University Hospitals Birmingham NHS
NHS Foundation Trust

Standard Operating Procedure (SOP) for the use of the AutoPulse® Resuscitation System in the Emergency Department

CONTROLLED DOCUMENT

CATEGORY:	**Procedural Document**
CLASSIFICATION:	**Clinical**
PURPOSE	**The purpose of this SOP is to provide guidance to clinical staff in the management of patients suitable for AutoPulse® mechanical chest compressions specifically in the Emergency Department**
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Controlled Document Sponsor:	**Dr Matthew Boylan**
Controlled Document Lead:	**Dr Matthew Boylan**
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Distribution: • **Essential Reading for:** • **Information for:**	**All clinical staff, who are involved in the management of Cardiac Arrest patients in the Emergency Department who require AutoPulse® mechanical chest compressions** **All clinical staff involved in the care of patients in the Emergency Department**

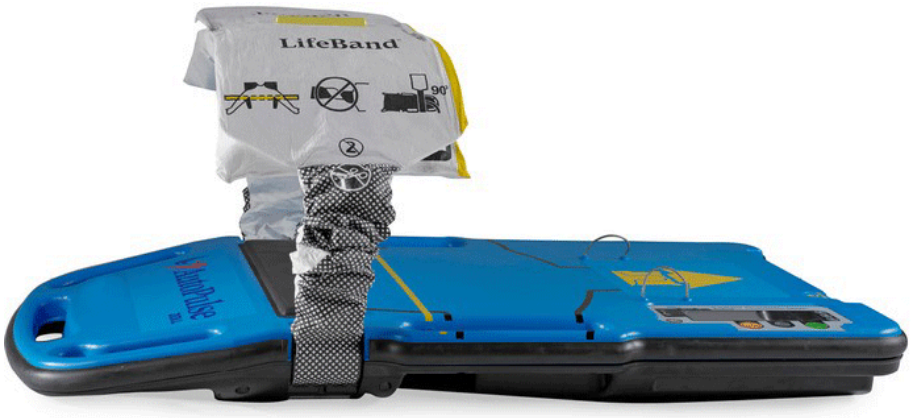
https://www.zoll.com/medical-products/product-manuals/?pid=9497

1.0 Introduction

This document describes how the AutoPulse® Resuscitation System should be used within UHB Emergency Department.

2.0 Zoll AutoPulse® Resuscitation System

The AutoPulse® Resuscitation System is an automated, portable, battery-powered chest compressor, which provides mechanical chest compressions as an adjunct to manual CPR.



The AutoPulse administers standardised chest compressions at a consistent rate of 80±5 compressions per minute to allow complete recoil of the chest cavity. The rate of compressions is lower than for manual, unidirectional compressions, as the chest cavity takes longer to recover from a circumferential compression. The depth of compression causes a chest displacement equal to a 20% reduction in anterior-posterior chest depth, calculated for each patient according to their chest size. The combination of these factors leads to a constant blood flow to the vital organs (including brain, heart and lungs) and the periphery.

The user can select the pattern of compression by choosing between 2 different modes: **30:2 mode** gives 30 compressions followed by 2 ventilation pauses of 1.5 seconds, and **continuous mode** provides continuous compressions.

The AutoPulse® Resuscitation System consists of the 4 components:

(1) AutoPulse Platform

The AutoPulse Platform contains the mechanical drive mechanism, control system, and electronics necessary to generate and control the force required to perform mechanical chest compressions. User controls and indicators are contained in the User Control Panel.

(2) LifeBand™ Chest Compression Assembly (CCA)

The LifeBand CCA consists of a cover plate and two bands integrated with a compression pad with a Velcro® fastener. Attached to the AutoPulse Platform, the LifeBand CCA is automatically adjusted to the patient by the AutoPulse Platform and provides compressions to the patient's chest in the region of the heart. The LifeBand CCA is a single-use component that is attached to the AutoPulse Platform before each use. The latex-free LifeBand CCA is for single-patient use only.

(3) AutoPulse Power System Battery

The AutoPulse Power System Battery (also known as the Battery) is a removable component that supplies power for the AutoPulse Platform operation. The Battery is a proprietary, rechargeable, nickel- metal hydride (NiMH) battery that is the exclusive power source for the AutoPulse Platform. Each battery will provide approximately 30 minutes of compression time.

(4) AutoPulse Power System Battery Charger

The Battery is mechanically keyed to the AutoPulse Platform and Battery Charger to facilitate correct installation. The Battery's back end contains connections for power and communications to the Battery Charger and to the AutoPulse Platform. A Battery Status Check button illuminates the Battery's status light-emitting diodes (LEDs).

3.0 Rationale for use

For many years research has shown that when performed efficiently and well, manual chest compressions will provide about 10-20% of normal blood flow to the coronary arteries and about 30-40% of blood flow to the brain (Kern et al, 2000; Ornator et al, 2005). It has been found that near normal coronary artery and cerebral artery blood flow can be delivered within 3 compressions from the Autopulse® Resuscitation Device (Ikeno et al, 2006; Sandroni et al, 2007). The use of a mechanical device such as the AutoPulse ensures consistency in compression by avoiding compression fatigue and poor performance during manual compressions. It allows also for a member of staff to be free to undertake other tasks (Halperin et al, 2004). Two randomised controlled trials (Hallstrom et al. 2006; Wik et al. 2014) and several non-randomised studies have shown that outcomes with the AutoPulse® device are at least non-inferior compared with manual compressions.

The Autopulse® is <u>not</u> part of the hospital life support (HLS), intermediate life support (ILS) or advanced life support (ALS) algorithm or part of the Trust resuscitation guidelines therefore does not routinely replace manual chest compressions. It is for use in specific clinical indications that are detailed in this SOP.

4.0 Indications for use

The Autopulse® must only be used by competent personnel. Patients must meet the criteria listed in Box A and have one of the clinical indications for mechanical CPR (mCPR) in Box B:

BOX A

- Age over 16 years (NB: Off-license use in 16-18 year olds if adult sized)
- Weight ≤136kg
- Chest circumference range 76cm – 130cm

If the lifeband can be closed, it can be used

PLUS a clinical indication for mCPR

BOX B

1. ***To Support Prolonged Resus***

- Thrombo-embolic Arrest
- Toxicological Arrest
- Hypothermic Arrest
- Arrest due to Metabolic Derangement
- Refractory/Recurrent VF/VT Arrest with:
  - No major comorbidities (ASA≤2)
  - Witnessed arrest
  - No Flow time <10mins[1]
  - Low Flow time <30mins[2]
  - $ETCO_2$ >1.3 KPa

2. To Support Intra-arrest transfer to another therapeutic area

- To Cath Lab for Intra-Arrest PCI
- To Theatres for ECMO-CPR or Cardio-Pulmonary Bypass

5.0 Relative Contraindications to use

The Autopulse® should not be used on:

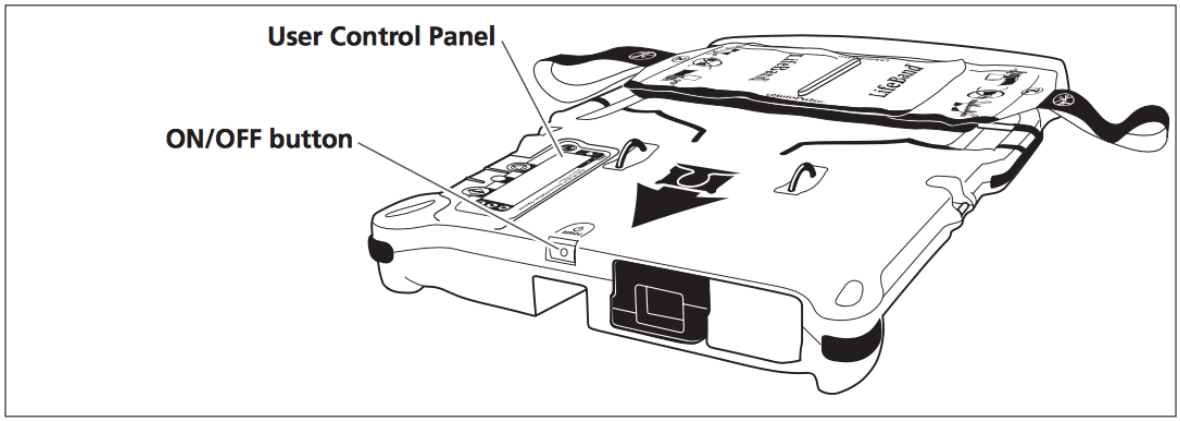
[1] No Flow Time = time from arrest to first basic life support
[2] Low Flow Time = time receiving CPR, which stops with ROSC

- Trauma patients (with hypovolaemic / obstructive aetiology)
- Patients who have had open chest surgery
- Patients who are under 16 years old
- Patients exceeding machine parameters

6.0 Deploying the Autopulse® Resuscitation System

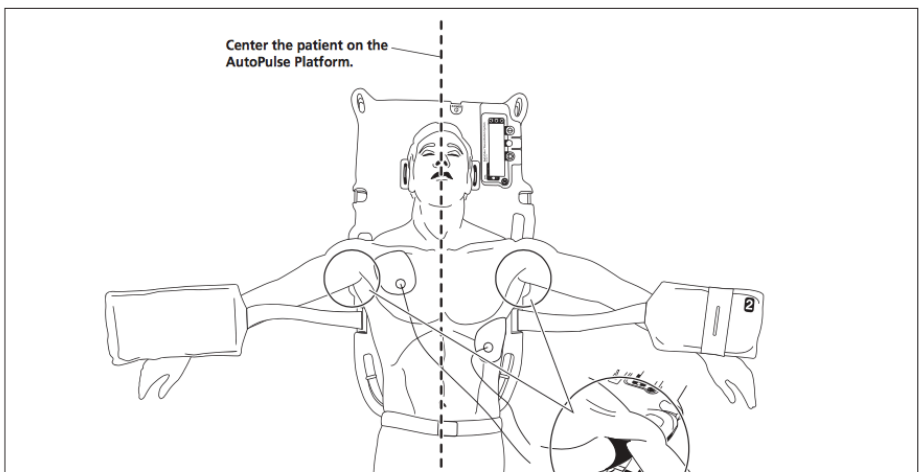
6.1 Step 1

The ON/OFF button is located adjacent to the Battery on the AutoPulse® Platform. Press the ON/OFF button once to power up the AutoPulse® Platform and initiate the self-test. The User Control Panel's green Power LED lights up. The life band arms should be separated, inspected and prepared for use.



6.2 Step 2

The patient should have their clothing cut away in preparation for AutoPulse® application. A coordinated cessation of manual CPR should occur, following which the patient should be rapidly sat forward (supported on both sides) and the AutoPulse® platform slid in behind the patient. A posterior defibrillation pad may be applied at this point. If an advanced airway is in place the vent circuit should be disconnected from the airway device and the head supported throughout the manoeuvre. The patient should then be laid back on the device ensuring they are appropriately centred with their armpits aligned with the yellow line positioning guides on the AutoPulse® Platform.



6.3 Step 3

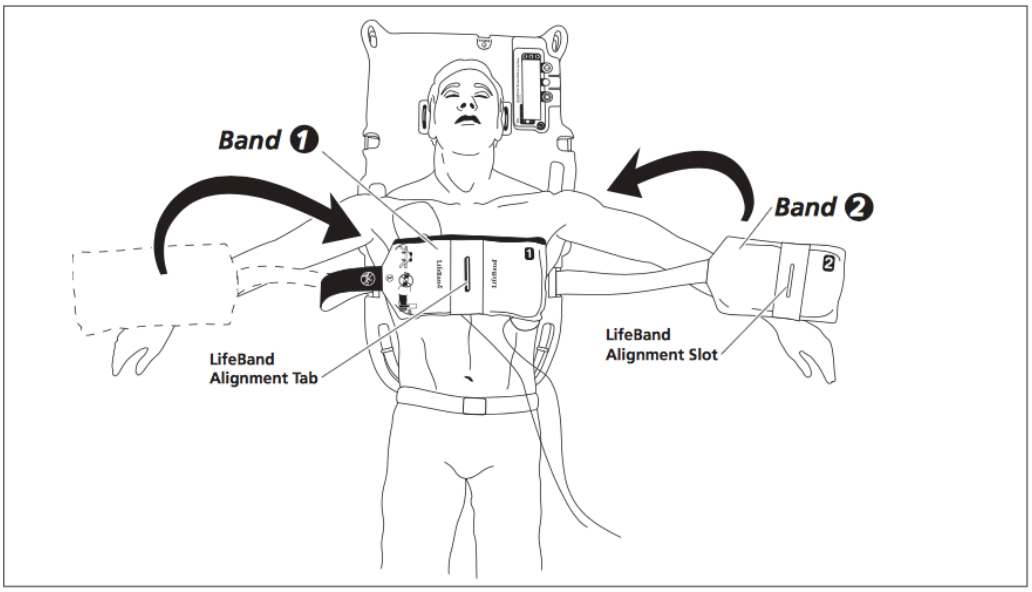
a) Place band ❶ on top of patient's chest

b) Locate mating slot of band ❷ over the alignment tab ❶

c) Press the bands together to engage and secure the Velcro® fastener.

d) Once both arms of the lifeband are attached, gently pull the lifeband upwards until fully extended

Caution: Make sure that the bands are not twisted before automatic compressions begin. Note: If the bands cannot be closed or there is a delay to band closure, recommence manual CPR.



6.4 Step 4

Press and release the Start/Continue button once. The AutoPulse Platform automatically adjusts the bands to the patient's chest and determines the appropriate compression. Do not touch the patient or the LifeBand CCA while the AutoPulse Platform is analysing the patient's size

Verify that the patient is properly aligned and that the LifeBand CCA has taken up any slack in the bands. If the patient is not properly aligned, press the Stop/Cancel button, realign the patient, recommence manual compressions and start again from Step 3.

If the patient is aligned press the Start/Continue button a second time to start compression cycles.

NOTE: The Lifeband can be placed over defibrillator pads and there is no need to stop the Autopulse® when delivering a shock from a defibrillator when using pads.

6.5 Changing the Compression Mode

Press the grey Menu/Mode switch button to switch between 30:2 and continuous compressions. The current mode is displayed in the upper left corner of the screen. The words above the grey Menu/Mode switch button indicate the alternate mode that the Platform will switch to. Once the grey Menu/Mode switch button has been pressed you will be asked to confirm the mode switch by pressing the gray Menu/Mode switch button twice in rapid secession. A single tone will sound to confirm that the mode change has been accepted.

6.6 Pausing compressions

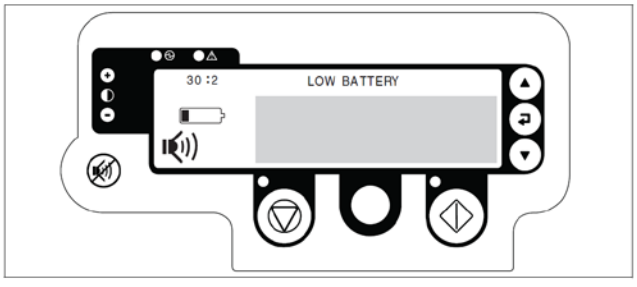
If access to the patient is required or to pause the AutoPulse Platform for any reason, press the Stop/ Cancel button. The AutoPulse Platform releases the tension on the LifeBand chest bands allowing the user to pull out the bands to the maximum extended position. To restart compressions press the Start/Continue button

6.7 Turning the device off

After either successful resuscitation or termination of activities, press the Stop/Cancel button followed by the ON/OFF button. To remove the patient from the device open the Velcro® fastener and lift or log roll off the patient from the AutoPulse Platform.

6.8 Changing batteries during CPR

When five minutes of active operation remain on a Battery, the User Control Panel will give a “Low Battery” indication (See overleaf). The “Low Battery” indication will remain on until the Battery is replaced or depleted. The Low Battery warning display will be accompanied with an audio warning of four rapid beeps which will be followed by two beeps every 30 seconds until the battery is replaced or depleted. It is recommended that, if available, a fully-charged Battery be exchanged for the Battery with the low charge.



To exchange Batteries:

a) Autopulse operator to declare ‘low battery’ to team
b) Ensure second operator ready to take over manual CPR
c) Press the Stop/Cancel button.

d) Extend the band out to full length and rest on the abdomen.
e) Second operator resumes manual chest compressions
f) Press the ON/OFF button.
g) Remove the Battery
h) Install the fully-charged Battery
i) Resume mechanical chest compressions

7.0 Special Considerations

7.1 Managing the obese patient

There is a maximum weight of 136kg for the board. Zoll advise that if the lifeband is big enough to close around an obese patient then it can be used. Additional personnel and equipment may be required to sit the patient forward. Consider prepositioning lifting belts on the bed prior to receiving the patient

7.2 Cardiopulmonary resuscitation-induced consciousness (CPRIC)

CPRIC occurs in around 1% of all resuscitation cases (Olaussen et al, 2017) and may consist of spontaneous eye opening, jaw tone, speech and/or body movements. It is associated with improved survival and seems to be more commonly seen with mechanical CPR. CPRIC should be managed with sedative boluses of ketamine or fentanyl followed by muscle relaxation if required.

8.0 Troubleshooting

8.1 Lifeband becomes jammed

In the process of putting the Autopulse® in place, it is possible that the lifeband may become 'jammed'. This can happen when the arms of the lifeband have hung down beside the bed and become twisted at the base, where they enter the device. If the arms of the lifeband are then brought up and connected, without noticing this, when the Autopulse® is started the arms of the lifeband become jammed in the device and compressions stop.

To avoid this problem – be aware and take a few seconds to check that the lifeband is not twisted.

8.2 Lifeband unable to make full assessment

In order to make a full assessment of chest girth and the power of compression required, once the two arms of the lifeband are stuck together via the Velcro, the whole lifeband must be fully extended by pulling it upwards. Failure to do this means that the device will not start compressions.

To avoid this problem - once both arms of the lifeband are attached to each other, gently pull the lifeband upwards until fully extended.

8.3 Battery failure

The device may fail to work due to loss of power, if the battery in the device is not changed daily or after every use. There is no way to power this device other than by battery.

To avoid this problem – ensure daily and annual checking of the battery.

8.4 Lifeband Failure

If the lifeband is damaged in any way, the device may fail. If a lifeband is found to be defective, do not discard but keep and give to the lead resus nurse so that it can be sent back to Zoll for further investigation.

To avoid this problem - a new lifeband must be used each time. After the device has been used on a patient and removed, then the lifeband must be changed.

9.0 Maintenance

9.1 Lifebands

Lifebands are single use and so are disposable. A lifeband should always be inserted into the device.

If any lifebands are found to be faulty they are <u>not</u> to be discarded but instead kept and sent back to Zoll for further investigation and potentially replacement**.**

9.1.1 **Removal**.

To remove the lifeband from the Autopulse®, release to locks located on each side of the lifeband panel and free the two clasps highlighted in yellow. This will free the lifeband panel. To free the lifeband from the motor, unwind the band to completion until the release catch is facing upwards. Press the white catch inwards and remove the band completely.

9.1.2 Installation

To install the lifeband, insert the clip into the motor. Pull the band up completely to ensure secure installation. Align the yellow section of the lifeband panel against the Autopulse® and push the panel down to close the catch. Lastly, close the locks locked on each side of the Autopulse®. Do not cut the lifeband from the motor. This can cause the motor to lock without being reset to neutral. This will ultimately cause delay in emergency usage, as the motor will need to be reset manually by the link nurses.

9.2 Autopulse® Cleaning

The Autopulse® must be cleaned daily during checking and between patient use, using Trust approved Clinell universal wipes (green). Please refer to Trust Infection Prevention and Control Policy and Procedures.

9.3 Autopulse® Batteries

The Emergency Department has three lithium batteries for the Autopulse®. One must always be in the Autopulse® and the other two are in the charger in Resus Bay 1.

The battery charger is able to charge two batteries at any one time. At the front of the charging unit, there is a system of lights that show whether a battery is charged or charging. The full charging time for a battery is 60 minutes. A fully charged battery will deliver a minimum of 30 minutes of compressions.

Batteries will be rotated daily and after every use. There is a daily checking procedure in place.

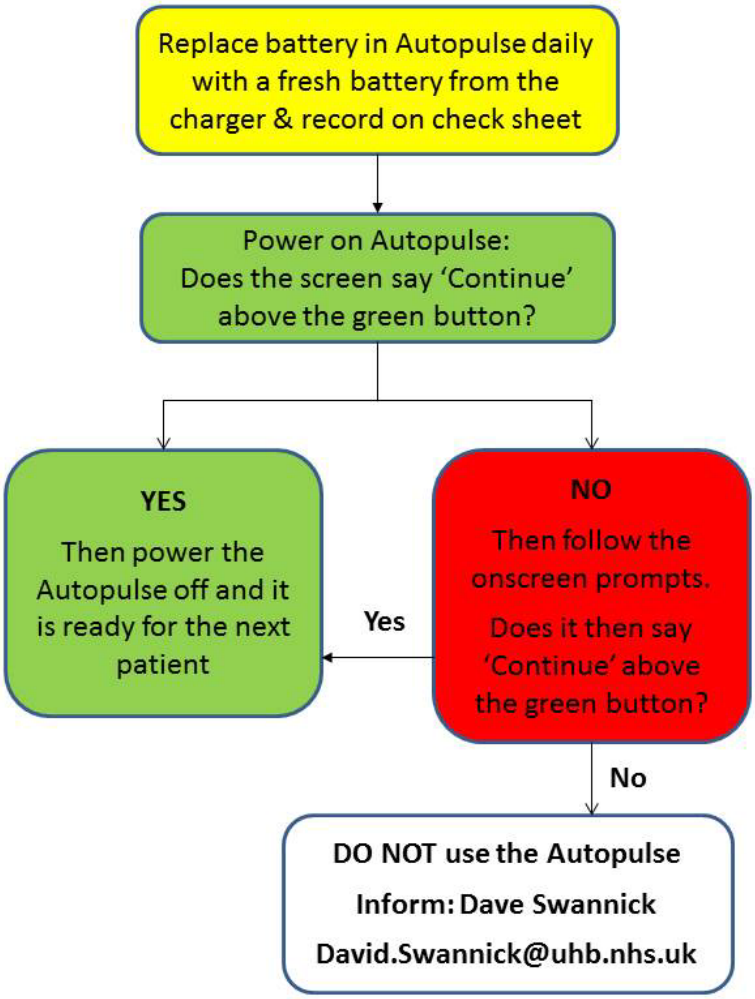
Once a month, each battery needs to undergo a test cycle. This is where the battery is fully drained and then recharged. This process takes 12 hours and is done to preserve the life of the battery.

10.0 Daily and annual checking of the Autopulse®

The ED Autopulse® will be kept in Resus Bay 1 and will be checked daily every morning by a competent staff member.

The daily check consists of:

- Check all batteries (1 x in Autopulse® 2 x in charger) are fully charged.
- Rotate the battery that has been in the Autopulse®.
- Ensure the Autopulse® is clean and free of contaminant/body fluid.
- Ensure the lifeband is fully extended and has not shrunk.
- Turn the Autopulse® ‘on’, check there are no error messages and then turn ‘off’.
- Sign the daily checking sheet on the Autopulse® trolley.



The Autopulse® is sent back to Zoll once a year for its annual check up to maintain its extended warranty. During this time, Zoll replace the Autopulse® unit with one of their loan ones.

This standard of practice also applies to the Zoll loan Autopulse®.

11.0 Training and Competence

All staff using the Autopulse® must have been trained by an approved trainer. Only staff who have been trained and assessed as competent should use the Autopulse ®.

The training must include:

- Demonstration of how to set up the Autopulse® using a mannequin. All icons and controls are identified to the learner.
- Practical use of the Autopulse® using a mannequin and the learner identifies controls and icons.

- Troubleshooting problems.
- Cleaning of the device.
- Changing the batteries, and daily checks and monthly test cycles of batteries.
- Changing of the lifeband, demonstration and then practice.

Staff must be assessed as competent in use of the Autopulse®, prior to using it unsupervised.

Evidence of competence will be recorded in a centrally held AutoPulse competency log.

Staff must be re-assessed YEARLY to ensure continued competence and to safeguard patient safety.

12.0 Usage Restrictions

The device should not be removed from the Emergency Department **UNLESS** it is being used for intra-arrest transfer of a patient to the operating theatre or the Cath Lab. In these cases a trained operator must always accompany it from the ED.

The device is NOT for use in other hospital departments.

13.0 Monitoring and Audit

There will be an ongoing audit of use of the Autopulse® within the Emergency Unit as part of a rolling Cardiac Arrest Audit.

Any untoward incidents and near misses must be reported via the Trust incident reporting system, and where required escalated to the appropriate management team. In addition, the Risk and Compliance Unit must be notified by telephone of any Serious Incidents (SI).

14.0 References

Hallstrom A, Rea TD, Sayre MR et al. (2006) *JAMA* 295: 2620–8

Halperin HR et al(2004). *Journal of the American College of Cardiology*.44(11):2214-2220.

Ikeno F et al(2006) *Resuscitation*. 68:109-118.

Kern K et al(2000). *Bailliere's Clinical Anaesthesiology*. 14(3):591-609.

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Spiro JR et al(2015) *International Journal of Cardiology.* 180: 7-14.

Timerman S et al(2004). *Resuscitation*. 61:273-280.5.

Olaussen A, et al (2017). Resuscitation. 113:44-50

Wik L, Olsen JA, Persse D et al. (2014) *Resuscitation* 85: 741–8

15. Appendices

1) Application of the Autopulse® Mechanical Chest Compression System in the Emergency Department
2) Autopulse® mechanical chest compression competenciy Sheet
3) Assessment of competence in the use of the Autopulse® by ED staff.
4) UHB ED Autopulse® Usage Record
5) Autopulse® Battery Maintenance & Rotation Record

Standard Operating Procedure prepared by:

M BOYLAN (Emergency Medicine Consultant)

D SWANNICK (Emergency Nurse Educator)

Adapted from:

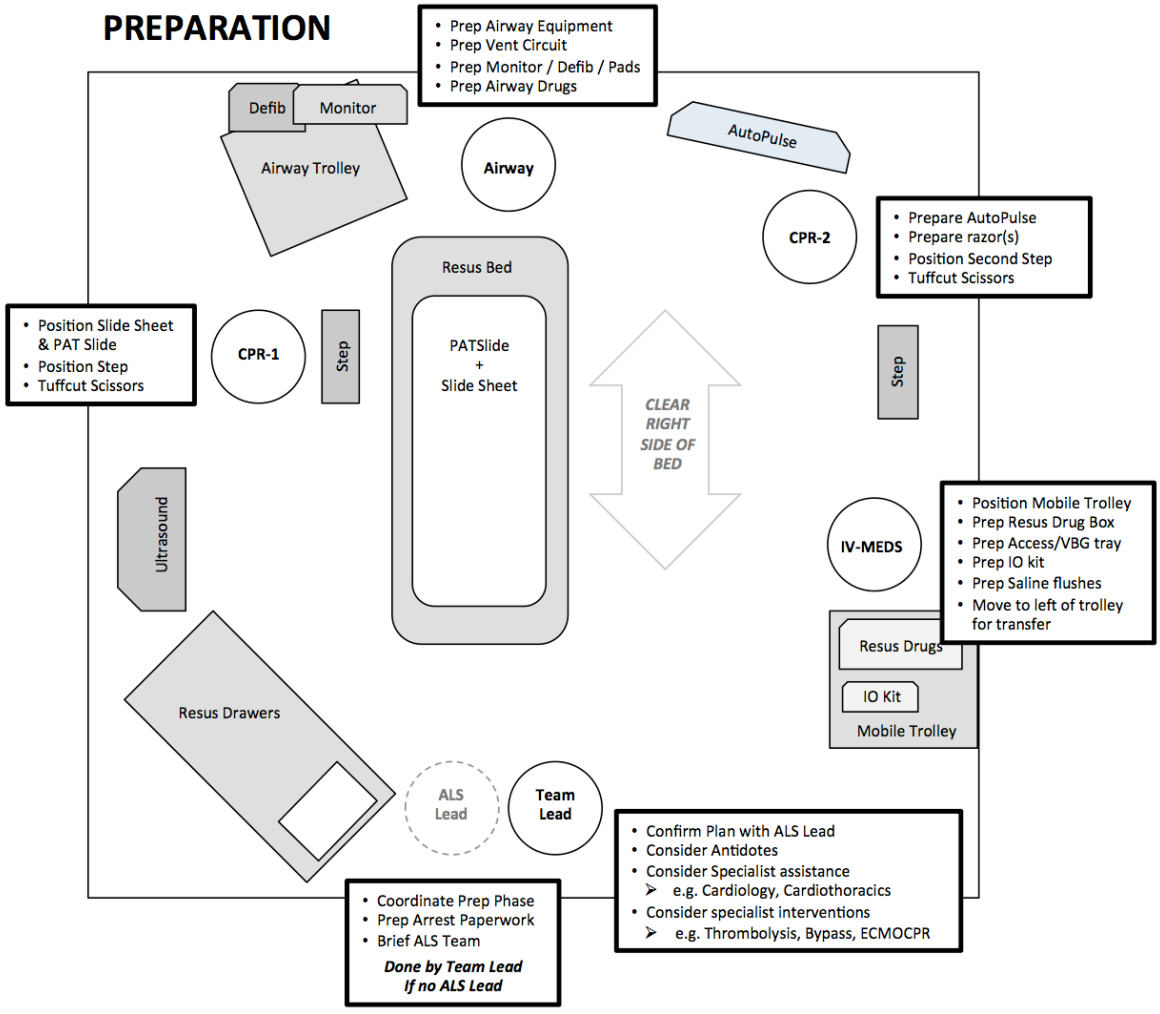
Sookia A and Kwok R. SOP for the use of the 2.0 Autopulse Mechanical Chest Compression System on the Coronary Care Unit/Cardiac Cath Labs. 2016.

Appendix 1

Application of the Autopulse® Mechanical Chest Compression System in UHB Emergency Department

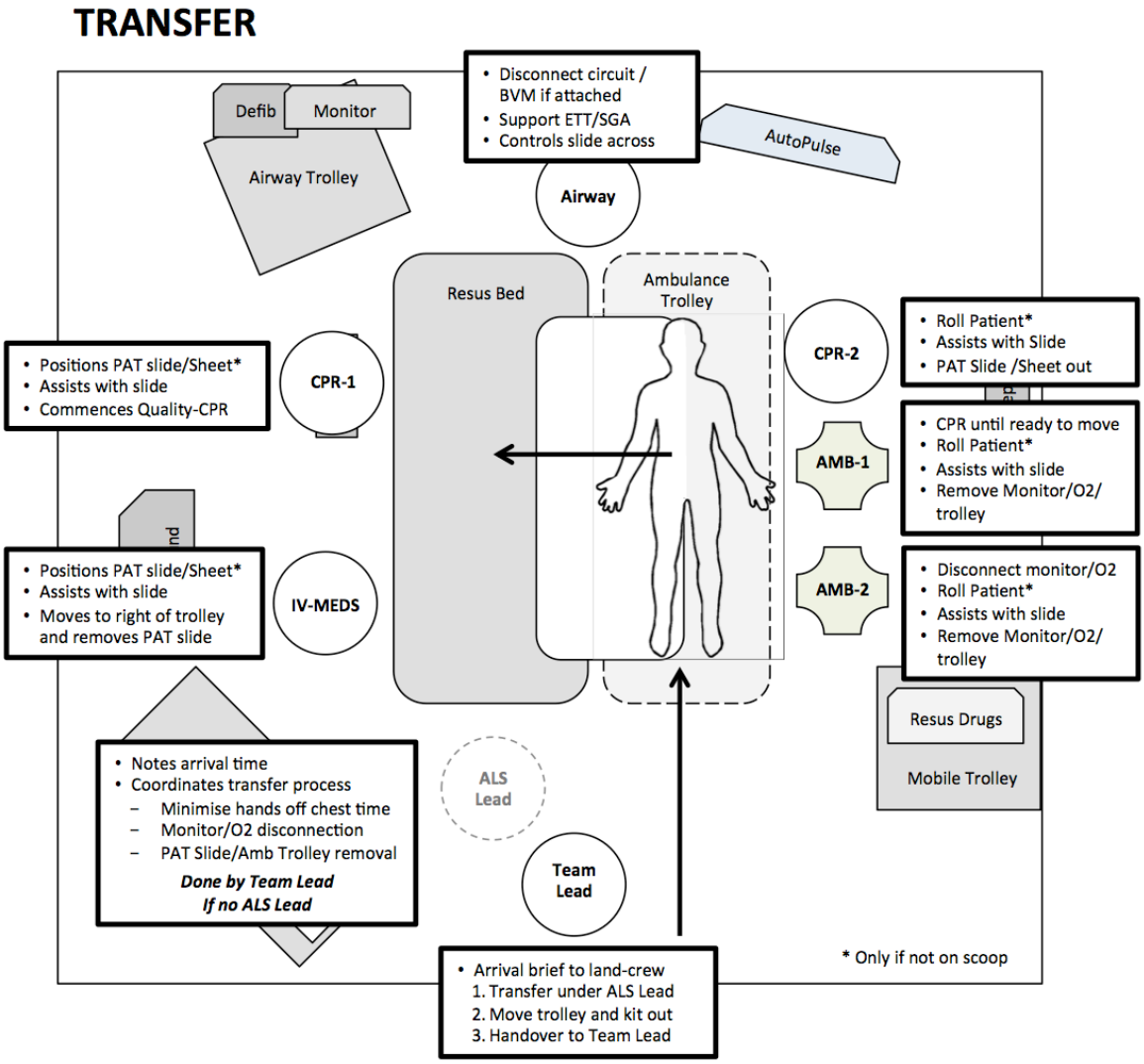
Application of the AutoPulse® device must be authorised by the Team Lead (Spr/Consultant) but will be applied by the UHB ED Nursing staff as part of a protocolised cardiac arrest reception/management pathway:

1. PREPARATION PHASE



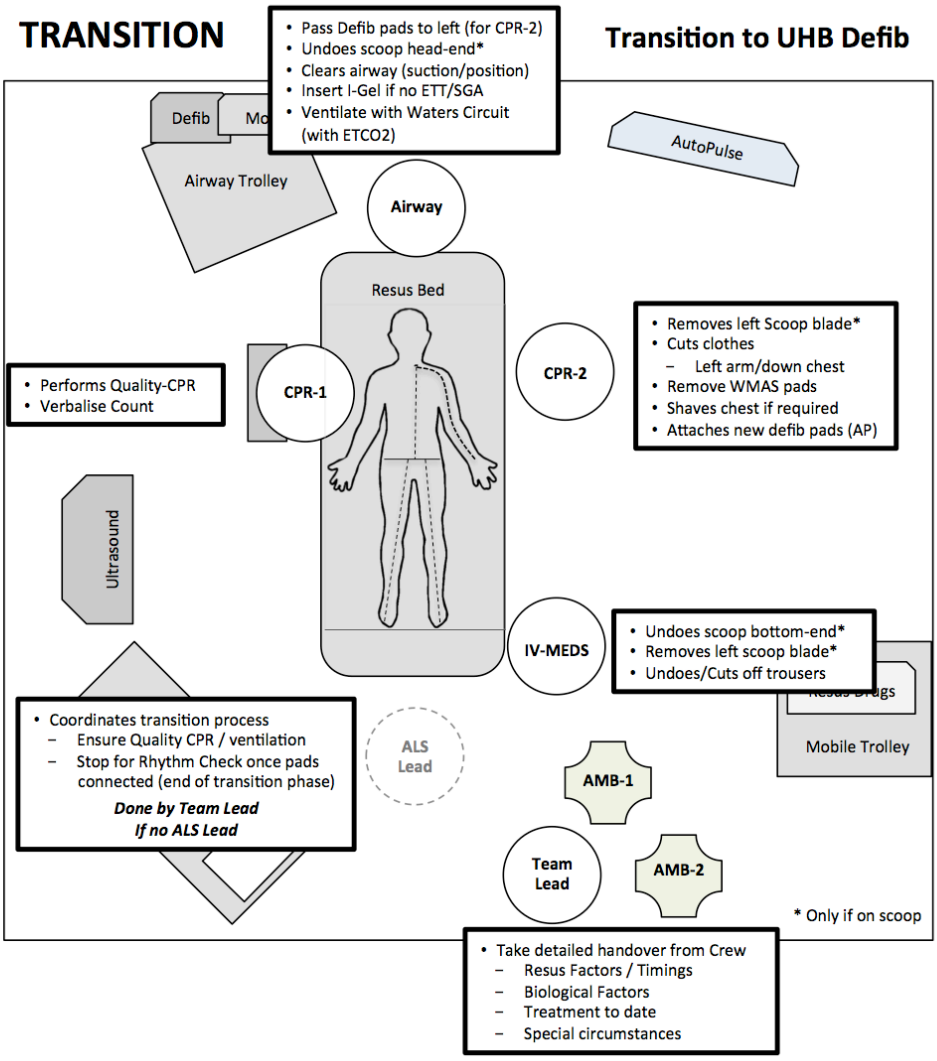
- The Autopulse® must be prepared and positioned in advance of all out-of hospital cardiac arrest cases.
- The Autopulse® must be brought to all in-hospital cardiac arrests within the Emergency Department.
- The Autopulse should not be pre-positioned on the bed in advance of patient arrival as most patients will need clothing removal prior to application

2. TRANSFER PHASE



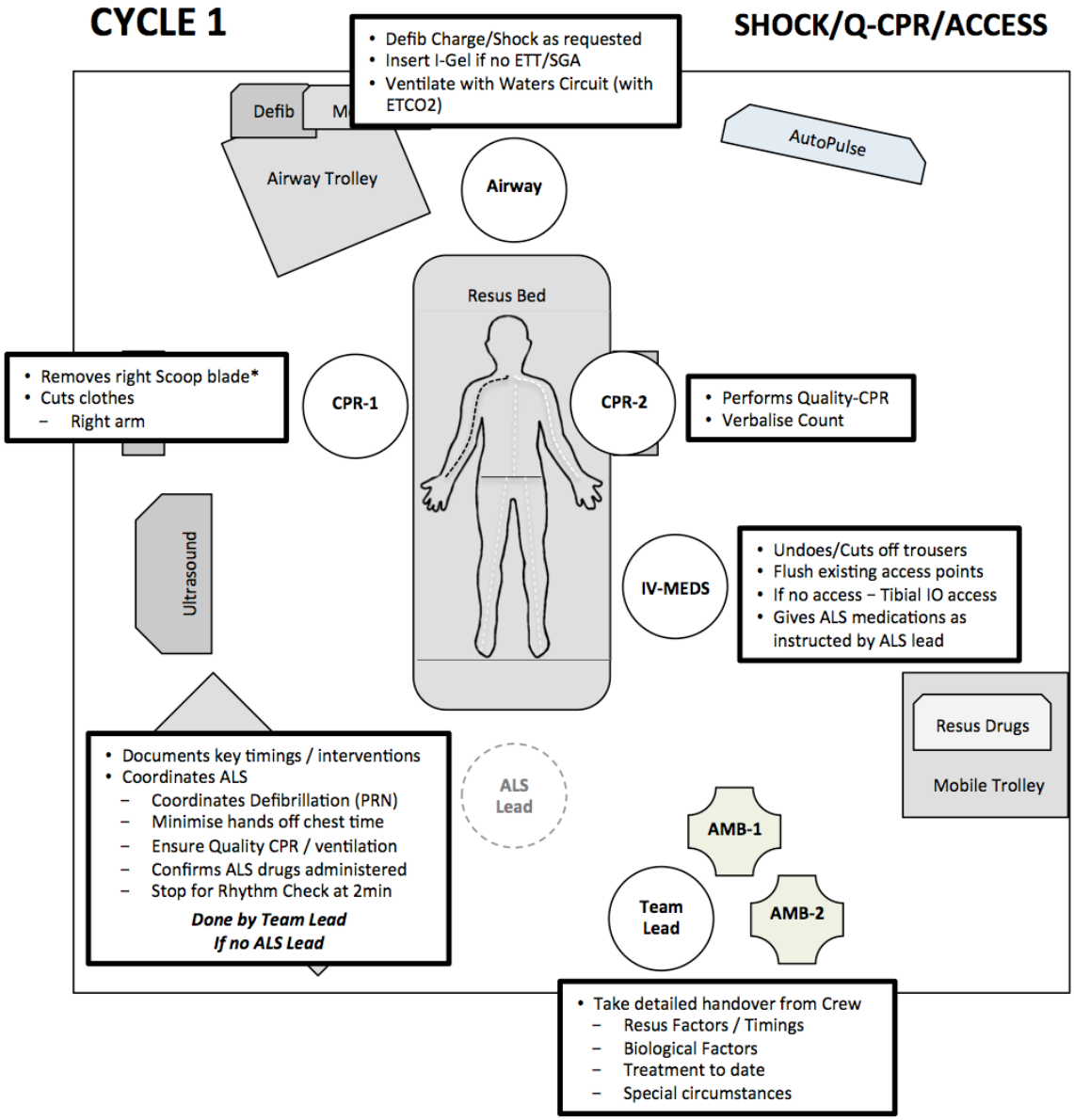
- The patient should be disconnected from all Ambulance Service monitoring /O_2 / ventilation circuit before transfer across
- Patients on Scoop stretchers can be lifted straight across on the scoop
- Patients not on scoop stretchers should be log-rolled onto a PAT slide /slide sheet before being slid across
- Minimise interruptions to CPR
- Once across the ambulance trolley and equipment should be removed
- The ambulance crew will handover to the Team Lead after transfer is complete
- The ALS team will complete defibrillator transition and then continue ALS

3. TRANSITION PHASE



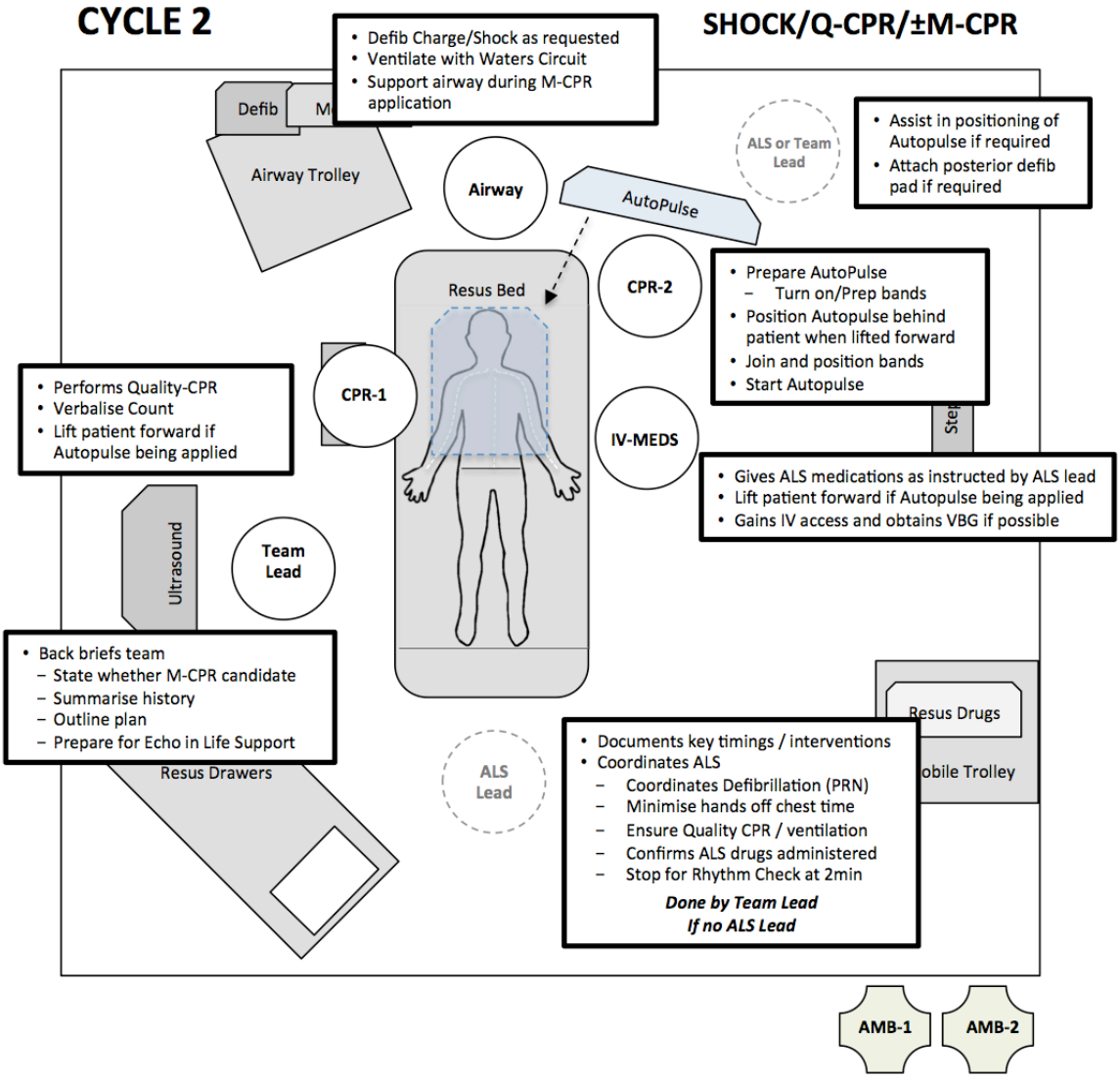
- Transition involves exposing the chest, removing ambulance service defib pads and replacing with ED defib pads in the optimum AP position.
- During this transition phase CPR must be continued and the airway supported.
- A separate ALS lead (e.g. senior nurse) can be used to coordinate the transition phase and subsequent ALS thereby allowing the Team Lead to focus on rapid / accurate history gathering in order to obtain the key information required to formulate a plan and make key decisions. The ALS lead will be responsible for recording all key timings and interventions.
- The transition phase will end when the UHB defib pads are attached and the team pauses for the first rhythm check/ pulse check.

4. ED ALS CYCLE-1



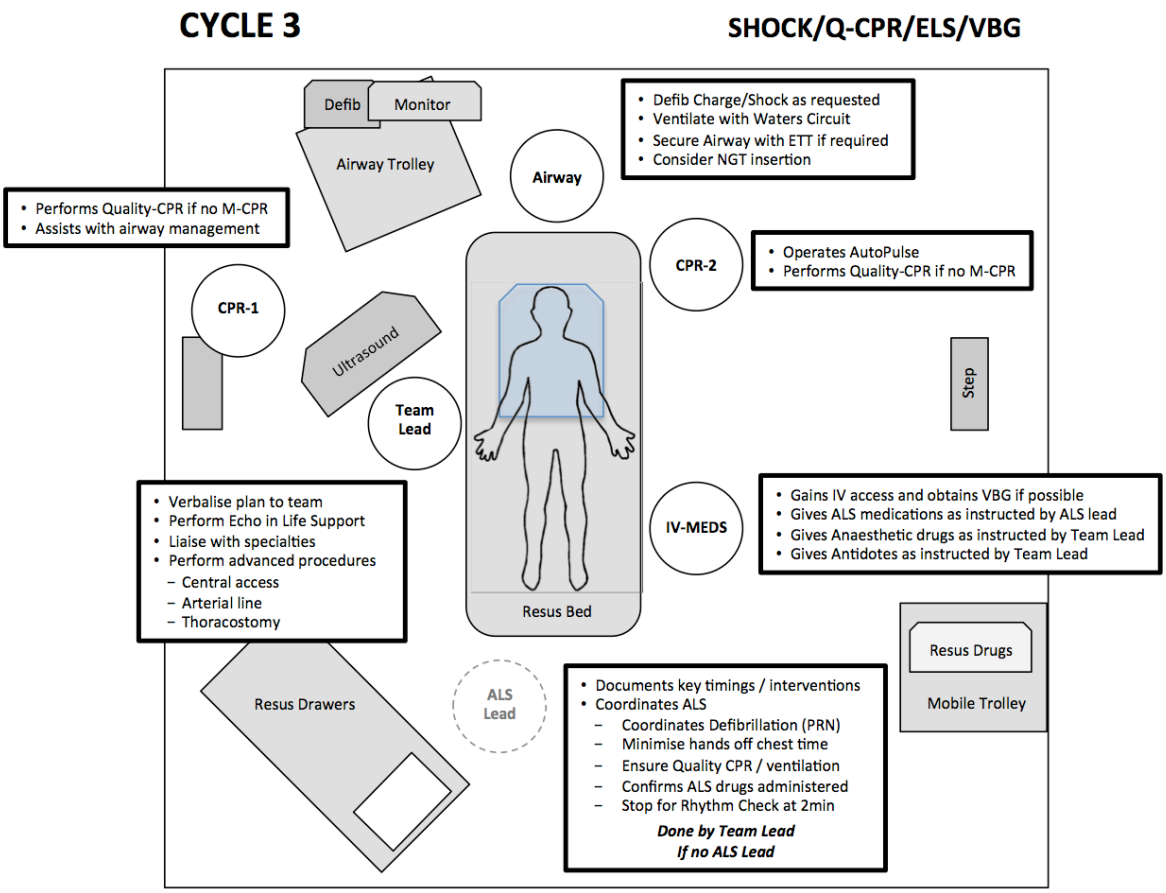
- Where defibrillation is indicated, CPR should be recommenced whilst the defib charges. A short pause should be allowed to deliver the shock before CPR is recommenced.
- Further cutting of clothes at this stage will facilitate subsequent Autopulse® application if indicated.
- Existing IV/IO access is checked. If no IV access then IO access is gained.
- The Team lead continues to gather the key history required to inform the decision making process.

5. ED ALS CYCLE-2



- The Team Lead should indicate by the start of ED ALS cycle 2 whether Mechanical CPR is indicated or not. There must be a clear indication recorded in the notes.
- When M-CPR is indicated the ALS lead will coordinate a pause in CPR for the patient to be lifted forward and allow the AutoPulse® to be positioned behind the patient. The patient will then be lowered back onto the device. The Autopulse® operator will connect and correctly position the life band before starting the device.
- Application of the Autopulse® will require 3-5 trained people – two to sit the patient forward, one to support the airway, one (or two) to insert the device.
- Time off the chest must be minimized and the application should not distract from defibrillation or delivery of high quality CPR.

6. ED ALS CYCLE-3



- Where indicated, M-CPR should be commenced prior to the end of the third ALS cycle.
- The Team lead should have verbalised a clear plan by this stage
- A venous blood gas and/or Echo in Life Support (ELS) may be undertaken to help inform decision making
- The Team Lead may consider:
    - Reversible causes
    - Antidotes
    - Advanced interventions
    - Specialist Input
    - Termination of Resus
    - Organ Donation

Appendix 2

AUTOPULSE® MECHANICAL CHEST COMPRESSION COMPETENCIES

EVIDENCE OF SUPERVISED PRACTICE

To become a competent practitioner, it is the responsibility of each practitioner to undertake supervised practice in order to become competent to care for patients requiring mechanical chest compressions in the Emergency Department.

Name of practitioner: ……..

DATE	DETAILS OF PROCEDURE	SATISFACTORY STANDARD MET	COMMENTS	PRINT NAME, SIGNATURE & DESIGNATION
		Yes / No		
		Yes / No		
		Yes / No		
		Yes / No		
		Yes / No		
		Yes / No		

Appendix 3

Assessment of competence in the use of the Autopulse® by ED staff.

End competence: To safely use the Autopulse® Resuscitation System

Name of practitioner: **Grade / Band:**

Name of assessor:

Element of competence to be achieved	Assessor's Signature	Practitioner's signature	Date
Provide evidence of current Life Support training update			
Provide evidence of training in the use of the Autopulse®			
Describe indications for use of Autopulse®			
Describe contraindications for use of Autopulse®			
Describe how the Autopulse® works			
Discuss how to prepare the members of the Cardiac Arrest team for the use of the Autopulse®			
Discuss how to prepare the area for the use of the Autopulse®			
Demonstrate on a mannequin how to place the patient on the Autopulse® correctly			
Demonstrate on a mannequin correct positioning of the lifeband			
Demonstrate on a mannequin correct preparation of lifeband for use			
Demonstrate how to switch on and then start the Autopulse®			
Discuss when and demonstrate how the settings on the Autopulse® would be changed from 30:2 to continuous compressions			
Describe the meaning of the text and icons on the Autopulse® screen Discuss any actions that may be required by the practitioner in response to one of these icons or texts.			
Describe when the Autopulse® would be paused or stopped and who would make that decision Demonstrate how to pause and stop			

the Autopulse®			
Describe what documentation is required after the use of the Autopulse®			
Demonstrate correct cleaning of the Autopulse®			
Demonstrate correct changing of the lifeband and discuss when this would occur			
Demonstrate correct changing of the batteries and discuss when this would occur			
Demonstrate the daily checking procedure and discuss what a Test Cycle is and how often this is performed			
Discuss special considerations/troubleshooting/what to do if the Autopulse® is faulty			

I declare that I have expanded my knowledge and skills and undertake to practice with accountability for my decisions and actions.

Signature of Practitioner:…….

Print name:……..

Designation:……

Date:……

I declare that I have assessed this practitioner and found her/him to be competent as judged by the above criteria

Signature of Assessor: ……..

Print name:……..

Designation: ……..

Date:……

Appendix 5

UHB ED Autopulse® Usage Record

Date	Time	Patient no.	Time used	Autopulse Operator	Problems
10-02-15	*13:30*	*EXAMPLE*	*20mins*	*Adam*	*Band twist – delayed application*

Appendix 6

Autopulse® Battery Maintenance & Rotation Record

Month:_____ Year:_____

Day	Battery in Autopulse®	Fully charged?	Initial	Batteries in charger	Initial
Example	***1***	***Y***	***AS***	***2 + 3***	***AS***
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

The charger will automatically Test-Cycle the battery every 30days
Yellow & Amber lights occur when Testing – do not remove until green light