FLUID RESUSCITATION: A DEFENCE MEDICAL SERVICES DELPHI STUDY INTO CURRENT PRACTICE

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Abstract

A Delphi study was carried out to investigate recent changes in the fluid resuscitation of patients. A thirty member panel was selected primarily from the UK Defence Medical Services but also included contributors from other NATO members and civilian practice. The study was carried out in two rounds and achieved consensus on a range of statements relating to fluid resuscitation. Key recommendations are grouped by category. Statements reaching consensus included the use of adult intraosseous access, limited hypotensive resuscitation and goal directed therapy in trauma patients. Consensus was not achieved with respect to the selection of non-oxygen carrying synthetic colloids. The study provides a broad review of current practice and adds to previous consensus publications on fluid resuscitation.

Introduction

The initial impetus for a Delphi study came from an instruction from the office of the Surgeon General to the Royal Centre for Defence Medicine. The use of resuscitation fluids in the military environment needed review because the main stocked colloid was to be discontinued by the manufacturer. There had also been changes in the way fluids are selected and administered by military practitioners since the consensus views published in 2004 [1,2].

The question of which intravenous fluids are appropriate for use in resuscitation is complex. Even the apparently simple choice between colloids and crystalloids is disputed and a range of new products has appeared on the market in recent years. The study was run alongside a review of the literature, stakeholder interviews and analysis of operational trauma data.

Methods

The Delphi Process

The Delphi technique is a structured process that uses a panel of experts to investigate a complex or imprecise issue using a series of unstructured statements. An example of its application is if medical practice is underpinned by experience rather than science but practitioners wish for an evidence based footing [3]. The process uses a minimum of two rounds and aims to achieve consensus.

In the initial round the panel responded to a series of open questions about the use of intravenous fluids during medical care. This was done individually and anonymously. The responses were studied, common themes extracted and collated into a series of sixty statements. In the second round these statements (Box 1) were redistributed to the panel members who were invited to record their level of agreement with each statement using a nine-point Likert scale [4]. This is a visual ordinal scale allowing the participant to record a range of opinion (Figure 1). Those statements that reached 80% agreement amongst the panel were deemed to have achieved consensus.

Strongly Disagree				No Opinion				Strongly Agree	Insufficient Knowledge
1	2	3	4	5	6	7	8	9	

Figure 1. The Likert scale.

Expert panel selection

The panel was selected by the Academic Department for Military Emergency Medicine led by the Defence Consultant Adviser in Emergency Medicine. The panel membership was restricted to thirty; all of whom had experience in the use of intravascular fluid resuscitation or were researchers in this field from the Defence Science and Technology Laboratory (DSTL) and included experts from NATO member states. Of the experts approached, only one declined to participate in the study giving lack of expertise in the field as the reason. The panel members are listed at the end of this article.

Results

Each results section presents selected results from the Delphi study based on the consensus statements achieved. Throughout reference is made to the supporting statements from the study which are appended at the end of this paper in Box 1.

General indications for intravenous fluids

The study began by establishing agreement over the spectrum of conditions that may require intravenous fluid administration. 100% agreement was achieved with respect to the requirement for intravenous fluids in treating shock. Shock was described as a state of reduced oxygen delivery and tissue perfusion. The causes of shock included haemorrhagic (trauma and gastro-intestinal bleeds), burns, sepsis and neurogenic shock as a result of spinal cord injury. There was agreement that dehydration accompanied by inadequate oral intake frequently requires

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management with intravenous fluids (statements A1a – A1i).

Intravascular Access

Intravascular fluids are not always indicated. If intravascular administration is unnecessary then an electrolyte solution such as Diorylate® is the oral rehydration fluid of choice (B2). Oral fluids can be used to treat a trauma patient in specific situations; for example, an alert casualty with prolonged transfer time to definitive care and no suspected gastrointestinal tract injury (B6).

When oral fluid administration is impossible or contra-indicated then intravascular access must be carried out. Intravascular access must be simple to achieve and it must be effective and safe. Peripheral intravenous cannulation remains the first line choice for quick and effective intravascular access for fluid administration. However, intra-osseous access (limb and sternal) has superseded venous cut-down following failed peripheral cannulation in the pre-hospital environment (B13). This use of adult intraosseous access is now widespread in military practice but is only recently gaining acceptance in the civilian pre-hospital field.

When peripheral cannulation has failed then the technique used for intra-circulatory access depends on the competencies of the practitioner (B16). 86% of panel members disagreed with the suggestion that non-doctor grades of medical practitioners should be taught how to cannulate the femoral vein (B14). The panel emphasized that obtaining intravascular access should not delay the patient's transfer to definitive care (B17).

Use of fluids in pre-hospital care

Techniques to control blood loss (dressings, combat application tourniquets, pelvic and long-bone splints) should be applied before considering intravenous fluid resuscitation in the bleeding trauma patient (C7). Once external blood loss has been halted then fluid resuscitation can be considered. An absent radial pulse is the most useful indicator in the supine trauma patient of the requirement for pre-hospital fluid resuscitation and so restoration of a radial pulse is a useful target in fluid resuscitation (C21, C27). The radial pulse is unsuitable for use in children younger than eight years old as an assessment for pre-hospital fluid resuscitation (C22). Respiratory rate, pallor, tachycardia, capillary refill time and estimation of blood loss on scene may all be used to influence the decision to administer fluid resuscitation (C23). Conscious level is another useful guide to fluid resuscitation but only in the absence of head injury (C24). Improvement of physiological parameters, including conscious level and radial pulse, should be used to determine the adequacy of pre-hospital fluid resuscitation (C26). Intravenous fluids should be administered at a temperature as close to body temperature as possible. Fluid warming or cooling devices should be used as indicated by the situation (C20) and hypothermia must be avoided (in the military trauma patient in the pre-hospital environment - C33). Again the panel emphasized that the administration of fluids should not delay transfer to definitive medical care (C32).

Choice of fluids in pre-hospital care

The fluids used by pre-hospital care practitioners require careful consideration. There is a balance between having a selection of fluids for specific situations and the weight of the equipment that has to be carried. In non-trauma resuscitation either 0.9% 'normal' saline or Hartman's solution (Ringer's lactate) can be used (C10 and C12). If only one intravenous fluid is to be carried by pre-hospital personnel the panel recommended Hartman's solution (C18). For trauma resuscitation there are a range of fluids available to the pre-hospital practitioner including colloids, hypertonic crystalloids and combinations of these. Opinions varied about the different products and consensus was difficult to achieve but the panel did agree that hypertonic saline/dextran (HSD) *may* become the fluid of choice to be carried by pre-hospital personnel for trauma resuscitation (C8). The panel confirmed that the fluids currently in use can be employed in all theatres including arctic, temperate and desert environments and across all Service-specific environments (ships, submarines and aircraft) (C19).

The guiding principle of replacing the original missing fluid remains extant. For trauma, replacing blood-loss with blood-products is the ideal, and for this reason the use of blood products in the pre-hospital environment requires consideration. The panel agreed that in very specific circumstances such as prolonged entrapment and delayed transfer then units of packed red blood cells (type O negative) may be requested by medical officers, sent forward and administered in the pre-hospital environment (C34, C35).

Choice of intravascular fluids in the Emergency Department

Crystalloid solutions are the current initial intravenous resuscitation fluid of choice (D3). Although 0.9% 'normal' saline is recommended by NICE in the UK (2) on the basis of cost, the panel considered Hartman's Solution to be preferable due to the reduced potential for hyperchloraemic metabolic acidosis (D4). The standard Advanced Trauma Life Support (ATLSTM) teaching of administering two litres of crystalloid to trauma patients has been replaced by a more considered approach to the patient combining ongoing physiologically targeted (goal-directed) resuscitation with early damage-control surgery. Low-volume hypertonic solutions may have a role in this approach. Although consensus was not achieved, 68% of the panel believed that hypertonic saline/dextran (HSD) is currently the most useful initial fluid (D5) and 50% believed that the first 250mls of intravenous fluid administered to the trauma patient should be HSD specifically due to its immuno-modulatory role (D9). An attempt to identify a trend amongst practitioners between the use of colloids or crystalloids failed to achieve consensus although all members agreed that 0.9% 'normal' saline and Hartman's solution are useful resuscitation fluids. Attempts to identify which non-oxygen carrying colloids are preferred by the panel also failed and this may represent a current trend away from using colloids in practice. Although hydroxyethyl starch compounds such as Voluven® are widely used in NHS practice they did not achieve support from more than 50% of the panel. Pure gelatin based solutions were not supported by panel members. Modern synthetic oxygen-carrying compounds such as perfluorocarbons were not recommended by the panel reflecting their experimental status. Table 1 compares the fluids commonly used for resuscitation in the hospital environment.

As in the pre-hospital field, priority is given to stopping blood loss rather than replacement. The amount of time taken to get the patient from point of wounding to the operating theatre remains the main determinant of outcome in non-compressible haemorrhage in trauma patients (E38). Pre-hospital and Emergency Department procedures should aim to get the casualty to theatre in the shortest possible amount of time.

Use of blood products in trauma

In theory cross-matched fresh whole blood would be the fluid of choice for treatment of catastrophic haemorrhage in the military trauma patient (E41) but due to the effects of cell and immunoglobulin related graft-versus-host disease this may not be the case. In the absence of fresh whole blood, current practice includes packed red blood cells, re-warmed plasma and platelets administered in a volume ratio of 1:1:1 (E42). A 'massive-blood-loss' protocol for administration of blood products and recombinant Factor VIIa in appropriate patients with severe haemorrhage should be developed and validated (E43 and E44),

Fluid	Percentage Agree	Percentage Impartial	Percentage Disagree
Crystalloids			
D37a. 0.9% 'normal' saline (+/- 30 mmol KCl)	**92**	**4**	**4**
D37b. 3.0% hypertonic saline	26	32	42
D37c. 7.5% hypertonic saline	50	17	33
D37d. Hypertonic saline/dextran (HSD)	68	14	18
D37e. 5% dextrose	78	9	13
D37f. 10% dextrose	70	17	13
D37g. Hartman's solution (Ringer's lactate)	**100**	**0**	**0**
D37l. Sodium bicarbonate 8.4%	**87**	**9**	**4**
Synthetic Colloids			
D37h. Hydroxyethyl Starch (HES 130/0.4: 6% in NaCl) *Voluven®*	50	28	22
D37i. Hydroxyethyl Starch (HES 200/0.5: 6% in NaCl) *HAES-steril®*	44	22	33
D37j. Hydroxyethyl Starch (6% in balanced electrolyte buffer solution) *Hextend®*	42	37	21
Blood Products			
D37k. 4.5% or 5% or 20% (human) albumin	41	23	36
D37m. Packed red blood cells	**100**	**0**	**0**
D37n. Pooled platelets	**96**	**0**	**4**
D37o. Rewarmed plasma (FFP)	**91**	**9**	**0**
D37p. Cryoprecipitate	**95**	**5**	**0**
D37q. Recombinant Factor VIIa	**100**	**0**	**0**
D37r. Whole blood	**88**	**0**	**12**

Table 1. The intravenous fluids that should be available in the military hospital (D37).

and a military protocol currently exists for the use of recombinant Factor VIIa in the form of a Surgeon General's Policy Letter.

Goal directed therapy

Trauma patients benefit from hypotensive resuscitation (target systolic blood pressure of 80-90 mmHg) but only in the first hour following injury. After the first hour resuscitation should revert to a normotensive target systolic blood pressure of at least 110 mmHg (F28). Patients with head injury are not appropriate for hypotensive resuscitation and practitioners should try to achieve a minimum systolic blood pressure of 110 mmHg in order to mitigate the risk of reduced cerebral perfusion (F29) (Table 2). The same applies to blast casualties (F30). This reflects experimental animal-model data which reveals dramatically increased mortality when blast injuries are combined with hypotensive resuscitation.

- Greater than one hour since injury
- Significant head injury
- Children (<age12)
- Suspected blast injury

Table 2. Exclusions to hypotensive resuscitation in trauma patients.

The patient should be reassessed following each 250ml volume of intravenous fluid (F31). Specific goal directed therapy is appropriate in the Emergency Department *provided this does not delay transfer to the operating theatre.* Specific goals include a systolic blood pressure of 90mmHg, reduction of tachycardia below 100bpm, urine output greater than 0.5mls/kg/hr and improving conscious level (F39, F40). Aggressive goal-directed therapy reduces mortality in 'shocked' patients in the Intensive Care Unit (F48). Useful measured parameters for goal directed therapy here include central venous pressure, mean arterial pressure, central venous pH, haemoglobin concentration and central venous oxygen saturation SvO_2 >70% (F49, F50).

Head injuries

The panel agreed that hypotensive resuscitation is contra-indicated in head injury, that intra-cerebral perfusion pressure is a useful parameter in patients with head injury in the intensive care department (G51) and that Mannitol (5% - 25% solutions) should be available to the military intensivist for the management of raised intracranial pressure (G53). Although consensus was not achieved, 70% of panel intensivists agreed that hypertonic saline has a role in the management of head-injured patients in the intensive care department (G52). The use of hypertonic saline in the pre-hospital care of head injuries was not suggested by any panel members.

Children

The radial pulse is unsuitable for use in children younger than eight years old as an assessment for pre-hospital fluid resuscitation: larger arteries should be used to assess the patient's pulse volume and character (C22). Aide memoires and appropriately sized equipment should be available to medical practitioners at all stages in the treatment of children by the military medical services (H55). There is no reason to use different types of resuscitation fluids in children than in adults (H56).

Burns

In significant burns, fluid resuscitation should begin within one hour of wounding (I57). Consensus was not achieved about which formula was best for use in calculating the fluid requirements of a burns patient although the Parkland formula (crystalloid required in the first 24hrs (mls) = 4 x weight (kg) x % of body surface area burnt) was supported by 77% of the panel.

A burns calculator (body surface area nomogram) should be used to calculate initial fluid requirements when dealing with children with burns (I60). Only 52% of the panel felt that human albumin has a role in the management of adult burns patients.

Discussion

The study rapidly achieved consensus on a range of statements relating to fluid resuscitation practice. Where the study failed to achieve consensus was in respect to choosing a colloid fluid for resuscitation. HSD did emerge as a possibility (68% felt it was the most useful initial fluid, 68% felt it should be available for use in hospital and 50% felt HSD should be the first fluid administered to a trauma patient). Several panel members expressed concern over HSD, specifically the dextran component of the fluid. No panel member suggested using hypertonic saline as an initial resuscitation fluid and only 50% thought that it should be available for use in hospital. This differs from some civilian pre-hospital care groups who have begun to include hypertonic saline in their protocols for head-injury and haemorrhagic shock. Hydroxyethyl starches were most commonly suggested by panel members as suitable colloidal resuscitation fluids but even with these the highest level of agreement reached was only 50%. This reflects a move away from synthetic colloids in recent years. In contrast, crystalloids and blood products achieved >80% consensus. No members of the panel are currently using synthetic oxygen carrying solutions. Other areas that failed to achieve consensus included the specific roles of human albumin in fluid resuscitation and the exact method of calculating fluid requirements in burns patients.

The study has supported the use of hypotensive fluid resuscitation but with some definite caveats: hypotensive resuscitation should not be continued for more than one hour as after this the effect of a systolic blood pressure of only 90 mmHg becomes counter-productive; in addition, hypotensive resuscitation is contra-indicated in head injury, in children and especially if the patient has been exposed to blast. The value of blood products should not be underestimated in trauma and current NHS practice may not reflect military practice (and increasing evidence) that earlier and higher volume use of fresh frozen plasma and adjuncts to transfusion such as recombinant Factor VIIa may well benefit trauma patients. Goal directed therapy is not limited to the intensive care department but should be used at all stages of

A1a. Hypovolaemic Shock: blood loss due to penetrating and blunt trauma especially in uncontrolled haemorrhage (as distinct from controlled or self-limiting haemorrhage where other measures to reduce blood loss may be more important).
A1b. Other presentations of hypovolaemic shock that may require intravenous fluids include gastrointestinal bleeds or gynaecological presentations such as ectopic pregnancy.
A1c. Significant Burns: where transfer time is >1 hour.
A1d. Dehydration: due to diarrhoea, vomiting and/or exertion and heat illness with inadequate oral replacement. Also includes metabolic causes of dehydration such as diabetic ketoacidosis.
A1e. Sepsis: including meningococcal disease and pyelonephritis.
A1f. Anaphylaxis: with systemic angio-oedema and vasodilatation leading to hypotension.
A1g. Poisoning: including self-harm and chemical warfare.
A1h. Spinal Cord injury with neurological shock.
A1i. Maintenance Fluids: for patients who cannot take oral fluids.
B2. Diorylate or commercial equivalent is the oral rehydration fluid of choice.
D3. Crystalloid solutions are the current initial intravenous resuscitation fluid of choice.
D4. Although 0.9% 'normal' saline is recommended by UK-NICE1 on the basis of cost, the panel considers Hartman's Solution (Ringer's lactate) to be preferable due to the reduced potential for hyperchloraemic metabolic acidosis.
D5. Small volume resuscitation will be the next development in fluid resuscitation. Hypertonic saline/dextran is currently the most useful initial fluid.
B6. Oral fluids can be appropriate in trauma in specific situations such as an alert casualty with prolonged transfer time to definitive care and no suspected gastrointestinal tract injury.
C7. Techniques to control blood loss (such as dressings, combat application tourniquets, pelvic and long-bone splints) should be applied before considering intravenous fluid resuscitation.
C8. Hypertonic saline/dextran may become the fluid of choice to be carried by pre-hospital personnel for trauma resuscitation.
D9. The first 250mls of intravenous fluid administered to the trauma patient should be Hypertonic saline/dextran (HSD) due to its immuno-modulatory role.
C10. 0.9% 'normal' saline should be available to medical personnel for use in non-trauma resuscitation in the pre-hospital military environment.
C11. 5% Dextrose should be available to medical personnel for use in non-trauma resuscitation in the pre-hospital military environment.
C12. Hartman's solution (Ringer's lactate) should be available to medical personnel for use in non-trauma resuscitation in the pre-hospital military environment.
B13. Intra-osseous access (limb and sternal) has superseded venous cut-down following failed peripheral cannulation in the pre-hospital environment.
B14. Non-doctor grades of medical practitioners (MAs, CMTs, RMAs) should not be taught how to cannulate the femoral vein.
C15. Intravenous central access is inappropriate in the pre-hospital environment.
B16. When peripheral cannulation has failed then the technique used for intra-circulatory access depends on the competencies of the practitioner.
B17. Obtaining intra-circulatory access should not delay transfer to definitive care.
C18. If only one intravenous fluid is carried by pre-hospital personnel then it should be Hartman's solution (Ringer's lactate).
C19. The fluids recommended for use by pre-hospital personnel can be used in all theatres including Arctic, Temperate and Desert environments and across all Service-specific environments (ships, submarines and aircraft).
C20. Intravenous fluids should be administered at a physiological temperature as close to body temperature as possible. As such fluid warming or cooling devices should be used as indicated by the situation.
C21. An absent radial pulse is the most useful indicator in the supine trauma patient of the requirement for pre-hospital fluid resuscitation.

C22. The radial pulse is unsuitable for use in children younger than eight years old as an assessment for pre-hospital fluid resuscitation.
C23. Respiratory rate, pallor, tachycardia, capillary refill time, estimation of blood loss on scene may all be used to influence the decision to administer fluid resuscitation.
C24. Conscious level is a useful guide to fluid resuscitation in the absence of head injury.
C25. Pulse oximetry is the most useful way of monitoring change in patient's condition while being transferred by helicopter.
C26. Improvement of physiological parameters should be used to determine the adequacy of pre-hospital fluid resuscitation.
C27. Restoration of a radial pulse is a useful target in fluid resuscitation.
F28. Hypotensive resuscitation (as defined by a target systolic blood pressure of 80-90 mmHg) is appropriate only in the first hour following injury. After the first hour then normotensive resuscitation should be used (as defined by a target systolic blood pressure of at least 110 mmHg).
F29. Patients with head injury are not appropriate for hypotensive resuscitation; a minimum target systolic blood pressure of 110 mmHg should be used instead.
F30. Patients with blast injury are not appropriate for hypotensive resuscitation; a minimum target systolic blood pressure of 110 mmHg should be used instead.
F31. The patient should be reassessed following each 250ml volume of intravenous fluid.
C32. Administration of fluids should not delay transfer to definitive medical care.
C33. Avoiding hypothermia is as important as administering intravenous fluids in the military trauma patient in the pre-hospital environment.
C34. In very specific circumstances such as prolonged entrapment and delayed transfer then packed red blood units (type O negative) may be requested, sent forward and administered in the pre-hospital environment.
C35. In the pre-hospital environment blood products should only be administered by medical officers (doctors).
E36. There should be a wider choice of fluids available to the medical practitioner in the Emergency Department than in the pre-hospital environment.
D37. Intravenous fluids available in the military hospital (ship/land) should be.
E38. Time from point of wounding to operating theatre remains the single most important determinant of outcome in uncontrolled haemorrhage in trauma.
F39. Specific goal directed therapy is appropriate in the Emergency Department provided this does not delay transfer to the operating theatre. Examples include a systolic blood pressure of 90mmHg, reduction of tachycardia below 100bpm, urine output and conscious level.
F40. Urine output is a useful target in fluid resuscitation in prolonged care in the Emergency Department.
E41. Cross matched fresh whole blood would be the ideal fluid of choice during catastrophic haemorrhage in the military trauma patient.
E42. Current practice should be packed red blood cells, rewarmed plasma and platelets, administered in volume ratio of 1:1:1 during catastrophic haemorrhage in the military trauma patient.
E43. A 'massive-blood-loss' protocol for administration of blood products in appropriate patients with severe haemorrhage should be developed and validated.
E44. Recombinant Factor VIIa should be administered to patients as part of a 'massive-blood-loss' protocol.
E45. Tranexamic acid is not considered for use in trauma by the panel until the results of the CRASH 2 trial are published.
D46. The fluids available to the military anaesthetist during damage control surgery are no different to those available in the Emergency Department.
D47. Albumin replacement therapy is indicated in some patients. Therefore (human) albumin should be available for use in the Field Hospital.
F48. Aggressive goal-directed therapy reduces mortality in 'shocked' patients in the intensive care department.
F49. Examples of useful measured parameters for goal directed therapy in the intensive care department include central venous pressure, mean arterial pressure, central venous pH and haemoglobin concentration.
F50. Central venous oxygen saturation SvO_2 >70% is a useful goal in fluid resuscitation in the intensive care department.
G51. Intra-cerebral perfusion pressure is a useful parameter in patients with head injury in the intensive care department.
G52. Hypertonic saline has a role in the management of head-injured patients in the intensive care department.
G53. Mannitol (5% - 25% solutions) should be available to the military intensivist for the management of raised intracranial pressure.
D54. There are no differences in the fluids required during the aero-medical transfer of patients than in the field-hospital or ship-hospital environments.
H55. Appropriately sized equipment and aide memoires should be available to medical practitioners at all stages in the treatment of children by the military medical services.
H56. There is no reason to use different types of resuscitation fluids in children than in adults.
I57. In significant burns, fluid resuscitation should begin within one hour of wounding.
I58. The Parkland formula (crystalloid required in the first 24hrs (mls) = 4 x weight (kg) x % of body surface area burnt) is appropriate for the calculation of volume replacement in adult burns patients.
I59. The modified Brooke formula (crystalloid required in the first 24hrs = 2 x weight (kg) x % of body surface area burnt) is appropriate for the calculation of volume replacement in adult burns patients.
I60. A burns calculator (body surface area nomogram) should be used to calculate initial fluid requirements when dealing with children with burns.
I61. (Human) albumin should be available to the military intensivist for the treatment of military burns patients.

Box 1. Delphi Study Statements.

Military Practitioners	
Lieutenant Colonel Ian Greaves	Professor Emergency Medicine
Lieutenant Colonel Jeremy Henning	Consultant Intensivist
Lieutenant Colonel Sam Pambakian	Consultant Anaesthetist
Lieutenant Colonel Scott Frazer	Consultant Anaesthetist
Lieutenant Colonel Pete Davis	Consultant Emergency Medicine
Lieutenant Colonel Richard Cantelo	Consultant Anaesthetist
Lieutenant Colonel Simon Hunter	Consultant Emergency Medicine
Lieutenant Colonel Katherine Hartington	Consultant Emergency Medicine
Lieutenant Colonel Duncan Wilson	Consultant Medicine
Lieutenant Colonel Jon Clasper	Consultant Orthopaedic Surgeon
Lieutenant Colonel Doug Bowley	Consultant General and Trauma Surgeon
Wing Commander Lars Lundberg	Swedish Military Medical Services
Lieutenant Colonel Michael Michelutti	Italian Military Medical Services
Lieutenant Colonel Kurt Grathwohl	United States Army Medical Services
Surgeon Commander Jason Smith	Consultant Emergency Medicine
Major Tom Woolley	Specialist Registrar, Anaesthetics
Major Rhys Thomas	Specialist Registrar, Anaesthetics

Civilian Practioners, Commanders and Researchers	
Professor Keith Porter	Professor of Traumatology
Mr Hugh Montgomery	Consultant Emergency Medicine
Mrs Jackie Hanson	Consultant Emergency Medicine
Surgeon Captain James Campbell	Consultant Surgeon, CO RHH MDHU
Colonel David Morgan-Jones	Chief Instructor DMSTC, General Practitioner
Colonel Jonathan Leach	Deputy Dean, General Practitioner
Major Simon Davies	Trauma Nurse Coordinator
Lieutenant Julian Despres	Nurse, Emergency Medicine
Flight Lieutenant Adam Manson	GP, Tactical Medical Wing
Staff Sergeant Justin Pointon	Paramedic, Medical Regiment Training Wing
Doctor Emrys Kirkman	Defence Services Technical Laboratory
Flight Lieutenant Neal Jacobs	Specialist Registrar, DSTL

Expert Panel Members

resuscitation. The goals selected and the targets used depend upon the environment and the type of monitoring that is appropriate for that environment. Throughout this study and previous similar papers there has been a continued emphasis that the trauma patient should undergo surgery where indicated, as soon as possible.

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