated upward, off a hyperangulated stylet.

Partially removing the stylet and then **rotating the TT to the right** (clockwise) should help overcome mechanical TT advancement issues by favorably aligning the distal TT with the axis of the trachea (Figures 3B and 3C).

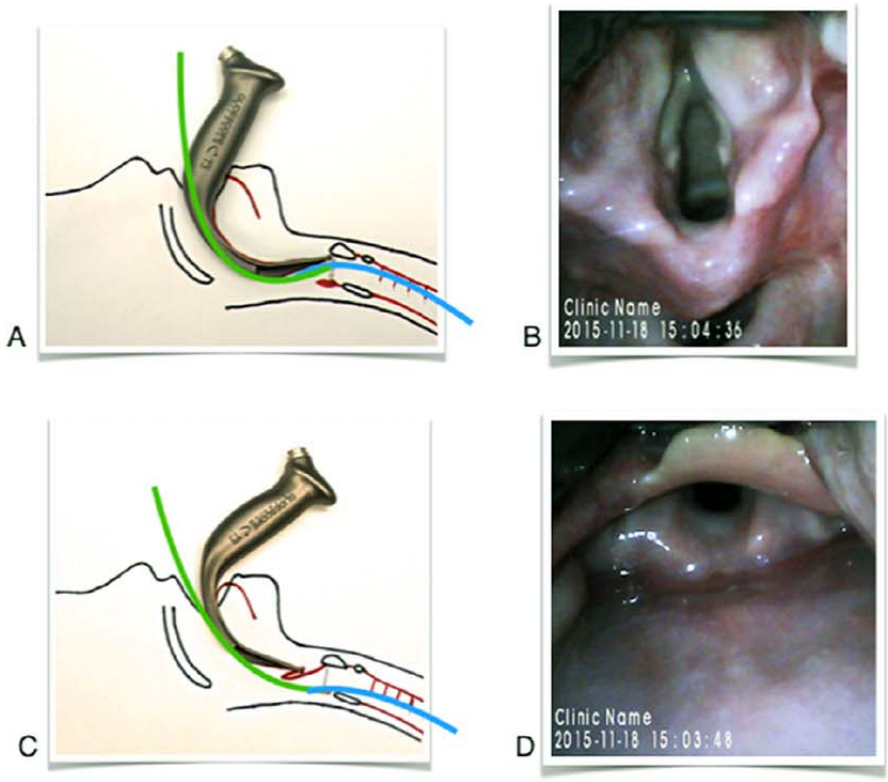


Figure 2. (**A and B**) Using a HA-VL device and having a full view of the laryngeal inlet with the blade posterior to the epiglottis, the distal blade camera is angled up toward the anterior trachea. This results in a more acute transition between the primary (*green*) and secondary (*red*) curves that must be managed by a styletted TT. (**C and D**) Using the same HA-VL device with the blade tip in the vallecula, anterior to the epiglottis. A 50/50 view on the screen (larynx occupying ~50% of screen and ~50% of laryngeal inlet in view) is achieved. The distal blade and camera are then more in line with the long axis of trachea. This positioning reduces the transition angle between the primary (*green*) and secondary (*red*) curves that must be managed by a styletted TT.

Video example of "Optimized Hyperangulated (HAVL)"for patients including those with suspected COVID-19:
https://vimeo.com/404091445

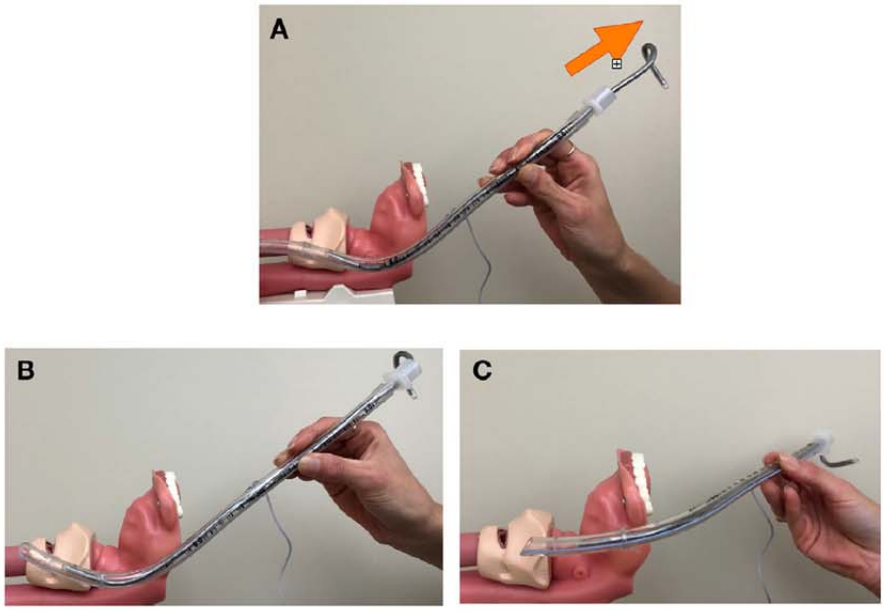


Figure 3. (**A**) Partially pulling back the stylet allows the distal advancing TT to transition posteriorly down the trachea. (**B and C**) By rotating the TT clockwise, the open face of the bevel is redirected anterior and the distal portion of the tube is better aligned with the tracheal axis.

Publications for 2020

1) PUMA -Project for Universal Management of Airways **https://www.universalairway.org**

The goal of the Project for Universal Management of Airways is to produce a set of principles that reflects, as much as possible, the consensus of existing published airway guidelines and can be applied to all episodes of airway care, across boundaries of geography, clinical discipline or context. The term 'universal' is used to reflect that the guideline developed will not only reflect international consensus but that it articulates appropriate management principles independent of:

Geography
Provider: anesthesiologists, emergency physicians, intensivists, neonatologists, pre-hospital clinicians, nurse anesthetists, airway assistants, surgeons - whether trainees or consultants
Patient characteristics: adult, paediatric, obstetric, trauma, critically-ill, fasted, unfasted
Indication: surgery, resuscitation, respiratory compromise, impaired conscious state, etc
Urgency: emergency, elective
Location: operating room, emergency department, intensive care unit, 'off-the-floor 'anesthetising locations, wards, prehospital
Complexity: routine or complex cases, independent of whether airway difficulty is anticipated or encountered
Primary intended airway: face-mask, supraglottic airway or tracheal tube.

The intention is for the universal guideline to complement existing guidelines by emphasising unifying basic principles, facilitating interdisciplinary team performance and assisting to standardise the approach to airway management globally.

They are an international and multidisciplinary working group of airway specialists. The working group is:

- Carin Hagberg, Anesthesiology, United States (Executive Chair)
- Nicholas Chrimes, Anaesthesiology, Australia (Project Lead)
- Paul Baker, Anaesthesia, New Zealand
- Richard Cooper, Anesthesiology, Canada
- Robert Greif, Anaesthesiology, Switzerland
- Andy Higgs, Anaesthesia and Intensive Care Medicine, United Kingdom
- George Kovacs, Emergency Medicine, Canada
- J. Adam Law, Anesthesiology, Canada
- Sheila Nainan Myatra, Anaesthesiology and Intensive Care Medicine, India
- Ellen O'Sullivan, Anaesthesia, Ireland
- William Rosenblatt, Anesthesiology, United States
- Christopher Ross, Emergency Medicine, United States
- John Sakles, Emergency Medicine, United States
- Massimiliano Sorbello, Anaesthesiology and Intensive Care Medicine, Italy

They have been assembled to determine the key issues to be addressed by airway management guidelines and review the existing guidelines in order to identify areas of consensus in relation to these. Where the working group identifies that strong consensus exists amongst airway guidelines on key issues, these will be adopted as the recommendations of the universal guideline. The input of a broader advisory group of airway practitioners will be sought, in combination with a selective review of the relevant literature, to support any recommendations made in the following situations:

- Where guideline recommendations on key issues diverge.
- Where key issues are not addressed by the existing guidelines in a manner that supports universal application of a recommendation.
- Where there have been recent significant developments in relation to key issues that are not widely reflected in the existing guidelines.
- As otherwise required in the judgement of the working and/or advisory groups.

The working and advisory groups for this project are comprised of physicians working in anesthesiology, critical care, emergency medicine, surgery and pre-hospital care and include representation from authors of most of the published practice guidelines produced by the various airway societies.

The PUMA project will produce four main documents that together provide comprehensive recommendations for airway management.

1.) Universal Principles for Airway Assessment: What should clinicians be looking for?
2.) Universal Principles for Airway Strategy: What should clinicians do in the face of their airway assessment?
3.) Universal Principles for Airway Rescue: What should clinicians do if it all goes wrong?
4.) Universal Principles for Communication of Airway Outcomes: What should clinicians tell the next person?

I am on the Advisory group to the PUMA working group so I am really looking forward to the Publication of recommendations hopefully this year.

2) Under review presently PS56 ANZCA

Guideline on equipment to manage difficult airways

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Dr Paul (Bugs) Gardiner
Airway Lead ADHB

The College

Dr Vanessa Beavis
Specialist Anaesthetist, ADHB / President, ANZCA

I managed to start my term as President of ANZCA on 4 May 2020, just as the COVID-19 pandemic was biting New Zealand and Australia. People were in justified fear of their lives. They were adjusting to restrictions on a scale not experienced since World War II.

Very little was known about the virus. Uncertainty was everywhere. One of the few certainties was that anaesthetists would be on the front line in the management of the most acute cases.

Against that backdrop, all the comforting traditions and rituals of the handover of the governance of ANZCA were impossible. Instead of gathering the new Council in one place to start our new working relationships in person, we were constrained by the limitations of a camera, a microphone and a screen.

Zoom, almost unheard of a year ago, is now the glue that holds organisations together. While it is vastly better than phone conferences, in the words of the song, "There ain't nothin' like the real thing." It is still possible to get from a set of meeting papers at the beginning to a set of minutes at the end, but the missing elements include the unguarded conversations over lunch and dinner, where problem-solving often happens. Also missing is togetherness in time. Five hours of time zones separate the western and eastern boundaries of ANZCA. To take part in the same conversation, Perth has to get up early, and New Zealand has to stay up late.

On 4 May 2020, six of the 13 ANZCA Council members were new. It is a credit to them, and to the returning councillors, that the new relationships are off to a good start.

The hardest project so far has been to find a way to conduct the trainees' exams. COVID-19 restrictions on gatherings and travel have upended the basic principles on which exams have been conducted until now. For consistency of standards, they were always held in the same place, at the same time, sitting the same papers under the same invigilation and questioned *viva voce* by the same panel of examiners. Suddenly, most of those requirements could not be satisfied. Alternatively, no more exams could be held in 2020. That would clog the pipeline of training for significantly longer than merely during the year of interruption.

The different viewpoints were hard to reconcile. The examiners focused on standards, with a concern that the graduates of 2020 should not be perceived as less thoroughly examined than their predecessors and their successors. They also had a justified anxiety that, while video conferencing has become workaday, a technological failure in a single region could damage the integrity of the whole exam process, to such an extent that recovery would be impossible.

The trainees had equally valid concerns. No-one who has sat a high-stakes exam is ever too old to remember the emotional stresses that go with it, even in the best of times. Candidates pace their preparation in sprints and rests, the sprints requiring intense mental effort. To have the rhythm of their preparation interrupted unpredictably by the caprice of outbreaks of the virus is an exhausting and dispiriting experience for them. That effect is worsened by long periods of uncertainty, while plans to examine in regions were put together, against a backdrop of fresh outbreaks.

With so many variables, there is no perfect answer. Each new problem sparks a search for the best alternative, or the least worst one.

For me and for the ANZCA Councillors and committee members, life is a seemingly endless procession of Zoom meetings. The impact on the running of the College activities has been immense. Despite this, we are in a stable position, and are able to continue support for fellows and trainees.

Strategic plan 2018-2022

1. **Leading** professional identity and Perioperative Medicine;
2. **Growing** lifelong education, training and professional support;
3. **Driving** research and quality improvement; and
4. **Supporting** the workforce and wellbeing.

I expect that my presidency will be dominated by COVID. However, there are 2 (of 4) important things that I flagged at the start, and would still like to achieve if possible.

- Advance Perioperative Medicine
- Te Reo Māori name for the College

Perioperative Medicine – (Strategic plan item 1)

I am still hopeful that I will be able to advance the development of perioperative medicine and deliver the diploma of clinical perioperative medicine, or at least be well on the way towards it by 2022.

The COVID-19 pandemic has suddenly raised public awareness of what anaesthetists do. Against the backdrop of a disease that has killed more than 530,000 people worldwide, our professional expertise has never been so visible, appreciated and sought after. Now is the time to establish ourselves as more than just "intubator experts".

Perioperative Medicine Clinical Diploma

ANZCA has committed significant financial and other resources to this project. Following the positive results from surveys of ANZCA (previously reported), the College of Intensive Care Medicine (CICM) and the Royal Australasian College of Physicians (RACP) (see below), the expert education consultancy group Curio was chosen to review the perioperative medicine "market", and test the interest in enrolling for a diploma.

The findings are:

- There is demand for a formal perioperative medicine qualification.
- The qualification does not need to be conducted in conjunction with a university, because it calls for practical learning experience.
- Potential trainees for the diploma are most likely to be at one to three years post-fellowship.
- The preference is for a course that can be completed within 12 months, or within a flexible, longer timeframe.
- The qualification would probably be broken down into modules or units.
- Units could be completed without doing the whole course.
- The course would be multidisciplinary and inter-professional, with various specialists.
- Prior learning and prior experience of those currently working in perioperative medicine would be recognised. Those individuals could act as supervisors of training.
- One of the key findings was the need to incorporate nonclinical components into the perioperative medicine course such as communication, leadership and collaboration skills.

RACP survey- key findings:

- The group recognised that more experienced geriatricians were less interested in a perioperative medicine qualification, as they believed that they were already practicing perioperative medicine.
- Less experienced geriatricians, including advanced trainees, showed interest and recognised the qualification's benefit.
- Members considered that there was enough support within the geriatric community to develop the qualification.
- The College of Physicians is to work with ANZCA on education and qualification coordination, and logistics.

CICM survey- key findings:

- Intensivists believe they already participate substantially in Perioperative Medicine, and they want to increase participation, as part of multidisciplinary teams.
- A qualification would be attractive for trainees, and would not require much additional training for specialists in higher level ICUs.
- There is ambivalence about the benefit of ICU/HDU admission for patients that are less certain to benefit - i.e., those who do not require invasive ICU support.
- Only 5% agreed that their anaesthetic, physician and surgical colleagues had sufficient expertise to decide on the need for ICU/HDU admission for high risk elective surgical patients.
- If decision-making regarding admission were moved from intensivists, it would potentially create an under, or over, utilisation of scarce ICU/HDU resources and, in turn, could negatively influence patient outcomes and create inefficiencies in ICU utilisation.

Perioperative Medicine Collaborations

Several other initiatives are underway, for example, collaboration with the UK College Centre for Perioperative Care (the Monty Mythen/Mike Grocott group), who have been very generous with their material and time: see https://cpoc.org.uk/

Monty Mythen and Mike Grocott (along with me and members of the Perioperative Steering Committee of ANZCA) attended the "hidden pandemic summit" organised by Prof Guy Ludbroke in Adelaide, facilitated by Norman Swan, and focused on postoperative complications. 88 attended, with representatives from clinicians, administrators, funders public and private, consumer researchers and quality and safety people. The goal was to produce recommendations for the prevention of post-operative complications.

The key principles are -

1. All planning must be based around the patient - their family, their expectations and needs;
2. Risk assessment should be formally determined when surgery is considered;
3. System thinking for perioperative care should apply for all surgery and procedures;
4. The pathway for managing surgical complications starts with primary care;
5. The business case for quality should accompany all activities, initiatives and improvements in the system;
6. Evidence-based approaches should be used within all elements of the system; and
7. Appropriate performance measures should be in place, to guide quality;

There are 34 recommendations in total. All are consumer centric, evidence based, simple to follow, locally adaptable, and applicable to public and private systems. The report is available on their website. https://www.thehiddenpandemic.com/

ANZCA and Māori Health (Strategic plan item 4)

Before 2010, ANZCA had no Indigenous Health Committee (IHC). The College was not involved in mentoring. Data were not collected on Aboriginal, Torres Strait Islands or Māori fellows or trainees. The College had one Indigenous anaesthetist in the whole of Australia.

In early 2018, we launched our Indigenous Health Strategy 2018-2022 and associated background paper, as part of ANZCA's overall strategic plan.

This year, there are a number of exciting developments for Māori and indigenous health in the College:

1. Māori Anaesthetists Network Aotearoa (MANA)

- ANZCA has 45 Māori anaesthetists, with a growing number of trainees every year. ANZCA is committed to growing this number and supporting trainees and Fellows.
- The MANA group convened its first formal network meeting in early July. It will focus initially on connecting with Māori anaesthetists, guiding the College on Māori health policies, protocol and perspectives, and connecting and mentoring Māori trainees.
- MANA members will support the ANZCA efforts at Te Ohu Rata o Aotearoa (the Māori Doctors' Association) Te Ora Annual Scientific Meeting in November 2020, and plan to have a social outing to introduce participants to each other.

2. Te Reo Māori name for the College

To have a Te Reo Māori name for the college is a long-held ambition of mine. It is essential to making Māori fellows and trainees feel welcome and at home in the College – both at the physical premises in St Kilda Rd, and within the fellowship. Acknowledgement of the rich contribution Tangata Whenua bring to the College is an essential part of the journey to equity.

- ANZCA's New Zealand office has engaged Te Reo Māori expert Stephanie Tibble to provide options for a Te Reo Māori name for use in parallel with the College's name in English.
- Three options have been considered by MANA. A preferred option will be put to the ANZCA New Zealand National Committee (NZNC) in November 2020.

3. Indigenous Health Learning Outcomes Project Group

- This group has been convened via the Education Development Executive Committee (EDEC), to improve indigenous learning outcomes in the current curriculum, ready for assessment and accreditation with the Australian Medical Council by March 2023.
- This project group will consider our offerings for education in cultural safety, cultural competence, health equity, and indigenous health principles and practices for both Māori, Aboriginal and Torres Strait Islands people.

4. Growing the profile of indigenous health and Māori and Aboriginal and Torres Strait Islander Fellows at ANZCA.

- In November 2021, the NZNC is hosting a Leadership Hui in Waitangi, with a focus on leadership in the New Zealand context.
- A Reconciliation Action Plan will be progressed at ANZAC in 2021. This this will build on the work of the Indigenous Health Strategy 2018-2022.
- Māori health will be similarly supported with aligned goals and practices.
- In 2021 (if travel is possible) the ANZCA Council will be welcomed to Aotearoa New Zealand with a pōwhiri/welcome at Te Papa (our National Museum), followed by a seminar on Māori health issues.

- In May 2021, the Geoffrey Kaye Museum of Anaesthetic History will produce an exhibition focusing on Māori, Aboriginal and Torres Strait Islander health, to coincide with the Melbourne 2021 ANZCA Annual Scientific Meeting (ASM).

Overview of ANZCA

ANZCA house (Ulimoroa) is located at 630 St Kilda Road which is the traditional land of the Boon Wurrung people of the Kulin nation.

We have about 7,000 fellows and 2,000 trainees. In New Zealand, there are 820 fellows and 220 trainees. Our gender split for trainees is approximately 50:50 and for specialists about 64:46 M:F.

There are 8 regional offices including New Zealand.

Overall, there are about 130 FTE including the Directors of Professional Affairs.

We have over 50 committees and subcommittees that carry out the business of the College. They are all volunteers, supported by the staff.

The College could not be the well-respected, learned institution it is if it were not for the outstanding work and dedication of its Fellows. I thank you for your commitment.

The Erector Spinae Plane Block

Dr James Lai

Specialist Anaesthetist, ADHB

The erector spinae plane block (ESPB) is a recently (2016) described regional anaesthetic technique that embodies many of the qualities of the ideal block. Studies have shown it to be safe, effective, simple to perform and widely applicable to many kinds of acute and chronic pain.

The ESPB is an ultrasound guided, paraspinal fascial plane approach to a potential space adjacent to emerging thoraco-lumbar nerve roots. ESPB can be performed pre- or postoperatively, in awake/sedated or asleep patients. Because of the superficial nature of the block, ultrasound imaging is usually easy to perform. ESPB locations are distant to major vascular or neuraxial structures. There is a lower potential incidence of pneumothorax when compared to paravertebral block.

The indications for ESPB include rib fracture, Thoracic, Breast, Abdominal and Cardiac surgery. Emerging indications include shoulder, lower limb and spinal surgery.

As in common with other fascial plane blocks, mechanism of action is thought to involve distal spread of LA and DIFFERENTIAL neural blockade of (slow pain) C-fibres. There is some evidence of paravertebral and epidural LA spread (MRI and cadaveric studies).

The ESPB continuous catheter is also emerging as a useful technique in providing modern, balanced opioid-sparing analgesia, particularly for cancer surgery. ESPB catheters are an alternative to neuraxial analgesia for postoperative management of pain following major abdominal or vascular surgery, and largely avoid the devastating consequences of spinal cord injury/hematoma and infection.

Further recommended reading and viewing

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3. ESP and Paraspinal Blocks Lecture - May 2018 Ki-Jinn Chinn
https://www.youtube.com/watch?v=HcS3BWHNlDg&list=WL&index=4&t=387s

4. The ESP (erector spinae plane) Block - Our Current Understanding – VR Escolar
https://www.youtube.com/watch?v=EVowRjEFUfk

Update in Paediatric Anaesthesia

Dr Indu Kapoor
Specialist Anaesthetist, CCDHB

The update will covers topics relevant to all anaesthetists providing anaesthesia care to children.

The aim of the talk is to highlight new and/or revised guidelines in –

- Preoperative fasting in children and its implications
- Management of postoperative nausea and vomiting
- Paediatric airway management including equipment, role of high flow nasal oxygen as well as implications of obstructive sleep apnoea
- Opioid use in children and implications of tramadol advisory by Medsafe
- Perioperative management of children with Covid

An update on maintaining competency and currency in paediatric anaesthesia as required by ANZCA document PS29, including courses and networks in New Zealand, will also be discussed on the day.

White Island Eruption – The Middlemore Experience

Dr Matt Taylor
Specialist Anaesthetist, CMDHB

No abstract for this talk.

Covid-19 and Beyond

Dr Sally Roberts

Clinical Head of Microbiology and Clinical Lead for Infection Prevention and Control, ADHB
Member of the Ministry of Health Technical Advisory Group (TAG) and Chair of the Infection Prevention and Control Sub-TAG

An outbreak of an acute respiratory infection was first reported from Wuhan, Hubei Province in China in late 2019. The WHO declared a Public Health Emergency of International Concern on 30th January and the Pandemic was declared on 11th March. Since then, close to 50 million cases have been reported worldwide with 1.2 million attributable deaths.

The first case was reported in New Zealand on 28th February. The case had returned from Iran and had been unwell during her time there. She presented with lower respiratory tract signs and symptoms and SARS-CoV-2 RNA was detected in upper and lower respiratory tract specimens. Since then there have been just under 2000 confirmed (82%) or probable cases in New Zealand.

The cause of COVID-19 infection is the SARS-CoV-2 virus. Coronaviruses are a large family of RNA viruses that have a broad host range. Four coronaviruses cause a common cold-like syndrome in humans and a further two, SARS and MERS, cause lower respiratory tract infections. Bats may be a zoonotic reservoir for SARS-CoV-2.

Transmission is predominantly via direct and indirect contact with infectious respiratory droplets; termed contact and droplet transmission. The incubation period is 2-14 days with a median of 5.5 days and cases are infectious two days before onset of symptoms. Closed confined spaces with poor ventilation, crowding and close conversation/contact are recognised as high risk for transmission. In these settings inhalation of small particles may also occur; airborne transmission.

Transmission to healthcare workers is well reported. The hierarchy of infection prevention and control measures include source control (removal or mitigation of the source of the infection), engineering and environmental controls, administrative controls (policies and procedures) and the personal protection by hand hygiene and the wearing of personal protective equipment. Adherence to these measures will reduce the risk of exposure. Additional measures may be required in specific situations.

Public health measures, including vaccination, will be the mainstays for controlling the pandemic.

White Island Eruption – Disaster Management

Dr Tony Smith
Intensive Care Medicine Specialist, ADHB

No abstract for this talk.

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1. Kress R. Townley, Jason Lane, Robyn Packer, and Rajnish K. Gupta. Unintentional Infusion of Phenylephrine into the Epidural Space. A&A Case Rep. 2016 Mar 1; 6(5):124-6

2. https://www.iso.org/standard/50734.html (2017-05-23)

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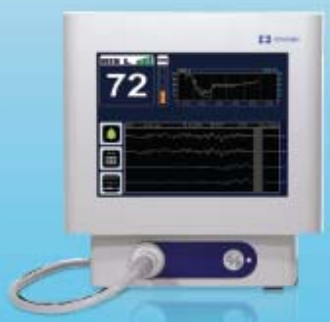

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National Trauma Network

Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

Improving trauma care for critically bleeding patients

A national best-practice critical bleeding bundle of care with associated guidance and massive transfusion protocol

Published by the National Trauma Network and the Health Quality & Safety Commission, December 2020.

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Contents

List of abbreviations

ABC	assessment of blood consumption
ABG	arterial blood gas
ACC	Accident Compensation Corporation
ACT	activated clotting time
ANZ-MTR	Australian and New Zealand Massive Transfusion Registry
aPTT	activated partial thromboplastin time
BP	blood pressure
Ca	calcium
CFF	citrated functional fibrinogen
CKR	citrated kaolin test reaction time
coag	coagulation
coags	coagulation screen
CPGs	clinical procedures and guidelines
CRT	citrated rapid TEG®
cryo	cryoprecipitate
CT	computerised tomography
DHB	district health board
DOAC	direct oral anticoagulant
dTCT	dilute thrombin clotting time
ED	emergency department
E-FAST	extended focused assessment with sonography for trauma
ERG	expert reference group
ETA	estimated time of arrival
FBC	full blood count
FC	fibrinogen concentrate
FFP	fresh frozen plasma
FC	fibrinogen concentrate
ICU	intensive care unit
IMIST	identification, medical complaint, injuries related to the complaint, signs, treatment and trends
INR	international normalised ratio
IV	intravenous
K	potassium
LY	lysis
MA	maximum amplitude
MTP	massive transfusion protocol
NZBS	New Zealand Blood Service
OR	operating room
PR	prothrombin ratio
RBC	red blood cell
ROTEM®	rotational thromboelastometry
SBP	systolic blood pressure
TAT	turnaround time
TCT	thrombin clotting time
TEG®	thromboelastography
TMS	transfusion medicine specialist
TXA	tranexamic acid
VBG	venous blood gas
VHA	viscoelastic haemostatic assay

Background

The improving trauma care for critically bleeding patients project (also known as the critical haemorrhage project) is a partnership between the National Trauma Network (the Network), the Accident Compensation Corporation (ACC), the Health Quality & Safety Commission (the Commission), the New Zealand Blood Service (NZBS), the Australian and New Zealand Massive Transfusion Registry (ANZ-MTR), ambulance services and district health boards (DHBs), specifically emergency departments (EDs), perioperative teams and intensive care units (ICUs).

The Network is guided by an overarching governance group, the membership of which includes the Ministry of Health, Waka Kotahi New Zealand Transport Agency, DHBs, ACC and the Commission.

This document is the key deliverable from the critical haemorrhage project. Its development has been informed by two expert reference groups (ERGs), to whom the Commission and Network are very grateful for their time and expertise. Appendices C and D list the members of these two groups.

Our earlier publication, *Improving trauma care for critically bleeding patients: A history, evidence summary and proposed quality improvement approach*,[1] also published in 2020, provides the background and evidence for the development of this document.

Because it is based on the earlier publication, this document does not include the evidence or rationale for why it suggests or recommends what it does. Instead, we have written this document as a practical guide for clinical staff to use to inform their care of critically haemorrhaging patients. Each of its images is available as a separate document. This means they can be printed in poster size and displayed on emergency department or operating room walls, for example. To access these images, go to the Commission's major trauma website pages: www.hqsc.govt.nz/our-programmes/national-trauma-network/projects/national-critical-haemorrhage.

We also intend this document to be used to inform clinical governance discussions. Ideally, if existing processes and approaches do not match this guidance, the latter will be used to inform a change process that adjusts pathways so critically haemorrhaging trauma patients receive the best and most timely care possible (within the constraints of the local context, capacity and capability).

1 Health Quality & Safety Commission/National Trauma Network. 2020. *Improving trauma care for critically bleeding patients: A history, evidence summary and proposed quality improvement approach.* Wellington: Health Quality & Safety Commission. URL: www.hqsc.govt.nz/our-programmes/national-trauma-network/publications-and-resources/publication/4119.

Introduction

The critical haemorrhage project began in January 2020. It seeks to reduce mortality and complications in critically haemorrhaging trauma patients by working in partnership with the health sector and experts to:

- support the ambulance sector and hospitals to review and update existing massive transfusion protocols (MTPs) to meet current best-practice trauma care
- develop a national best-practice critical bleeding bundle of care for ambulance services and hospitals to adjust to their local context and implement
- develop associated national critical bleeding best-practice guidance.

These deliverables will support New Zealand health care providers with early recognition and appropriate action for trauma-related critical haemorrhage across ambulance services, EDs, perioperative teams and ICUs. While other types of critical haemorrhage (eg, obstetric haemorrhage, large blood loss surgery, transplants and gastro-intestinal haemorrhage) are out of scope, general hospital haemorrhage patients will benefit from improved guidance and practice.

The critical haemorrhage project's aspirational goal is to achieve zero in-hospital deaths from trauma-related critical haemorrhage. The overall project aim is to eliminate avoidable deaths from trauma-related critical haemorrhage and related multiple-organ failure by 2025.

Data analysis, audit and performance metrics

A key objective of the critical haemorrhage project is to support the identification of high-risk trauma patients with exsanguinating haemorrhage and improve their outcomes. To know whether improvement has occurred, data analysis and performance measurement are needed. To that end, at a national level New Zealand Trauma Registry data will be combined with data from the ANZ-MTR,[2] the NZBS data on transfusion, the pre-hospital data sets from St John Ambulance and Wellington Free Ambulance services and, where possible, data from aero-medical services. This expanded data set will be used to develop national performance metrics that identify the key attributes of a critically bleeding trauma patient and their care.

The intention is to divide the national data collection into three sections related to:

1. patient progress through the care pathway to definitive bleeding control
2. the presence or absence of a system approach to the national best-practice critical bleeding bundle of care
3. the delivery of key therapies to the critically bleeding trauma patient.

We will provide more information about this in due course, via the Commission and Network websites and through communication to key stakeholders.

2 Zatta AJ, McQuilten ZK, Mitra B, et al. 2014. Elucidating the clinical characteristics of patients captured using different definitions of massive transfusion. *Vox Sanguinis* 107(1): 60–70. DOI: 10.1111/vox.12121 (accessed 3 November 2020).

In addition, local audit and measurement can and should occur. A combination of national and local measures will then inform relevant trauma quality assurance and improvement activity.

In the short term, see Appendix B for critical bleeding bundle performance indicators to support local trauma service audit. We offer these as suggestions for consideration.

Implementation, education and system change

To implement a new best-practice critical bleeding bundle of care, it is necessary to consider its fit into existing trauma care models and local contexts. To translate this guidance into practice, it may also be necessary to review local access to the recommended bundle therapy components, equipment and skilled staff. Process improvement may necessitate modification of the bundle for local circumstances.

In addition, we suggest taking a human factor approach to understanding and supporting change, as it enables trauma teams to look at the specific challenges they face in implementing the bundle within their organisation and locality. This approach has proven to be of real benefit in a series of in-situ simulation-based trauma scenarios, first piloted here in New Zealand in 2018 by Trauma NetworkZ®, and now established as part of the NetworkZ programme.[3] This type of educational support will be a key component of success for the implementation of this guidance and bundle.

Finally, the introduction of any change to practice requires a level of monitoring that enables an organisation to know that the change is happening and to what extent the change is an improvement over current practice. To that extent, we encourage teams to apply improvement and implementation science methods in their local context, as these will benefit system change projects that result from implementation of the national best-practice critical bleeding bundle of care.

Purpose and focus of the national best-practice critical bleeding bundle of care

The critical bleeding bundle of care (the bundle) will improve the identification of patients with life-threatening active bleeding so they can benefit from rapid (fast-tracked) assessment and treatment. The purpose of the bundle is to guide health care providers through the ideal, accelerated treatment pathway.

The key aspect of the bundle is to accelerate the treatment pathway (compared with what might otherwise occur), so that definitive control of the bleeding, which usually occurs in an operating room or an interventional radiology suite, occurs as quickly as possible.

It incorporates:

- a bundle of interventions that are standardised, but reflect the uniqueness of the environment
- the activation of a system (using the activation term ‘Code Crimson’) that is designed to accelerate the patient through the pre-hospital and early hospital (ie, ED) period towards definitive haemorrhage control
- a resuscitative strategy that delivers blood products and antifibrinolytics in a delivery system that limits exsanguination and coagulopathy but embraces permissive hypovolaemia prior to control of bleeding.

3 www.networkz.ac.nz/16.html

The bundle is designed to be applied in parallel with existing trauma pathways. It strengthens the focus on making an early transfer to the operating room or interventional radiology suite and limiting unnecessary delay.

Scope of the national best-practice critical bleeding bundle of care

The bundle is intended for use in all New Zealand trauma systems, which include:

- pre-hospital emergency road ambulances
- pre-hospital emergency air ambulances
- trauma-receiving hospital EDs
- trauma-receiving hospital operating rooms
- ICUs
- interventional radiology departments.

Clinical examples of potential injuries that meet the above criteria include, but are not limited to:

- blunt trauma associated with signs of critical bleeding and any of the following:
  - abdominal trauma with a positive extended focused assessment with sonography for trauma (E-FAST) scan
  - uncontrolled maxillo-facial haemorrhage
  - gross pelvic disruption
  - massive haemothorax
  - traumatic amputation
- penetrating trauma associated with signs of critical bleeding and any of the following:
  - penetrating trauma to the trunk
  - junctional penetrating trauma
  - pericardial tamponade on E-FAST
  - penetrating neck wounds.

Overview of the remainder of this document

The next section defines activation of Code Crimson, the code that begins the accelerated treatment pathway. The sections that follow cover associated key treatment aspects, such as tranexamic acid (TXA), the Code Crimson MTP, blood product delivery, patient warming, resuscitation priorities, rapid investigations, goals of treatment and reversal of anticoagulant drugs.

Appendix A then provides action or cue cards that define roles and functions for key members of the team. These are, in principle, aimed at achieving:

- appropriate expertise so that, on activation of Code Crimson, the required team assembles in the emergency resuscitation room waiting for the arrival of the patient (or as soon as possible after in-hospital activation)

- early (less than 10 minutes after assessment) decision-making on the treatment priorities of the bleeding component of the trauma
- rapid movement of the patient to the location where bleeding control occurs.

Appendix B suggests relevant performance indicators for the critical bleeding bundle. Appendices C and D list the members of the two expert reference groups involved in this project. Appendix E includes acknowledgements.

Activating Code Crimson

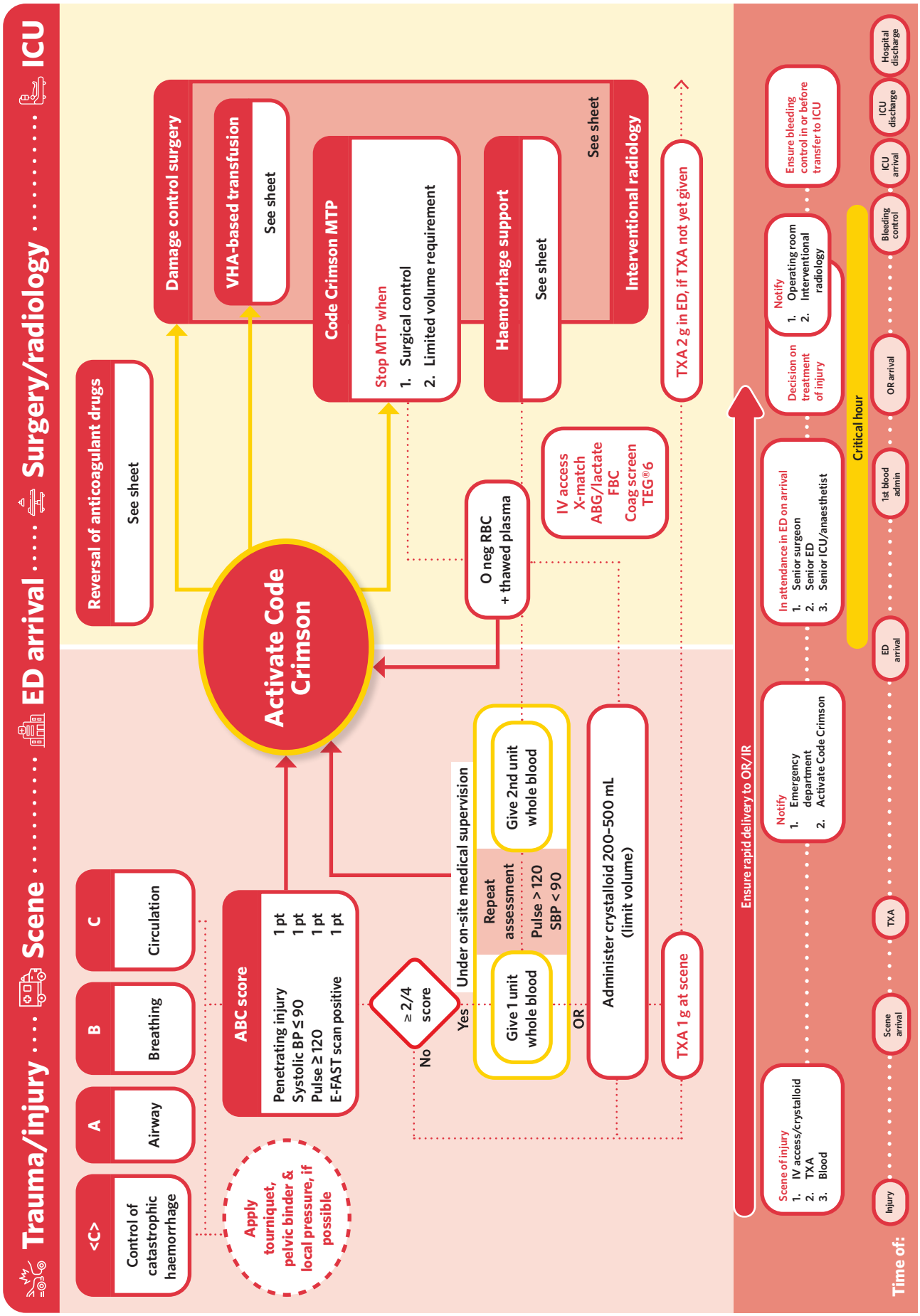
Code Crimson is a suggested activation code for the accelerated treatment pathway. Calling Code Crimson (or equivalent) means the clinical team, whether pre-hospital or within hospital, agrees that the patient's acuity warrants urgent action. It is an agreed elevation in acuity of a trauma patient that can be initiated anywhere during the progress of a patient though the system. Calling Code Crimson should immediately result in faster, more optimal care for the critically haemorrhaging patient.

Activation would apply when the patient **has signs of clinically significant ongoing haemorrhage and any one of the following criteria:**

- an assessment of blood consumption (ABC) score greater than or equal to 2, with:
  - heart rate ≥ 120 bpm
  - systolic blood pressure (SBP) ≤ 90 mmHg
  - penetrating trauma (thoracic, abdominal or junctional)
  - a positive E-FAST scan
- received pre-hospital blood products in a resuscitative strategy
- received ≥ 2 units of red blood cells in the ED as a resuscitative strategy.

Timeline of the accelerated treatment pathway on activating Code Crimson

The following diagram summarises the timeline for the accelerated treatment pathway in the critical bleeding bundle of care. Later sections describe the major components of the bundle in detail.



Note: ABC = assessment of blood consumption; ABG = arterial blood gas; BP = blood pressure; coag = coagulation; E-FAST = extended focused assessment with sonography for trauma; ED = emergency department; FBC = full blood count; ICU = intensive care unit; IV = intravenous; MTP = massive transfusion protocol; OR = operating room; RBC = red blood cell; SBP = systolic blood pressure; TEG® = thromboelastography; TXA = tranexamic acid; VHA = viscoelastic haemostatic assay.

What the activation of Code Crimson initiates

With the activation of Code Crimson, key senior members of the emergency team immediately attend the patient.

A trauma call is made to all of the members of the routine call plus the:

- blood bank
- on-call surgeon
- on-call anaesthetist
- operating room nurse coordinator
- interventional radiologist (or endovascular surgeon).

The activation of these additional key members of the team will by necessity require adjustment to individual hospital structures.

Key outcomes of Code Crimson activation

The key outcomes of Code Crimson activation are that it results in:

- effective primary survey with a focus on stopping controllable haemorrhage
- the application of principles of damage control resuscitation, in line with the critical bleeding bundle
- senior early decision-making to achieve definitive surgical/radiological control
- a facilitated transfer to an operating room or interventional radiology suite without unnecessary delay.

Activating Code Crimson initiates a process that speeds up transfer and releases staff and rooms in the operating room and/or interventional radiology suite, so delays are minimised.

Pre-hospital activation procedure by aero-medical services carrying blood

In summary, the pre-hospital transfusion triggers for pre-hospital Code Crimson activation are when a patient either:

- has a traumatic cardiac arrest, where pelvic binder placement, intubation and bilateral thoracostomy with or without thoracotomy (when indicated) has occurred, or
- in adults, has an ABC score ≥ 2 **and** both the pre-hospital and retrieval medicine doctor and intensive (critical) care paramedic at the scene agree a pre-hospital transfusion is in the patient's best interests.

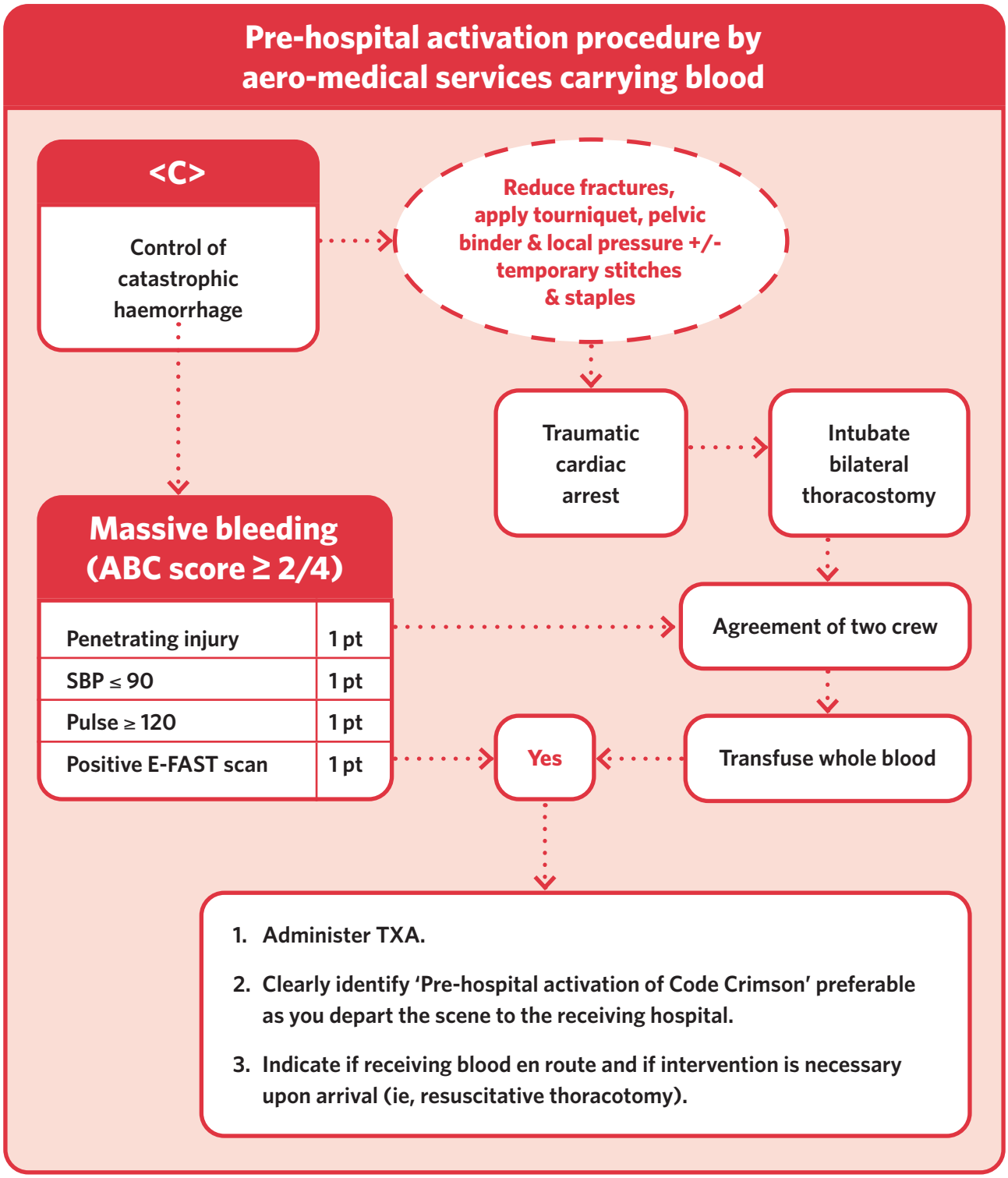
In children with trauma, blood should be transfused in 10 mL/kg boluses if there are signs of shock **and** if both clinicians at the scene agree to the transfusion.

The receiving hospital should be notified as early as possible that the patient is receiving a blood transfusion and that a Code Crimson activation is required.

If the pre-hospital critical care team considers that a specific intervention may be necessary soon after arrival (ie, a resuscitative thoracotomy or rapid transit to the operating room), it should clearly communicate the need for this intervention.

A positive E-FAST scan is the component of the ABC score that most strongly predicts critical haemorrhage. For this reason, the clinical team must carry the ultrasound equipment for, and be competent in performing and interpreting, a pre-hospital E-FAST scan.

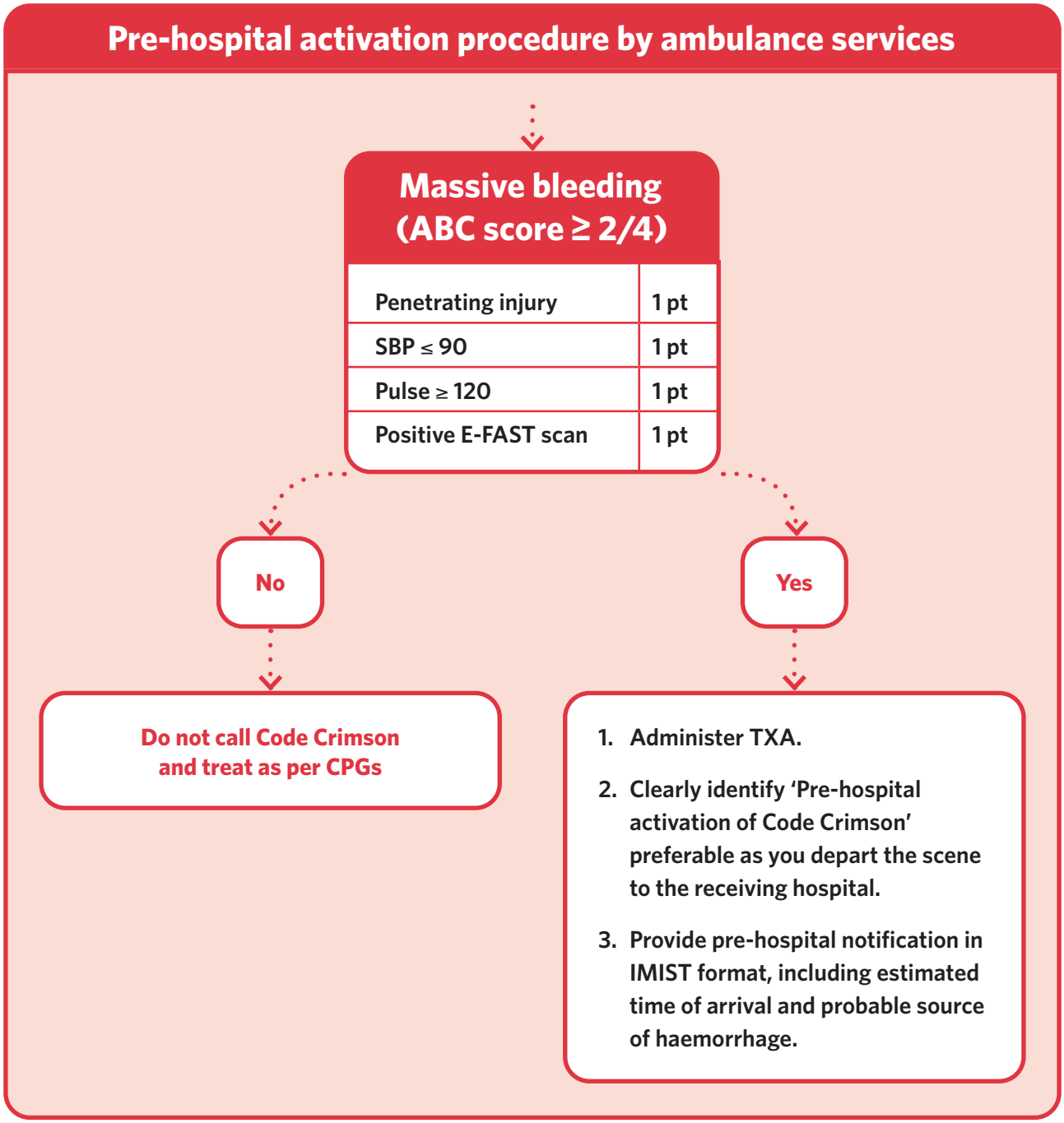
Pre-hospital activation procedure by aero-medical services carrying blood



Note: E-FAST = extended focused assessment with sonography for trauma; SBP = systolic blood pressure; TXA = tranexamic acid.

Pre-hospital activation procedure by ambulance services

Pre-hospital paramedics will inform the receiving hospital of the unstable nature of the patient and the patient's ABC score, suggesting that hospital staff should consider activating Code Crimson.



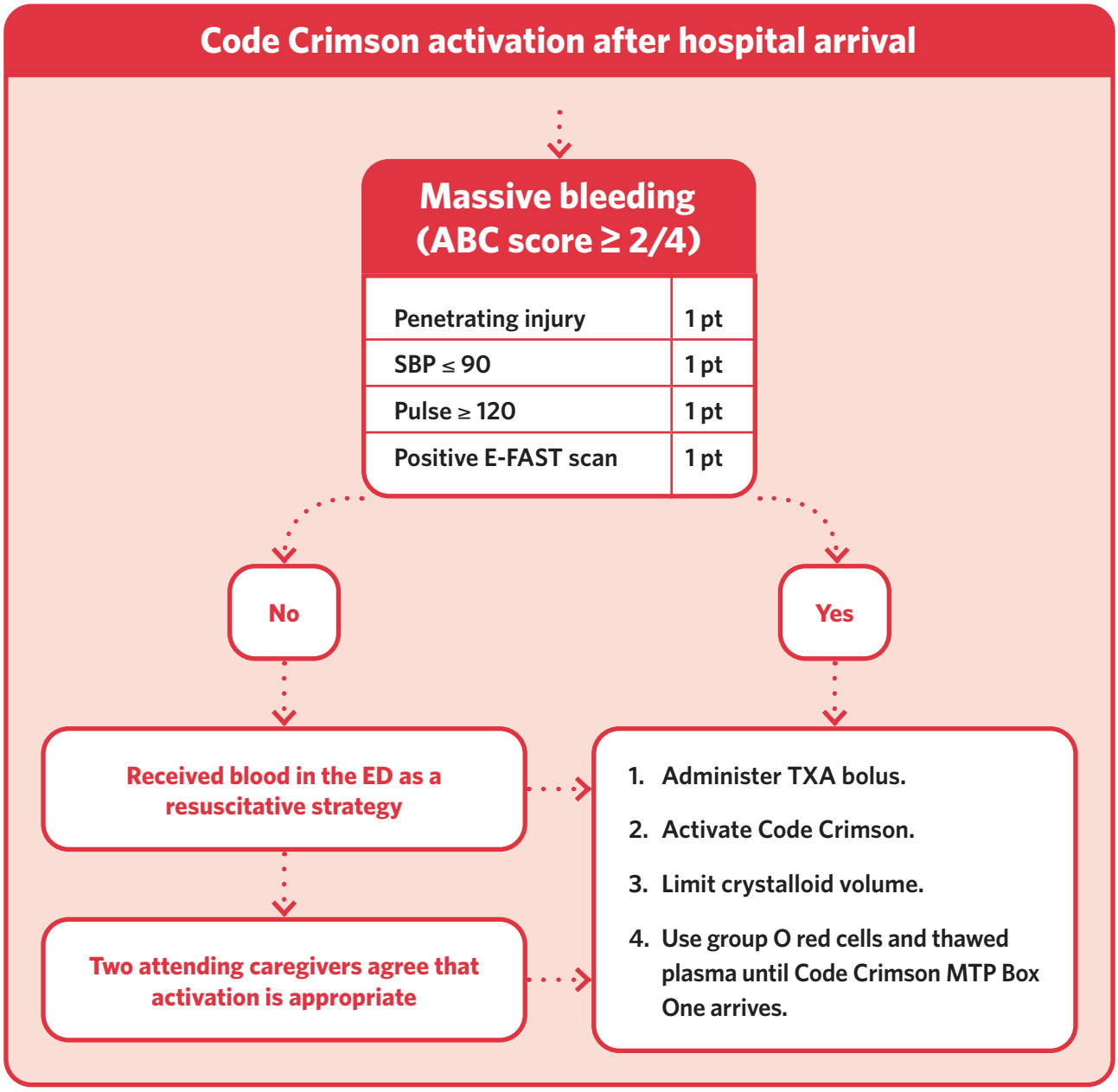
Note: CPGs = clinical procedures and guidelines; E-FAST = extended focused assessment with sonography for trauma; IMIST = identification, medical complaint, injuries related to the complaint, signs, treatment and trends; SBP = systolic blood pressure; TXA = tranexamic acid.

Where pre-hospital clinical guidelines have been developed for the use of vasopressors in trauma patients with hypotension and with ongoing bleeding, you may follow these to maintain a systolic BP at > 80 mmHg with permissive hypovolaemia.

Code Crimson activation after hospital arrival

Code Crimson activation after the patient arrives at the hospital would occur if the pre-hospital team has not activated or requested Code Crimson, but on arrival:

- the patient has:
  - an ABC score greater than or equal to 2, or
  - received ≥ 2 units of red blood cells in the ED as a resuscitative strategy, or
  - significant haemodynamic instability despite maximal crystalloid therapy (heart rate > 120 bpm, BP < 90 mmHg, base excess < –5), and
  - signs of clinically significant ongoing haemorrhage
- two attending caregivers agree that activation is appropriate.



Note: E-FAST = extended focused assessment with sonography for trauma; ED = emergency department; MTP = massive transfusion protocol; SBP = systolic blood pressure; TXA = tranexamic acid.

Tranexamic acid

TXA should be given to critically haemorrhaging patients immediately (ideally within three hours of injury) on Code Crimson activation and as indicated by pre-hospital clinical practice protocols.

Tranexamic acid

Give adults 1 g TXA IV early in intervention or < 3 hours after injury.

Where patients weigh < 45 kg, give 15 mg/kg TXA IV.

On admission to hospital, communicate delivery of TXA.

- **If not yet administered give 2 g TXA bolus.**
- **If 1 g given pre-hospital, consider additional 1 g TXA bolus.**

Note: IV = intravenous; TXA = tranexamic acid.

Resuscitation priorities in the bundle

The critical bleeding best-practice bundle of care has the following resuscitation priorities.

A. In the pre-hospital period

1. Patients with a Motor Score of > 5 can be maintained with a palpable peripheral pulse that allows normal conscious mentation.
2. Consider elevation of systolic BP to > 110 mmHg with vasopressors if Motor Score is ≤ 5.
3. Insert a large bore IV and begin normal saline at a rate that supports points 1 and 2 above, if blood is unavailable; the amount of saline should be limited, if possible.
4. Give 1 g TXA IV as per protocol.
5. Expedite transport to destination hospital as per regional major trauma destination policies.
6. Initiate call to hospital, alerting them Code Crimson or possible activation, patient status, likely injuries and indicate an estimated time of arrival.
7. Two units of whole blood may be given under on-site medical direction.
8. Maintain normothermia, with warmed transport bed, body covering and warm ambulance.

B. In the emergency department

1. Take handover from ambulance personnel.
2. Initiate primary survey, damage control resuscitation and secondary survey.
3. Actively warm the patient and all IV fluids.
4. Activate Code Crimson if the patient meets the criteria and it has not already been activated.
5. Give 2 g dose of TXA IV within three hours of injury, **if TXA not yet given.** If 1 g given pre-hospital, consider additional 1 g IV bolus.
6. Take initial bloods for:
   a. full blood count, including platelet count
   b. coagulation screen, including dilute thrombin clotting time (dTCT) if on a direct oral anticoagulant (DOAC)
   c. arterial or venous blood gas (ABG or VBG) for lactate
   d. crossmatch sample
   e. thromboelastography (TEG®) or rotational thromboelastometry (ROTEM®), if available.
7. Call blood bank to activate Code Crimson MTP.
8. Limit or stop crystalloid fluids.
9. Call for group O negative red blood cells (RBCs) and thawed plasma initially, and begin transfusion to maintain goals if delay in delivery of Code Crimson MTP Box One.
10. If the Motor Score is ≤ 5 as a result of traumatic brain injury, consider elevation of systolic BP to > 110 mmHg with vasopressor.
11. Coordinate early team planning for definitive haemorrhage control, including:
    a. senior surgeon plan for destination and timing
    b. interventional radiologist for options of interventional radiology
    c. senior anaesthetist/intensivist for transfer and operating room availability.
12. Limit delay.

C. In the operating room or interventional radiology suite

1. Ensure resuscitation equipment is available and prepared.
2. Warm the room, and actively warm the patient and all IV fluid.
3. Check that the Code Crimson MTP has been activated and blood product delivery has been initiated.
4. Continue principles of damage control resuscitation (permissive hypovolemia, limited crystalloid, 1:1 blood/plasma ratio) until haemorrhage control achieved.
5. Transfer to viscoelastic haemostatic assay (VHA) guided therapy as soon as practicable and continue to perform a standard coagulation screen at 30–60-minute intervals.
6. Use goal-directed approach, allowing additional fluids to achieve normovolaemia after surgical/radiological control of bleeding has occurred.
7. If damage control surgery limits arrest of bleeding and packing occurs, concentrate on treating hypothermia, acidosis and coagulopathy.

8. Transfer patient to ICU for further stabilisation before considering re-operation.

All of the above actions are aimed at achieving:

- temperature ≥ 36° Celsius
- pH > 7.2
- base excess > –6 mmol/L
- ionised calcium > 1.12 mmol/L
- haemoglobin > 80 g/L
- platelet count > 100 x 10^9/L
- international normalised ratio (INR) < 1.5 or activated partial thromboplastin time (aPTT) < 50
- fibrinogen > 2 g/L
- TEG®
  - TEG-ACT (activated clotting time) < 110 seconds
  - Alpha angle > 55 degrees
  - MA (maximum amplitude) > 51 mm
  - LY-30 (lysis 30 minutes) < 2.2%.

Goals of treatment while bleeding

The critical bleeding best-practice bundle of care has the following goals of treatment.

Goals of treatment while bleeding

Maintain permissive hypovolemia (unless Motor Score ≤ 5 when elevation of systolic BP to 110 mmHg with vasopressor is recommended):

- **palpable radial pulse**
- **normal level of consciousness.**

Use of vasopressor may be appropriate with sedation, anaesthesia or intubation.

Limit crystalloid and avoid synthetic colloids.

Use blood as volume expander:

- **activate Code Crimson MTP**
- **minimum RBC: fresh frozen plasma (FFP) ratio 2:1**
- **consider O neg RBC and thawed FFP**
- **consider whole blood when available**
- **repeat FBC coagulation and VHA every 30 minutes until bleeding controlled.**

Transfusion end points:

- **haemoglobin = 80 g/L**
- **platelet count > 50 x 10^9 or > 100 x 10^9 if ongoing bleeding or intracranial haemorrhage**
- **fibrinogen 2.0 g/L.**

Note: FBC = full blood count; FFP = fresh frozen plasma; MTP = massive transfusion protocol; RBC = red blood cell ; VHA = viscoelastic haemostatic assay.

Code Crimson Massive Transfusion Protocol for adults

When Code Crimson has been activated, the Code Crimson MTP should also be activated.

Code Crimson Adult Massive Transfusion Protocol

Team leader responsibilities

- Notify coagulation lab and send coagulation requests.
- Activate protocol by ringing blood bank and saying 'I am activating the Code Crimson Massive Transfusion Protocol'.
- Call for each box as required.
- Make a decision to cease Code Crimson MTP and contact blood bank. Move to focused transfusion.

Blood bank responsibilities

- Process X-match sample as soon as possible.
- Notify NZBS medical specialist after issuing MTP Box Four.
- Thaw next box in advance and await request.
- Ensure supply of platelets.

Contacts

- Blood bank.
- Coagulation lab.

Additional treatment thresholds

- If PR > 1.5 or aPTT > 40, consider additional 4 units FFP.
- If fibrinogen < 1.5 g/L, consider additional 3 units cryo or 4 units FC.
- If platelets < 75 x 10^9/L, consider additional one pack platelets.
- If ionised Ca++ < 1.2 mmol/L give 10 mL calcium.

Massive bleeding with either shock (ABC ≥ 2) or abnormal coagulopathy

Give tranexamic acid 2 g IV bolus

Ensure delivery of X-match specimen to blood bank

Code Crimson add 2 units FFP or thawed plasma

Administer up to 2 units O-neg or type-specific RBCs

Ring blood bank to activate Code Crimson MTP

Code Crimson add 3 units cryo (or 4 g FC) and one pack platelets

MTP BOX ONE
2 whole blood
or 2 units RBC
and 2 units FFP

Check coags/ platelets/ FBC/ABGs/ Ca^{++}

MTP BOX TWO
4 RBC
4 FFP
1 adult platelets

Repeat every 30 min

MTP BOX THREE
4 RBC
4 FFP
3 units cryoprecipitate

Check coags/ platelets/ FBC/ABGs/ Ca^{++}

MTP BOX FOUR
4 RBC
4 FFP
1 adult platelets

Repeat every 30 min

and alternate 3 & 4

Check coags/ platelets/ FBC/ABGs/ Ca^{++}

Note: ABG = arterial blood gas; aPTT = activated partial thromboplastin time; Ca = calcium; coags = coagulation screen; cryo = cryoprecipitate; FBC = full blood count; FC = fibrinogen concentrate; FFP = fresh frozen plasma; NZBS = New Zealand Blood Service; PR = prothrombin ratio; RBC = red blood cell.

Blood product delivery as part of the critical bleeding bundle

An important part of the critical haemorrhage best-practice bundle of care is achieving appropriate blood product delivery.

- Activate the Code Crimson MTP.
- When Code Crimson has been activated, stop administering crystalloid.
- If the patient fails to meet resuscitation targets and the MTP blood is unavailable, then give O negative or group-specific RBCs and plasma (emergency/'desperate units') at a rate to maintain adequate perfusion.
- When the Code Crimson MTP blood arrives, start Box One at a rate consistent with the principle of damage control resuscitation, **not** to restore normovolaemia.
- If VHA is available, follow the VHA protocol to the same resuscitative endpoints.

Associated processes

Every hospital with Code Crimson activation should develop and understand a process that covers:

- the staff member who initiates the Code Crimson MTP and their contact details
- the need for 'desperate units' before MTP Box One arrives, the location of the emergency/'desperate units' and the process of checking and delivering these
- where to send the blood and who to notify about a change in location of the patient (eg, blood bank)
- how to terminate the Code Crimson MTP.

Haemorrhage support – patient warming

At all stages of the patient's progress through the bundle, actively manage the patient to reduce hypothermia.

1. Actively externally warm the patient and all IV fluid (goal is patient temperature of 36° Celsius).
2. Maintain hospital room environments at a temperature (21° Celsius) that allows examination without a drop in core body temperature.
3. Warm all blood with an approved high-flow blood warmer designed to safely deliver high flows without air entrainment.
4. In the related education programme, include how to use warming equipment safely and efficiently when Code Crimson is activated.
5. Cover the patient when moving them from one hospital area to another (in transit).
6. Resource operating rooms to deliver:
    a. a suitably warm ambient temperature (21° Celsius)
    b. active external warming of the patient
    c. high-flow rapid infusion devices for blood and fluid delivery.

The whole hospital system should coordinate purchases so that equipment in different areas of the hospital can be used in an efficient and effective manner, allowing warming to continue throughout the patient's entire transit.

Rapid investigations in the Code Crimson patient

Routine investigations should occur in the trauma patient as per local pathways. In addition, a patient that arrives with critical bleeding should receive:

1. an urgent pre-transfusion group and screen sent to the blood bank immediately upon arrival and processed as part of the Code Crimson process. Group O RBCs and group A or AB plasma will be released until typing is confirmed
2. an initial full blood count including platelet count, then repeated every 30–60 minutes
3. a coagulation screen including prothrombin ratio (PR), INR, aPPT, fibrinogen and thrombin time (dTCT, dabigatran or rapid TAT levels) if on a DOAC
4. an ABG or VBG, including base excess and lactate assessment
5. a TEG® or ROTEM® test if available (see algorithm below).

Hospitals should ensure resources and staffing, including point-of-care devices close to the areas of patient treatment, are available to deliver these investigations effectively.

TEG® 6S (trauma) simplified algorithm

Step 1: Maximum amplitude (MA) result in about 10–15 mins

CFF MA < 20 mm

Give cryoprecipitate or fibrinogen concentration

CFF MA	**< 20 mm**	**3 u cryo or 2 g FC**
	< 10 mm	**6 u cryo or 4 g FC**
	< 5 mm	**5–10 u cyro or 4–6 g FC**

To raise the CFF MA by 2 mm requires approx either 5 units of cryo (or 1 plasmapheresis pack) or 1 g FC

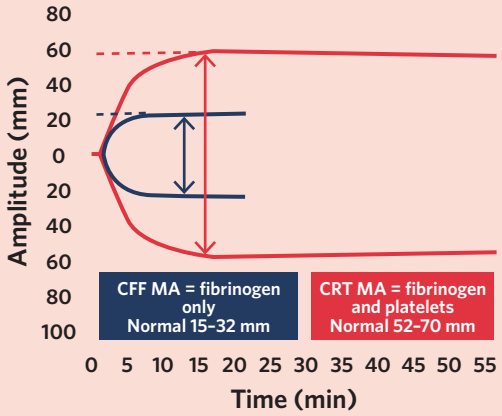
CFF MA normal **CRT MA < 52 mm**

Give pooled platelets

CRT MA	**< 50 mm**	**1 u**
	< 25 mm	**2 u**

MA = Maximum Amplitude

Strength of clot formed by fibrinogen crosslinking with platelets

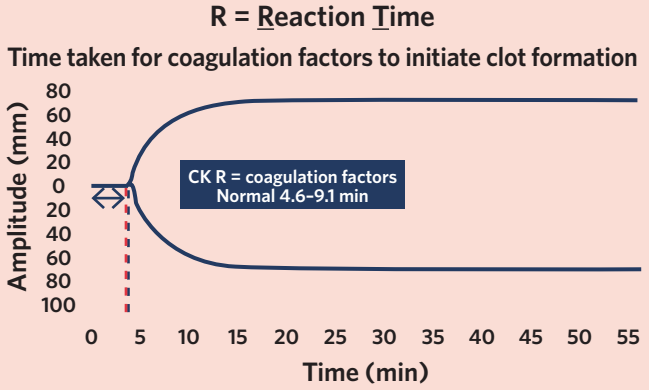


Step 2: Reaction time result in about 10–15 mins

CKR **> 9 mins**

Give FFP **2–4 u**

or prothrombinex **25–35 u/kg**



Note: CFF = citrated functional fibrinogen; CKR = citrated kaolin test reaction time; CRT = citrated rapid TEG®; cryo = cryoprecipitate; FC = fibrinogen concentration; FFP = fresh frozen plasma; MA = maximum amplitude.

Paediatric resuscitation

The definition of 'paediatric' in trauma should follow the local hospital guidelines.

If you have any doubt about whether a patient should be covered by the paediatric or adult criteria, we encourage you to consult with an experienced paediatric service or centre.

IV access may be more difficult for paediatric patients. Locally agreed policies should exist that identify alternatives to peripheral IV access if this cannot be found. Intraosseous and femoral venous access (with ultrasound assistance) are practical options but need equipment and education. Volume resuscitation can occur through these.

The routine initial IV dose should be 15 mg/kg (maximum 1 g). If practicable, start an infusion of 15 mg/kg (maximum 1 g) over eight hours.

Recognising the lower rate of operative intervention in paediatric patients, and the increased incidence of radiological investigation in trauma care, senior staff should monitor the child while unstable with full access to and support of the Code Crimson bundle. The child should be monitored in an intensive care environment until stable.

Paediatric massive transfusion protocol

When Code Crimson has been activated for a paediatric patient, the Paediatric MTP should also be activated.

Paediatric Massive Transfusion Protocol

Team leader responsibilities

- Call coagulation lab and send coagulation requests.
- Activate protocol: Call blood bank and say, 'I am activating the Paediatric Massive Transfusion Protocol Alpha, Bravo or Charlie.'
- Call for each box as required and send someone to pick it up.
- Alternate infusions of products to avoid swings in Hb and coagulation.
- Call blood bank when stopping MTP.

Blood bank responsibilities

- Process X-match sample as soon as possible.
- Call NZBS medical specialist after issuing MTP Box One.
- Thaw next box in advance and await request.
- Ensure supply of platelets. If no neonatal platelets for Alpha, contact TMS.
- Provide red cells less than 14 days old whenever possible.

Contacts

- Blood bank.
- Coagulation lab.

Additional treatment

- Ongoing haemorrhage after box three – if PR > 1.5 or aPTT > 40, consider additional 20 mL/kg FFP.
- If fibrinogen < 1 g/L, consider additional 5 mL/kg cryoprecipitate.
- If platelets < 75 x 10^9/L, consider additional 10 mL/kg platelets.
- If ionised Ca^{++} < 1 mmol/L, give 0.3 mL/kg calcium gluconate.
- Watch for hyperkalaemia and treat.

Massive bleeding with either shock or abnormal coagulopathy

Ensure delivery of X-match specimen to blood bank

Alpha 0–10 kg	Bravo 11–20 kg	Charlie 21–45 kg
1 adult RBC O neg or type specific Give 15 mL/kg	1 adult RBC O neg or type specific Give 150 mL	Give 1 unit O neg or type specific RBC

Ring blood bank to activate Paediatric MTP

REQUEST, DELIVER AND TRANSFUSE AS BELOW:

MTP BOX ONE 1 adult RBC 1 adult FFP 1 cryoprecipitate 1 neo platelet Transfuse 10 mL/kg of each in the following order: RBC, FFP RBC, cryo 0.45 mL/kg calcium gluconate RBC, FFP RBC, Plt 0.45 mL/kg calcium gluconate Beware of K^+	MTP BOX ONE 1 whole blood only *or* 1 adult RBC and 1 adult FFP 0.3 mL/kg calcium gluconate	MTP BOX ONE 1 whole blood only *or* 2 adult RBC and 2 adult FFP 0.3 mL/kg calcium gluconate	Check • Coags • FBC • ABGs • K^+/Ca^{++}
	MTP BOX TWO 1 adult RBC 1 adult FFP 1 cryoprecipitate 0.3 mL/kg calcium gluconate	MTP BOX TWO 2 adult RBC 1 adult FFP 2 cryoprecipitate 0.3 mL/kg calcium gluconate	Repeat every 30 min
	MTP BOX THREE 1 adult RBC 1 adult FFP 150 mL platelets 0.3 mL/kg calcium gluconate	MTP BOX THREE 2 adult RBC 2 adult FFP 1 adult platelets 0.3 mL/kg calcium gluconate	Check • Coags • FBC • ABGs • K^+/Ca^{++}
	Beware of K+	Beware of K+	Repeat every 30 min
and repeat	and alternate Boxes Two & Three	and alternate Boxes Two & Three	

Tranexamic acid (TXA)

- Loading dose: 15 mg/kg (max 1 g).
- Consider maintenance infusion: 2 mg/kg/hour.

Typical component volumes

- Red cells: adult: 300
- FFP: adult: 245
- Platelets: neonatal: 50 mL/adult 270
- Cryoprecipitate: 100 mL

Note: ABGs = arterial blood gases; aPTT = activated partial thromboplastin time; Ca = calcium; coags = coagulation screen; FBC = full blood count; FFP = fresh frozen plasma; K = potassium; NZBS = New Zealand Blood Service; PR = prothrombin ratio; RBC = red blood cell; TMS = transfusion medicine specialist; TXA = tranexamic acid.

Reversal of anticoagulant drugs

Consult haematological specialists for advice on reversing DOACs with active bleeding, referring to lab results if possible. If bleeding is life-threatening, administer therapy in addition to MTP or goal-directed therapy, including TXA.

If the patient has life-threatening bleeding and evidence of recent ingestion of warfarin, a DOAC or a platelet-inhibiting agent (except aspirin):

- take coagulation screen blood tests as described under 'Rapid investigations in the Code Crimson patient'
- consider a VHA study if available, especially a DOAC-specific cartridge
- administer relevant antidote early
- retest after administration completed.

Reversal of anticoagulant drugs

If the patient is bleeding and on:

	Send off	Administer
1. Warfarin	**INR**	**10 mg IV vitamin K and Prothrombinex 25–50 units/kg**
2. Dabigatran	**TCT, dabi level and aPTT**	**Idarucizumab 5 g**
3. Rivaroxaban or Apixaban	**INR, TAT and aPTT**	**Prothrombinex 50 units/kg**

Note: aPTT = activated partial thromboplastin time; dabi level = dabigatran level; INR = international normalised ratio; TAT = turnaround time; TCT = thrombin clotting time; IV = intravenous.

Appendix A: Action or cue cards setting out responsibilities of the critical haemorrhage management team

1. Ambulance pre-arrival notification (R40) and activation of Code Crimson

Trauma call criteria met on 'Ambulance pre-arrival notification'

Penetrating mechanism	(1)	☐
Systolic BP ≤ 90 mmHg	(1)	☐
Pulse rate ≥ 120	(1)	☐
Positive trauma E-FAST ultrasound	(1)	☐
	Score	☐

Score 2, 3 or 4

1. ED charge nurse or specialist organises trauma Code Crimson call that includes ETA.
2. ED charge nurse ensures the following teams are contacted with ETA:
   a. anaesthetist
   b. operating room nursing coordinator
   c. blood bank
   d. radiology registrar.
3. Surgical registrar contacts on-call surgical consultant.
4. If ED specialist is not in hospital, the charge nurse contacts them.

Score 0 or 1

If patient meets trauma call criteria, make trauma call with ETA.

Note: BP = blood pressure; E-FAST = extended focused assessment with sonography for trauma; ED = emergency department; ETA = estimated time of arrival.

2. Trauma team leader and emergency department charge nurse

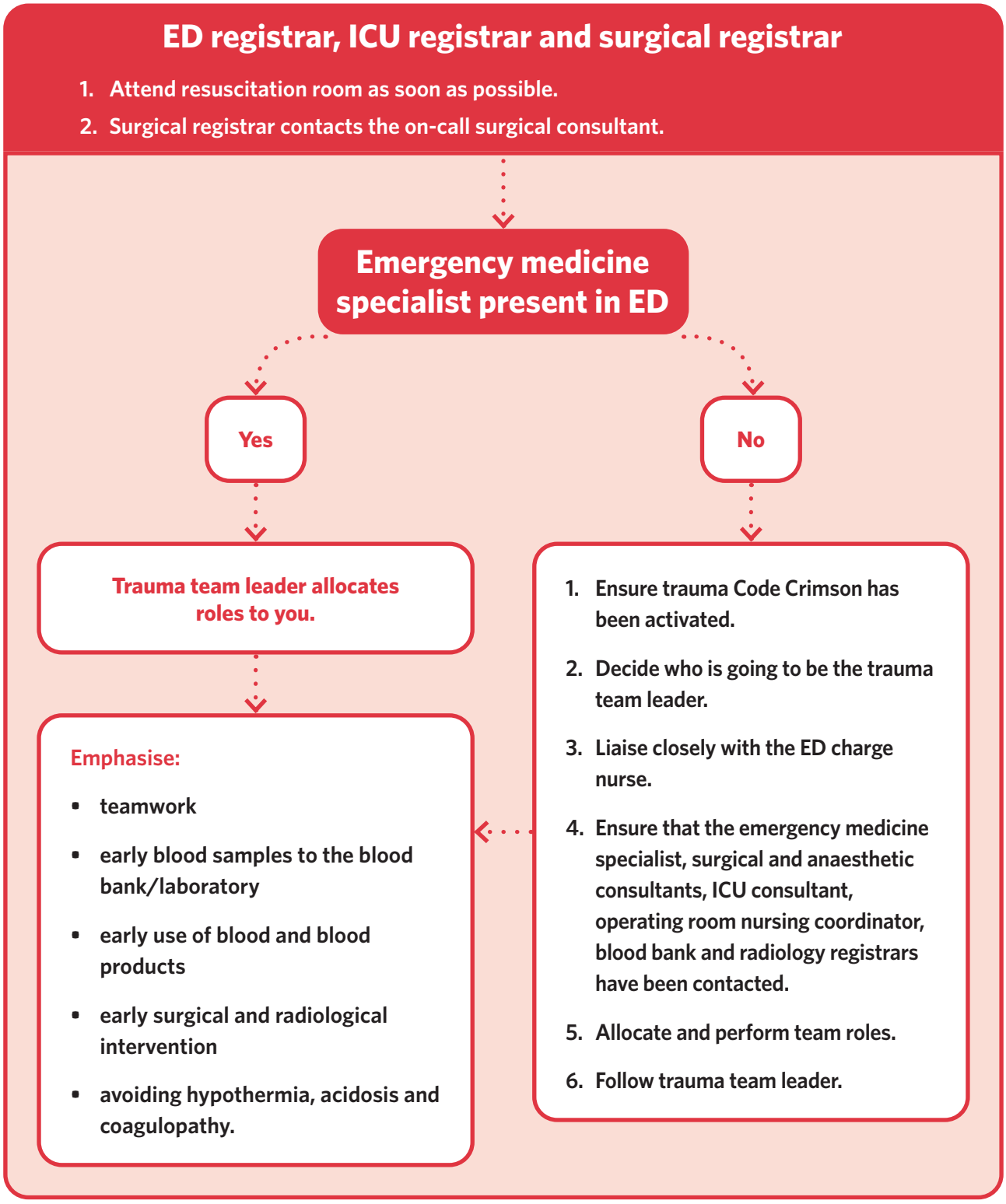
Trauma team leader and ED charge nurse

1. Ensure that Code Crimson has been activated and that the additional teams are contacted:
    a. anaesthetist
    b. nursing coordinator
    c. blood bank
    d. radiology registrar.
2. Check the on-call surgical registrar has contacted the on-call surgical consultant, stating only:

    Trauma Code Crimson in emergency department departing now or in X minutes
3. Allocate roles to the trauma team before the patient arrives and give a pre-arrival briefing. Everyone wears personal protection.
4. Set up resuscitation room appropriately.
    a. Rapid infuser is primed and ready for use.
    b. Ultrasound machine is at bedside.
    c. Pelvic binder is on trauma bed.
    d. Tranexamic acid is available.
    e. Blood products group O neg RBC and thawed plasma are available.
5. Resuscitate and manage as needed.
6. Liaise with inpatient specialty services as needed.

Note: ED = emergency department; RBC = red blood cell.

3. Emergency department registrar, intensive care unit registrar and surgical registrar



Note: ED = emergency department; ICU = intensive care unit.

4. Emergency medicine specialist

Emergency medicine specialist

1. Attend the trauma patient in the resuscitation room.
2. Along with the ED charge nurse ensure all additional teams have been contacted.
3. If you are the trauma team leader follow the action card for trauma team leader and ED charge nurse.
4. If you have come in from home and are not the trauma team leader:
   a. introduce yourself to the trauma team leader
   b. help with ongoing resuscitation and decision-making for this patient
   c. liaise closely with the trauma team leader, surgical and anaesthetic consultants to facilitate optimal management of the patient.
5. Key to optimal patient care and outcome is optimal teamwork.

Emphasise:

- teamwork
- early surgical and radiological intervention
- early use of blood and blood products
- avoiding hypothermia, acidosis and coagulopathy.

Note: ED = emergency department.

5. Senior surgeon

Senior surgeon

1. Attend the trauma patient in the resuscitation room.
2. Introduce yourself to the trauma team leader.
3. In conjunction with the trauma team leader:
   a. confirm surgical diagnosis to team
   b. indicate surgical action and urgency.
4. Key to optimal patient care and outcome is optimal teamwork.

Emphasise:

- teamwork
- early surgical and radiological intervention
- early use of blood and blood products
- avoiding hypothermia, acidosis and coagulopathy.

6. Anaesthetic consultant

Anaesthetic consultant

1. Attend the trauma patient in the resuscitation room.
2. Introduce yourself to the trauma team leader.
3. Assist with:
   a. airway management
   b. intravenous access
   c. resuscitation.
4. Expedite patient transfer to the operating room or the interventional radiology.
5. Key to optimal patient care and outcome is optimal teamwork.

Emphasise:

- teamwork
- early surgical and radiological intervention
- early use of blood and blood products
- avoiding hypothermia, acidosis and coagulopathy.

7. Radiology registrar

Radiology registrar

1. Liaise with CT medical radiation technologist to facilitate urgent trauma CT imaging.
   a. There may only be a very narrow window of opportunity to get CT imaging on these patients.
2. Contact the on-call interventional radiologist to let them know a trauma Code Crimson has been activated.
3. Communicate any imaging results early to the trauma team leader.
4. Communicate again with the trauma team leader if there are interpretive or management changes after interventional radiology imaging review.

Emphasise:

- teamwork
- early surgical and radiological intervention
- early use of blood and blood products
- avoiding hypothermia, acidosis and coagulopathy.

Note: CT = computerised tomography.

8. Blood bank

Blood bank

1. Send 2 units of O negative red cells and 2 units of thawed plasma to the resuscitation area.
2. Start to thaw the first box of the Code Crimson Massive Transfusion Protocol (MTP).
    a. Do not send the first box to the resuscitation room unless MTP is activated by the trauma team leader.
3. Facilitate early availability of blood and blood products as per Code Crimson MTP.

Emphasise:

- teamwork
- early surgical and radiological intervention
- early use of blood and blood products
- avoiding hypothermia, acidosis and coagulopathy.

Note: MTP = massive transfusion protocol.

9. Operating room nursing coordinator

Operating room nursing coordinator

1. Review procedures in operating rooms and facilitate early access as required.
2. Liaise closely with anaesthetic consultant/coordinator to facilitate staffing and access.

10. Emergency department health care assistant or orderly

Emergency department health care assistant or orderly

1. You are an integral part of the trauma team.
2. Deliver blood samples to blood bank/laboratory.
3. Retrieve blood and blood products for the blood bank.
4. Deliver the blood and blood products to the resuscitation room.
5. Facilitate transfers to radiology or operating room as requested.

Appendix B: Relevant critical bleeding bundle performance indicators

1. These structures are recommended for a hospital receiving trauma patients for Code Crimson or similar response.
    a. All hospitals should have a massive transfusion protocol to guide the management of a critically bleeding trauma patient.
    b. A multidisciplinary team should develop the protocol and the hospital or DHB transfusion committee should approve it.
    c. The protocol should consider the available resources at the institution.
    d. The protocol should be reviewed at a minimum every three years.
    e. The protocol should be called the 'Code Crimson Massive Transfusion Protocol' or similar.
    f. Participating team members should have access to formal training and drills to increase their awareness of and adherence to the Code Crimson MTP so they can deliver it more effectively.
    g. All team members should have ready access to the written Code Crimson MTP as a reference tool.
    h. The protocol must specify the team members required to respond when it is activated.
    i. The protocol should specify how the lead clinician at the bedside is designated.
    j. The protocol should specify the team member(s) designated to be responsible for blood component and sample transport.
    k. The laboratory must be notified of all Code Crimson MTP activations.
    l. All critical laboratory results and important coagulation parameters (haemoglobin, platelet count, INR and fibrinogen) must be communicated by phone to the clinical team as soon as they are available.
    m. The timing of protocol activation and termination must be recorded in the patient's chart.
    n. The collection and testing of the group and screen sample must be prioritised in the protocol to mitigate the impact on group O red blood cells (RBCs) and thawed plasma stocks.
    o. A critical haemorrhage trauma programme multidisciplinary committee should review Code Crimson MTP activations for quality assurance.
2. The following are recommendations for auditing patient care.
    a. All massively bleeding patients should have a temperature measured within 15 minutes of arrival or protocol activation, and then at a minimum of every 30 minutes (or continuously where available) until the protocol is terminated.
    b. All patients should receive interventions to prevent hypothermia and achieve normothermia (≥ 36° Celsius).
    c. All patients should receive warmed intravenous fluids, red blood cells and plasma to avoid hypothermia.
    d. RBCs should be delivered in a validated container to prevent wastage.
    e. Uncrossmatched RBCs should be available at the bedside within 10 minutes of MTP activation.

f. In bleeding patients who need RBC transfusion, uncrossmatched group O negative RBCs should be transfused until crossmatch compatible RBCs are available.

g. Pretransfusion bedside patient and product identification check must be performed before transfusion of any component to avoid mistransfusion.

3. Suggested quality metrics that should be tracked on all activations of the protocol are the:
   a. number of activations of Code Crimson pre-hospital with an ABC score greater than or equal to 2
   b. proportion of patients receiving TXA within 1 hour of protocol activation
   c. proportion of patients in whom RBC transfusion is initiated within 15 minutes of protocol activation
   d. proportion of patients achieving temperature ≥ 36° Celsius on termination of the protocol
   e. proportion of patients with appropriate activation (≥ 5 RBC units in first 24 hours, > 40 mL/kg per 24 hours of RBCs in paediatric patients) or before this level in patients dying due to haemorrhage within 24 hours
   f. proportion of patients that receive a ratio of RBC to plasma of 1:1 prior to definitive bleeding control
   g. proportion of patients without any blood component wastage (including plasma that is thawed and not used within the five-day limit on another patient)
   h. proportion of patients meeting pre-hospital activation criteria whose status is notified to the receiving emergency department
   i. proportion of patients meeting activation criteria on arrival at the emergency department who have Code Crimson activated within 10 minutes
   j. proportion of patients activated to Code Crimson who have a definitive bleeding management plan completed
   k. proportion of patients who begin movement from the emergency department to definitive bleeding control location within 30 minutes.

These suggested performance indicators have been drawn from work of the Ontario Regional Blood Coordinating Network.[4]

4 Callum JL, Yeh CH, Petrosoniak A, et al. 2019. A regional massive hemorrhage protocol developed through a modified Delphi technique. *CMAJ Open*. DOI: 10.9778/cmajo.20190042 (accessed 3 November 2020).

Appendix C: Core expert reference group

The core expert reference group (ERG) was formed in early 2020 and had six meetings throughout 2020, with developing this document a key focus.

Its terms of reference define its purpose as being:

> a 'safe' group that the project team can consult and debate with, in confidence. It will also be an 'expert' group and members have been appointed because their knowledge and skills are recognised in the sector (both locally and internationally). Finally, it will be a group that champions the project and its deliverables in the sector, both during their development and during their implementation.

The Health Quality & Safety Commission and the National Trauma Network would like to thank the core ERG members for their efforts and enthusiasm in guiding the work to improve trauma care for critically bleeding patients. The table below lists these members.

Name	Role	Organisation
Andy Swain	Medical director	Wellington Free Ambulance
Caroline Gunn	Consumer representative	N/A
Chris Jephcott	Anaesthetist	Waikato DHB
David Drower	Quality improvement advisor	Health Quality & Safety Commission
David Lang	Emergency medicine specialist	Nelson Marlborough DHB
David O'Byrne	Emergency medicine specialist	Hutt Valley DHB, Wellington Free Ambulance
Dominic Fleischer	Emergency medicine specialist	Canterbury DHB
Gabrielle Nicholson	Project manager	Health Quality & Safety Commission
Ian Civil	Clinical lead, National Trauma Network (vascular and trauma surgeon)	National Trauma Network
Jack Hill	Māori representative (anaesthetist)	Auckland DHB
James Moore	Intensivist	Capital & Coast DHB
Kerry Gunn (Chair)	Clinical lead, critical haemorrhage project (anaesthetist)	Health Quality & Safety Commission
Orla Fowden	Right Care advisor	St John Ambulance Service (South Island)
Paul McBride	Data scientist	Health Quality & Safety Commission

Name	Role	Organisation
Renate Donovan	Trauma nurse	Capital & Coast DHB
Richard Aickin	Paediatric emergency medicine specialist, Starship Children's Hospital and representative for the New Zealand Resuscitation Council	New Zealand Resuscitation Council
Richard Charlewood	Transfusion medicine specialist	New Zealand Blood Service
Sandy Ngov	Project coordinator	Health Quality & Safety Commission
Susan Mercer	Transfusion nurse specialist (intensive care unit)	New Zealand Blood Service
Tony Smith	Medical director	St John Ambulance Service

Appendix D: Wider expert reference group

Also crucial to the successful delivery of the critical haemorrhage project is the wider ERG, with which the project team consulted to 'sense check' deliverables and proposals before communicating them publicly.

The Health Quality & Safety Commission and the National Trauma Network would also like to thank the members of the wider ERG for their support of the core ERG and the project. The table below lists the wider ERG members.

Name	Role	Organisation
Andrew Holden	Head of interventional radiology, Auckland City Hospital	Auckland DHB
Angus Jennings	Orthopaedic surgeon	Nelson Marlborough DHB
Annemarie van der Slot-Verhoeven	Blood bank scientist	Wellington Blood Bank
Anthony Buddle	Trauma clinical lead, Southland Hospital	Southern DHB
Christopher Harmston	Surgeon	Northland DHB
Claire Hitchcock	Trauma coordinator	Nelson Marlborough DHB
Dean Bunbury	Anaesthetist/air retrieval	Paediatric anaesthetist at Counties Manukau DHB and pre-hospital retrieval medicine (PHRM) in Auckland
Emma Patrick	Anaesthetist	Chair Hospital Blood Transfusion Committee, Taranaki DHB
Fiona King	Transfusion nurse specialist	New Zealand Blood Service Wellington
Grant Christey	Surgeon	Waikato DHB
James Le Fevre	Emergency medicine specialist	Auckland Rescue Helicopter Trust
James McKay	Trauma surgeon	Canterbury DHB
Jim Faed	Transfusion medical specialist/ haematology	Southern DHB
Kaylene Henderson	Trauma team training	UniServices
Krishna Badami	Sponsor ANZ-MTR	New Zealand Blood Service
Laura Young	Haematologist	Auckland DHB
Mark Friedericksen	Emergency medicine specialist	Auckland DHB

Name	Role	Organisation
Michael Kalkoff	Intensivist	Northland DHB
Mike Hunter	Surgeon	Southern DHB
Murray Cox	Vascular surgeon	Taranaki DHB
Paul Blakemore	Emergency medicine specialist and pre-hospital physician	Bay of Plenty DHB, Auckland Rescue Helicopter Trust
Sarah Morley	Chief medical officer	New Zealand Blood Service
Scott Robinson	Anaesthetist	Waikato DHB
Tracey Clark	Blood bank team leader	New Zealand Blood Service

Appendix E: Acknowledgements

The Health Quality & Safety Commission and the National Trauma Network would like to specifically acknowledge the following individuals and organisations for sharing their expertise and resources:

- Dr Mark Friedericksen, emergency medicine specialist at Auckland DHB, for the Code Crimson templates for communication
- Dr James Le Fevre, for the Auckland Rescue Helicopter Trust 'Prehospital blood standard operating procedures' (SOPs)
- Auckland DHB for the use of the Adult and Paediatric MTP templates.

Te Hononga
Whētuki ā-Motu
National Trauma Network

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