IAEM Clinical Guideline

Push Dose Pressors Use for Adult Patients in the Emergency Department

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DISCLAIMER

IAEM recognises that patients, their situations, Emergency Departments and staff all vary. These guidelines cannot cover all clinical scenarios. The ultimate responsibility for the interpretation and application of these guidelines, the use of current information and a patient's overall care and wellbeing resides with the treating clinician.

Revision History

Date	Version	Section	Summary of changes	Author
November 2025	1.0	All	Final draft	MH, RL, HOR, PS

CONTENTS

GLOSSARY OF TERMS

cAMP	Cyclic Adenosine Monophosphate
CO	Cardiac output
ED	Emergency Department
EM	Emergency Medicine
HCP	Healthcare professional
IV	Intravenous
MAP	Mean arterial pressure
PDP	Push Dose Pressors
POCUS	Point of Care Ultrasound
RUSH	Rapid Ultrasound for Shock and Hypotension
SDM	Senior Decision Maker
SVR	Systemic vascular resistance

Push Dose Pressors Use for Adult Patients in the Emergency Department

INTRODUCTION

Acute hypotension and particularly prolonged periods of hypotension has been shown to result in higher morbidity and mortality.[5-7] Traditionally in Emergency Medicine (EM), intravenous (IV) fluids are utilised in the first instance in response to hypotension. Should an infusion of a vasopressor be commenced, the most commonly used are adrenaline, noradrenaline or phenylephrine.[4,7]

In anaesthesiology, however, it has been common practice for many years to use bolus-dose, or push dose pressors (PDPs), and their use has been generally accepted as safe.[8,9] Anaesthesiology generally enjoys a much more controlled milieu than EM, which is an important consideration. This is likely why the use of PDPs has only started becoming commonplace in EM in recent years[10], as well as the use of PDPs in a theatre setting being more likely due to vasodilatory effects of anaesthetic agents rather than the wide array of aetiologies encountered in the ED.[11]

While some studies have assessed for safety and efficacy of PDPs in an Emergency Department (ED) setting[12-17], this has been an evidence-light area until recently. Singer et al published a single-centre retrospective cohort study in 2022 to assess what the efficacy and safety of peripherally administered PDPs is for the treatment of acute hypotension outside of a theatre setting.[13] They assessed the use of bolus dose adrenaline and phenylephrine in many hospital settings outside of theatre, including the ED, and the final analysis included 1727 patients. While a prospective study is warranted to assess further, this study was well conducted and does suggest that PDPs use in the ED is a safe and effective option to manage acute hypotension.

Bearing this in mind, we need to be mindful of the potential harms of PDPs use, and minimize these harms with staff education sessions, appropriate governance including policies and procedures, and audit of our practice.

PARAMETERS

Target audience	This guideline is directed at all healthcare professionals (HCPs) involved in the delivery of resuscitative care to shocked adult patients in the ED.
Patient population	This guideline relates to adult patients, age of 16 and above, being cared for in the ED, who present with, or develop a shock state requiring haemodynamic support.
Exclusion criteria	• Patients under the age of 16 • Patients outside of an ED setting
Contraindications	• No appropriately trained senior decision maker (SDM) i.e. Consultant/Registrar with minimum of 6 months critical care/anaesthesiology experience. • Allergy to the relevant medications
Relative contraindications	• Patients with a haemorrhagic shock state[1-2] • Patients who have not received sufficient IV fluid resuscitation[3-4]

AIM

To provide a guideline for use by emergency HCPs to administer PDPs in a safe and standardised way across the country. This guideline should be implemented in each individual ED following consultation with relevant stakeholders, consideration of important local safety, operational considerations and a programme of staff education.

BACKGROUND

There are several medications that are commonly referred to as a “pressor.” While this is obviously a contraction of “vasopressor”, in practice it may be referring to vasopressors or inotropes.[18,19]

Considering them in terms of this equation:

MAP = CO x SVR

- Vasopressors are medications used to cause vasoconstriction, increasing systemic vascular resistance (SVR).
- Inotropes are medications used to increase cardiac contractility, increasing cardiac output (CO).

These medications are used with the aim of improving end organ perfusion by raising mean arterial blood pressure (MAP) and reducing the incidence of end organ dysfunction, multi-organ failure and death.

There are many drugs in each hospital formulary that will have vasopressor, inotropic or both effects, but not many are commonly used in the ED.

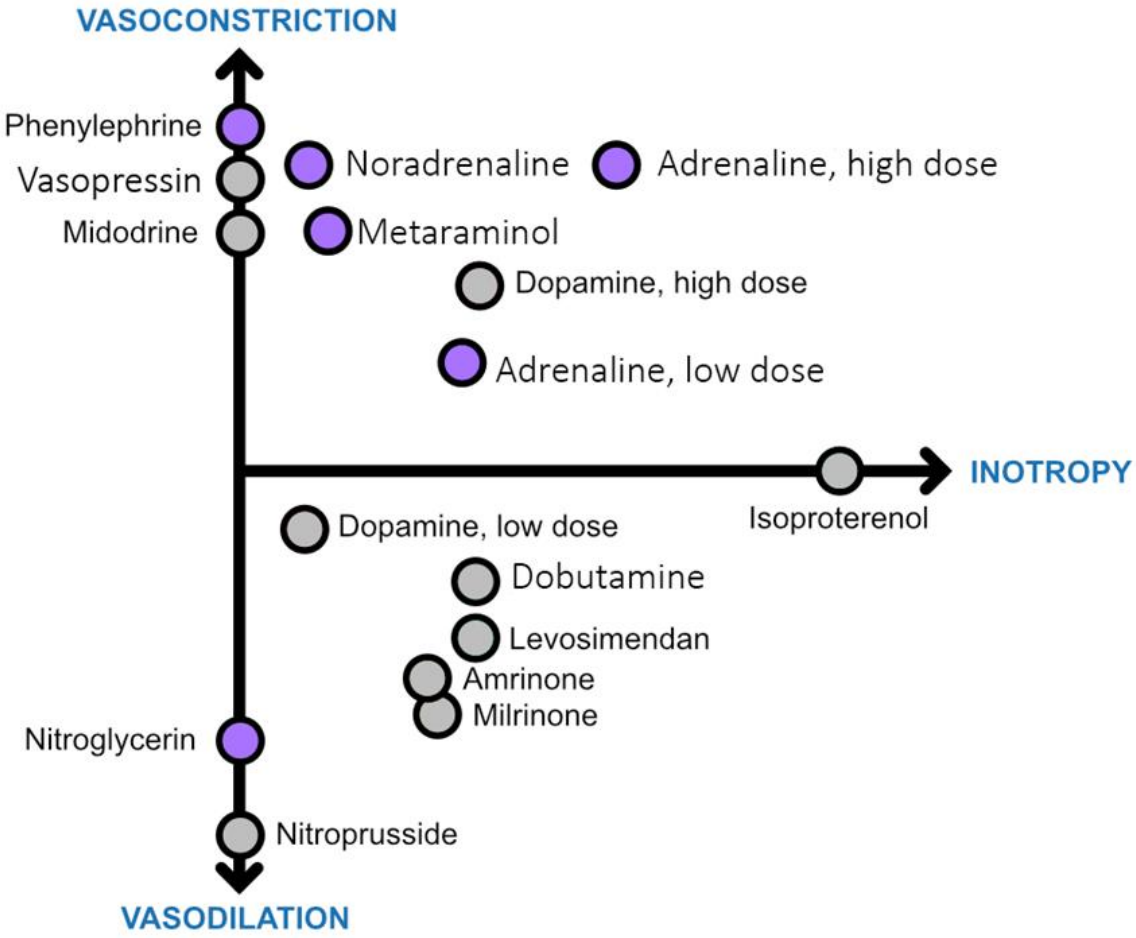

Figure 1: Vasoactivity and inotropy of commonly used medications (medications commonly used in ED setting are in purple).

STANDARDS

1. Policies should exist locally in each ED regarding
    a. Indications for PDPs use
    b. Recommended concentrations
    c. Medication preparation guidance
    d. Monitoring requirements for use

2. Prefilled syringes with standard concentrations should be used if available.

3. Where possible, a clinical pharmacist should be present where medication reconstitution is necessary.

4. PDPs must only be used by SDM, and ongoing training should occur in each ED.

5. Adverse events must be recorded as per local policy.

RECOMMENDATIONS

Clinical considerations

- Ensure clinical indication is appropriate, and that appropriate steps follow PDPs administration.
- Monitoring with ECG and regular non-invasive blood pressure at a minimum should be in place. Invasive blood pressure monitoring should be considered.
- The PDPs is a temporising measure and will not treat the underlying pathology.
- Care should be taken before the drug is given to determine the assumed cause of the hypotension, and to plan for the steps following PDPs administration.
- Repeated doses of PDPs in the absence of adequate preload expansion should be strictly avoided as this may mask inadequate fluid resuscitation and result in patient harm.[4,7]
- Determine whether the patient requires fluid resuscitation (crystalloids/blood products), diuresis, ongoing inotrope/vasopressor support, or theatre/interventional radiology for haemostasis.
- Consider utilising a point of care ultrasound (POCUS) shock protocol as an adjunct to the primary survey to help determine shock aetiology.[23]
- Monitor for adverse events and risks identified in the literature, which include:
    - Human error in:
        - Medication preparation or
        - Medication administration
    - Haemodynamic events
        - Bradycardia
        - Tachycardia
        - Hypertension
    - Ventricular arrhythmias
    - Hypersensitivity reactions

- The most common human errors noted in the literature are errors of dilution, or errors wherein an unintended overdose by factors of 10 is given.
    - The risk of these errors appears to be significantly reduced when a clinical pharmacist is present.[20,21]

Pharmacological consideration

PDPs are quicker to prepare and administer than vasopressor infusions, which can be invaluable when dealing with a critically unwell patient and they are also easily titratable to effect with repeated boluses.

Understanding the pharmacology of the pressors being used is important in order to choose the appropriate drug and dose for the patient's current clinical condition.[18,24]

Please refer to table 1 below for suggested agents for use as PDPs in the ED and their pharmacology and pharmacokinetics.

Pharmacology and pharmacokinetics of commonly used PDPs				
Medication	**Adrenaline**	**Phenylephrine**	**Metaraminol**	**Ephedrine**
Mechanism of action	Increased smooth muscle contractility, increased cAMP	Increased smooth muscle contractility	Release of noradrenaline by acting as a false neurotransmitter	Direct & indirect sympathomimetic amine; inhibits noradrenaline reuptake
Effect	Inotrope & vasopressor	Vasopressor	Vasopressor	Inotrope & vasopressor
Target receptor	β1, β2, α1	α	α1 >> β1	β1, β2 > α1
Onset (mins)	1	1	1-2	3-5
Duration (mins)	5-10	10-20	20-60	10-15
Recommended concentration	10mcg/ml	50mcg/ml	0.5mg/ml	3mg/ml
Recommended dosing	5-20mcg	50-200mcg	0.5-1mg	3-12mg
Patient selection	Low CO associated with shock; shock refractory to other agents	Hypotensive & tachycardic shocked patient	Hypotensive & tachycardic shocked patient	Hypotension related to induction of anaesthesia
Possible adverse events	Rebound hypertension, tachycardia	Rebound hypertension, bradycardia	Rebound hypertension, tachycardia, bradycardia	Rebound hypertension, delays in onset of other medications, arrhythmias

Table 1: Suggested agents for use as PDPs

Operational considerations

- Provision of standardised prefilled PDP syringes should be considered wherever financially and operationally feasible.
    - Prefilled phenylephrine 50mcg/ml syringes are widely used in ED settings in Ireland currently.
    - Metaraminol 0.5mg/ml and Ephedrine 3mg/ml syringes are available, but they are not routinely stocked in many EDs.
    - There are no currently available prefilled adrenaline syringes at an appropriate push dose concentration.
- Where this is not possible, clear guidelines and policies for safe drug preparation and administration should be provided, with regular audit against these guidelines.
- Staff education should be provided to disseminate the guidelines, including simulation training where possible.
- Risk can be further minimised by having packs prepared with all requisite equipment and a set of instructions, as provided by Weingart et al.[25]
- Involving clinical pharmacist colleagues is essential in implementing such a policy.
- **Drug preparation instructions** are demonstrated below in Figures 2-5. These should be adapted to fit local policy and procedures.

PREPARATION AND ADMINISTRATION INSTRUCTIONS

ADRENALINE 10mcg/ml Push Dose Pressor IV Administration Guideline	
Syringe Preparation	• Draw up 9ml of normal saline into a 10ml syringe • Into this syringe, draw 1ml of ADRENALINE 100mcg/ml (**1:10,000**) • Label Syringe **(ADRENALINE 10mcg/ml)**
Dosing & Administration	• Administer in 5-20mcg (0.5-2ml) aliquots • Repeat every 1-5 minutes or titrate based on response
Caution	• Extravasation risk; use large vein or CVC when available. • Use only as temporizing measure • Adrenaline has both α- and β- adrenergic activity; may cause tachycardia in addition to vasoconstriction
Monitoring	• For ED use only • Monitor HR and BP at least every 5 minutes while administering/titrating, and for a further 15 minutes following.

Figure 1: Adrenaline 10mcg/ml preparation instructions

METARAMINOL 0.5mg/ml Push Dose Pressor IV Administration Guideline	
Syringe Preparation	• Draw up 19ml of normal saline into a 20ml syringe • Into this syringe, draw 1ml of METARAMINOL 10mg/ml • Label Syringe **(METARAMINOL 0.5mg/ml)**
Dosing & Administration	• Administer in 0.5-1mg (1-2ml) aliquots • Repeat every 2-5 minutes or titrate based on response
Caution	• Extravasation risk; use large vein or CVC when available. • Use only as temporizing measure • Metaraminol has predominantly α1-adrenergic activity; may cause rebound hypertension, tachycardia or bradycardia.
Monitoring	• For ED use only • Monitor HR and BP at least every 5 minutes while administering/titrating, and for a further 15 minutes following.

Figure 2: Metaraminol 0.5mg/ml preparation instructions

PHENYLEPHRINE 50mcg/ml	
Push Dose Pressor IV Administration Guideline	
Syringe Preparation	• Draw up 1ml of PHENYLEPHRINE 10mg/ml • Inject into 100ml bag of Normal Saline, mix thoroughly • Draw up solution into a 10ml syringe • Label bag AND syringe **(PHENYLEPHRINE 50mcg/ml)**
Dosing & Administration	• Administer in 50-200mcg (1-4ml) aliquots • Repeat every 2-5 minutes or titrate based on response
Caution	• Extravasation risk; use large vein or CVC when available. • Use only as temporizing measure • Phenylephrine has predominantly α1-adrenergic activity; may cause rebound hypertension or bradycardia.
Monitoring	• For ED use only • Monitor HR and BP at least every 5 minutes while administering/titrating, and for a further 15 minutes following.

Figure 3: Phenylephrine 50mcg/ml preparation instructions

EPHEDRINE 3mg/ml	
Push Dose Pressor IV Administration Guideline	
Syringe Preparation	• Draw up 9ml of normal saline into a 10ml syringe • Into this syringe, draw 1ml of EPHEDRINE 30mg/ml • Label Syringe (EPHEDRINE 3mg/ml)
Dosing & Administration	• Administer in 3-12mg (1-4ml) aliquots • Repeat every 5-10 minutes or titrate based on response
Caution	• Extravasation risk; use large vein or CVC when available. • Use only as temporizing measure • Ephedrine has predominantly β-adrenergic activity; may cause rebound hypertension or tachyarrhytmnias. • May delay onset of rocuronium if administererd prior to it.
Monitoring	• For ED use only • Monitor HR and BP at least every 5 minutes while administering/titrating, and for a further 15 minutes following.

Figure 4: Ephedrine 3mg/ml preparation instructions

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