ICM7068 - The Physiology of Shock, Shock Syndromes and Tools of Resuscitation

This module is designed to teach the student how to identify which patients require resuscitation and the tools by which this is achieved.

View Online

A code of practice for the diagnosis and confirmation of death - Academy of Medical Royal Colleges (no date). Available at: http://www.aomrc.org.uk/publications/reports-guidance/code-practice-diagnosis-confirmation-death/.

'A Comparison of Albumin and Saline for Fluid Resuscitation in the Intensive Care Unit' (2004) New England Journal of Medicine, 350(22), pp. 2247–2256. Available at: https://doi.org/10.1056/NEJMoa040232.

'A European One Health Action Plan against Antimicrobial Resistance' (no date). Available at: https://ec.europa.eu/health/sites/health/files/antimicrobial_resistance/docs/amr_2017_action-plan.pdf.

'A Randomized Trial of Protocol-Based Care for Early Septic Shock' (no date) The New England Journal of Medicine, 370, pp. 1683–1693. Available at: https://search.proquest.com/docview/1520423050?pq-origsite=summon.

'Acute upper gastrointestinal bleeding in over 16s: management | Guidance and guidelines | NICE' (no date). Available at: https://www.nice.org.uk/guidance/cg141/chapter/1-guidance.

Alhashemi, J.A., Cecconi, M. and Hofer, C.K. (2011) 'Cardiac output monitoring: an integrative perspective', Critical Care, 15(2). Available at: https://doi.org/10.1186/cc9996.

'American Journal of Physiology-Regulatory, Integrative and Comparative Physiology' (no date). Available at: https://www.physiology.org/doi/full/10.1152/ajpregu.00304.2015.

An Ethical Framework for Controlled Donation after Circulatory Death: Executive Summary - Academy of Medical Royal Colleges (no date). Available at: http://www.aomrc.org.uk/publications/reports-guidance/ethical-framework-controlled-donation-circulatory-death-executive-summary/.

Angus, D.C. et al. (2015) 'A systematic review and meta-analysis of early goal-directed therapy for septic shock: the ARISE, ProCESS and ProMISe Investigators', Intensive Care Medicine, 41(9), pp. 1549–1560. Available at: https://doi.org/10.1007/s00134-015-3822-1.

Angus, D.C. and van der Poll, T. (2013) 'Severe Sepsis and Septic Shock', New England Journal of Medicine, 369(9), pp. 840–851. Available at: https://doi.org/10.1056/NEJMra1208623.

Antonelli, M. and Sandroni, C. (2013) 'Hydroxyethyl Starch for Intravenous Volume Replacement', JAMA, 309(7). Available at: https://doi.org/10.1001/jama.2013.851.

Assessment of Global Incidence and Mortality of Hospital-treated Sepsis. Current Estimates and Limitations | American Journal of Respiratory and Critical Care Medicine (no date). Available at: https://www.atsjournals.org/doi/10.1164/rccm.201504-0781OC.

Association of Anaesthetists of Great Britain and Ireland (no date). Available at: http://www.aagbi.org/.

Aya, H.D. et al. (2016) 'Pharmacodynamic Analysis of a Fluid Challenge', Critical Care Medicine, 44(5), pp. 880–891. Available at: https://doi.org/10.1097/CCM.0000000000001517.

Aya, H.D. et al. (2017) 'Hemodynamic Effect of Different Doses of Fluids for a Fluid Challenge', Critical Care Medicine, 45(2), pp. e161–e168. Available at: https://doi.org/10.1097/CCM.0000000000002067.

Blackstock, M.J. and Ray, D.C. (2014) 'Organ donation after circulatory death', European Journal of Emergency Medicine, 21(5), pp. 324–329. Available at: https://doi.org/10.1097/MEJ.0000000000000082.

Booth, R.A. et al. (2014) 'Performance of BNP and NT-proBNP for diagnosis of heart failure in primary care patients: a systematic review', Heart Failure Reviews, 19(4), pp. 439–451. Available at: https://doi.org/10.1007/s10741-014-9445-8.

Brohi, K., Cohen, M.J. and Davenport, R.A. (2007) 'Acute coagulopathy of trauma: mechanism, identification and effect', Current Opinion in Critical Care, 13(6), pp. 680–685. Available at: https://doi.org/10.1097/MCC.0b013e3282f1e78f.

Burch, V.C., Tarr, G. and Morroni, C. (2008) 'Modified early warning score predicts the need for hospital admission and inhospital mortality', Emergency Medicine Journal, 25(10), pp. 674–678. Available at: https://doi.org/10.1136/emj.2007.057661.

Cannon, J.W. et al. (2017) 'Damage control resuscitation in patients with severe traumatic hemorrhage', Journal of Trauma and Acute Care Surgery, 82(3), pp. 605–617. Available at: https://doi.org/10.1097/TA.0000000000001333.

Cecconi, M. et al. (2015) 'Fluid challenges in intensive care: the FENICE study', Intensive Care Medicine, 41(9), pp. 1529–1537. Available at: https://doi.org/10.1007/s00134-015-3850-x.

Chappell, D. et al. (2014) 'Hypervolemia increases release of atrial natriuretic peptide and shedding of the endothelial glycocalyx', Critical Care, 18(5). Available at: https://doi.org/10.1186/s13054-014-0538-5.

'Circulation' (no date). Available at:

https://www.ahajournals.org/doi/10.1161/CIR.0000000000000509.

Clarke, D.L. et al. (2016) 'Mortality rates increase dramatically below a systolic blood pressure of 105-mm Hg in septic surgical patients', The American Journal of Surgery, 212(5), pp. 941–945. Available at: https://doi.org/10.1016/j.amjsurg.2016.01.042.

Cook, I. et al. (2017) 'End of Life Care and Do Not Resuscitate Orders: How Much Does Age Influence Decision Making? A Systematic Review and Meta-Analysis', Gerontology and Geriatric Medicine, 3. Available at: https://doi.org/10.1177/2333721417713422.

De Backer, D. et al. (2019) 'Challenges in the management of septic shock: a narrative review', Intensive Care Medicine [Preprint]. Available at: https://doi.org/10.1007/s00134-019-05544-x.

Elliott, P. (2006) 'Rational use of inotropes', Anaesthesia & Intensive Care Medicine, 7(9), pp. 326–330. Available at: https://doi.org/10.1053/j.mpaic.2006.06.007.

EMCrit Blog - Emergency Department Critical Care & Resuscitation (no date). Available at: https://emcrit.org/.

Gayet-Ageron, A. et al. (2018) 'Effect of treatment delay on the effectiveness and safety of antifibrinolytics in acute severe haemorrhage: a meta-analysis of individual patient-level data from 40 138 bleeding patients', The Lancet, 391(10116), pp. 125–132. Available at: https://doi.org/10.1016/S0140-6736(17)32455-8.

Glassberg, E. et al. (2013) 'Freeze-Dried Plasma at the Point of Injury', Shock, 40(6), pp. 444–450. Available at: https://doi.org/10.1097/SHK.0000000000000047.

Glassford, N., Eastwood, G. and Bellomo, R. (2014) 'Physiological changes after fluid bolus therapy in sepsis: a systematic review of the contemporary literature', Critical Care, 18(S2). Available at: https://doi.org/10.1186/cc14037.

Gonzalez, E.A. et al. (2007) 'Fresh Frozen Plasma Should be Given Earlier to Patients Requiring Massive Transfusion', The Journal of Trauma: Injury, Infection, and Critical Care, 62(1), pp. 112–119. Available at: https://doi.org/10.1097/01.ta.0000250497.08101.8b.

Gray, A. et al. (2008) 'Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema', New England Journal of Medicine, 359(2), pp. 142–151. Available at: https://doi.org/10.1056/NEJMoa0707992.

Guidelines | British Society for Haematology (no date). Available at: http://www.b-s-h.org.uk/guidelines/.

Guidet, B. and Ait-Oufella, H. (2014) 'Fluid resuscitation should respect the endothelial glycocalyx layer', Critical Care, 18(6). Available at: https://doi.org/10.1186/s13054-014-0707-6.

Guyton, A.C. and Hall, J.E. (2016) Guyton and Hall textbook of medical physiology. Thirteenth edition. Philadelphia, PA: Elsevier. Available at: https://www-vlebooks-com.ezproxy.library.qmul.ac.uk/Vleweb/Product/Index/748473?page=0.

'Haemodynamic Monitoring: ESICM EDIC PACT Study Tool' (no date). Available at: https://www.esicm.org/education/.

Handbook of Transfusion Medicine (no date). Available at: https://www.transfusionguidelines.org/transfusion-handbook.

Helmerhorst, H.J.F. et al. (2015) 'Association Between Arterial Hyperoxia and Outcome in Subsets of Critical Illness', Critical Care Medicine, 43(7), pp. 1508–1519. Available at: https://doi.org/10.1097/CCM.0000000000000998.

Hogshire, L. and Carson, J.L. (2013) 'Red blood cell transfusion', Current Opinion in Hematology, 20(6), pp. 546–551. Available at: https://doi.org/10.1097/MOH.0b013e32836508bd.

Holcomb, J.B. (2011) 'Reconstitution: Reverse Engineering', The Journal of Trauma: Injury, Infection, and Critical Care, 70, pp. S65–S67. Available at: https://doi.org/10.1097/TA.0b013e31821a609c.

Holcomb, J.B. et al. (2015) 'Transfusion of Plasma, Platelets, and Red Blood Cells in a 1:1:1 vs a 1:1:2 Ratio and Mortality in Patients With Severe Trauma', JAMA, 313(5). Available at: https://doi.org/10.1001/jama.2015.12.

Howell, M.D. et al. (2007) 'Occult hypoperfusion and mortality in patients with suspected infection', Intensive Care Medicine, 33(11), pp. 1892–1899. Available at: https://doi.org/10.1007/s00134-007-0680-5.

Hutchings, S.D. et al. (2016) 'Microcirculatory perfusion shows wide inter-individual variation and is important in determining shock reversal during resuscitation in a porcine experimental model of complex traumatic hemorrhagic shock', Intensive Care Medicine Experimental, 4(1). Available at: https://doi.org/10.1186/s40635-016-0088-z.

Jhanji, S., Lee, C., et al. (2009) 'Microvascular flow and tissue oxygenation after major abdominal surgery: association with post-operative complications', Intensive Care Medicine, 35(4), pp. 671–677. Available at: https://doi.org/10.1007/s00134-008-1325-z.

Jhanji, S., Stirling, S., et al. (2009) 'The effect of increasing doses of norepinephrine on tissue oxygenation and microvascular flow in patients with septic shock*', Critical Care Medicine, 37(6), pp. 1961–1966. Available at: https://doi.org/10.1097/CCM.0b013e3181a00a1c.

Jhanji, S. et al. (2010) 'Haemodynamic optimisation improves tissue microvascular flow and oxygenation after major surgery: a randomised controlled trial', Critical Care, 14(4). Available at: https://doi.org/10.1186/cc9220.

Jiwaji, Z. et al. (2014) 'Emergency department management of early sepsis: a national survey of emergency medicine and intensive care consultants', Emergency Medicine Journal, 31(12), pp. 1000–1005. Available at: https://doi.org/10.1136/emermed-2013-202883.

Kilgannon, J.H. (2010) 'Association Between Arterial Hyperoxia Following Resuscitation From Cardiac Arrest and In-Hospital Mortality', JAMA, 303(21). Available at:

https://doi.org/10.1001/jama.2010.707.

Laine, Loren, MD (no date) 'Blood Transfusion for Gastrointestinal Bleeding', The New England Journal of Medicine, 368(8), pp. 75–6. Available at: https://search.proquest.com/docview/1266235512?pq-origsite=summon.

Lee, Y.K. et al. (2016) 'Prognostic Value of Lactate and Central Venous Oxygen Saturation after Early Resuscitation in Sepsis Patients', PLOS ONE, 11(4). Available at: https://doi.org/10.1371/journal.pone.0153305.

Lord, J.M. et al. (2014) 'The systemic immune response to trauma: an overview of pathophysiology and treatment', The Lancet, 384(9952), pp. 1455–1465. Available at: https://doi.org/10.1016/S0140-6736(14)60687-5.

Lucas, C.E. and Ledgerwood, A.M. (2013) 'FFP:RBC Resuscitation Ratio and Post-Shock Fluid Uptake', JAMA Surgery, 148(3). Available at: https://doi.org/10.1001/jamasurg.2013.623.

Maitland, K. et al. (2011a) 'Mortality after Fluid Bolus in African Children with Severe Infection', New England Journal of Medicine, 364(26), pp. 2483–2495. Available at: https://doi.org/10.1056/NEJMoa1101549.

Maitland, K. et al. (2011b) 'Mortality after Fluid Bolus in African Children with Severe Infection', New England Journal of Medicine, 364(26), pp. 2483–2495. Available at: https://doi.org/10.1056/NEJMoa1101549.

Maitland, K. et al. (2013) 'Exploring mechanisms of excess mortality with early fluid resuscitation: insightsfrom the FEAST trial', BMC Medicine, 11(1). Available at: https://doi.org/10.1186/1741-7015-11-68.

'Major trauma: assessment and initial management | Guidance and guidelines | NICE' (no date). Available at: https://www.nice.org.uk/guidance/ng39.

Marik, P.E., Baram, M. and Vahid, B. (2008) 'Does Central Venous Pressure Predict Fluid Responsiveness?*: A Systematic Review of the Literature and the Tale of Seven Mares', Chest, 134(1), pp. 172–178. Available at: https://doi.org/10.1378/chest.07-2331.

Masip, J. et al. (2005) 'Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema', JAMA, 294(24). Available at: https://doi.org/10.1001/jama.294.24.3124.

Mebazaa, A. et al. (2007) 'Levosimendan vs Dobutamine for Patients With Acute Decompensated Heart Failure', JAMA, 297(17). Available at: https://doi.org/10.1001/jama.297.17.1883.

Mellhammar, L. et al. (2016) 'Sepsis Incidence: A Population-Based Study', Open Forum Infectious Diseases, 3(4). Available at: https://doi.org/10.1093/ofid/ofw207.

Monge García, M.I. et al. (2015) 'Effects of fluid administration on arterial load in septic shock patients', Intensive Care Medicine, 41(7), pp. 1247–1255. Available at: https://doi.org/10.1007/s00134-015-3898-7.

Monnet, X. et al. (2006) 'Passive leg raising predicts fluid responsiveness in the critically ill*', Critical Care Medicine, 34(5), pp. 1402–1407. Available at: https://doi.org/10.1097/01.CCM.0000215453.11735.06.

Morelli, A. et al. (2010) 'Levosimendan for resuscitating the microcirculation in patients with septic shock: a randomized controlled study', Critical Care, 14(6). Available at: https://doi.org/10.1186/cc9387.

Morelli, A. et al. (2011) 'Effects of vasopressinergic receptor agonists on sublingual microcirculation in norepinephrine-dependent septic shock', Critical Care, 15(5). Available at: https://doi.org/10.1186/cc10453.

Myburgh, J.A. et al. (2012) 'Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care', New England Journal of Medicine, 367(20), pp. 1901–1911. Available at: https://doi.org/10.1056/NEJMoa1209759.

Myles, P.S. et al. (2017) 'Tranexamic Acid in Patients Undergoing Coronary-Artery Surgery', New England Journal of Medicine, 376(2), pp. 136–148. Available at: https://doi.org/10.1056/NEJMoa1606424.

Napp, L.C., Kühn, C. and Bauersachs, J. (2017a) 'ECMO in cardiac arrest and cardiogenic shock', Herz, 42(1), pp. 27–44. Available at: https://doi.org/10.1007/s00059-016-4523-4.

Napp, L.C., Kühn, C. and Bauersachs, J. (2017b) 'ECMO in cardiac arrest and cardiogenic shock', Herz, 42(1), pp. 27–44. Available at: https://doi.org/10.1007/s00059-016-4523-4.

Nevin, D.G. and Brohi, K. (2017) 'Permissive hypotension for active haemorrhage in trauma', Anaesthesia [Preprint]. Available at: https://doi.org/10.1111/anae.14034.

Nunes, T.S.O. et al. (2014) 'Duration of hemodynamic effects of crystalloids in patients with circulatory shock after initial resuscitation', Annals of Intensive Care, 4(1). Available at: https://doi.org/10.1186/s13613-014-0025-9.

O'Grady, N.P. et al. (2011) 'Guidelines for the prevention of intravascular catheter-related infections', American Journal of Infection Control, 39(4), pp. S1–S34. Available at: https://doi.org/10.1016/j.ajic.2011.01.003.

Ospina-Tascon, G. et al. (2010) 'Effects of fluids on microvascular perfusion in patients with severe sepsis', Intensive Care Medicine, 36(6), pp. 949–955. Available at: https://doi.org/10.1007/s00134-010-1843-3.

Oyeniyi, B.T. et al. (2017) 'Trends in 1029 trauma deaths at a level 1 trauma center: Impact of a bleeding control bundle of care', Injury, 48(1), pp. 5–12. Available at: https://doi.org/10.1016/j.injury.2016.10.037.

Perel, P., Roberts, I. and Ker, K. (2013) 'Colloids versus crystalloids for fluid resuscitation in critically ill patients', Cochrane Database of Systematic Reviews [Preprint]. Available at: https://doi.org/10.1002/14651858.CD000567.pub6.

Physiology of Ageing (no date). Available at: https://www.sciencedirect.com/science/article/abs/pii/S1357303916302298.

Piehl, M.D. et al. (2008) 'Pulse contour cardiac output analysis in a piglet model of severe hemorrhagic shock*', Critical Care Medicine, 36(4), pp. 1189–1195. Available at: https://doi.org/10.1097/CCM.0B013E31816592A3.

Pierrakos, C. et al. (2012a) 'Can changes in arterial pressure be used to detect changes in cardiac index during fluid challenge in patients with septic shock?', Intensive Care Medicine, 38(3), pp. 422–428. Available at: https://doi.org/10.1007/s00134-011-2457-0.

Pierrakos, C. et al. (2012b) 'Can changes in arterial pressure be used to detect changes in cardiac index during fluid challenge in patients with septic shock?', Intensive Care Medicine, 38(3), pp. 422–428. Available at: https://doi.org/10.1007/s00134-011-2457-0.

Pranskunas, A. et al. (2013) 'Microcirculatory blood flow as a tool to select ICU patients eligible for fluid therapy', Intensive Care Medicine, 39(4), pp. 612–619. Available at: https://doi.org/10.1007/s00134-012-2793-8.

Prytherch, D.R. et al. (2010) 'ViEWS—Towards a national early warning score for detecting adult inpatient deterioration', Resuscitation, 81(8), pp. 932–937. Available at: https://doi.org/10.1016/j.resuscitation.2010.04.014.

Reinhart, K. et al. (2017) 'Recognizing Sepsis as a Global Health Priority — A WHO Resolution', New England Journal of Medicine, 377(5), pp. 414–417. Available at: https://doi.org/10.1056/NEJMp1707170.

Reynolds, H.R. and Hochman, J.S. (2008) 'Cardiogenic Shock: Current Concepts and Improving Outcomes', Circulation, 117(5), pp. 686–697. Available at: https://doi.org/10.1161/CIRCULATIONAHA.106.613596.

Rhodes, A. et al. (2017) 'Surviving Sepsis Campaign', Critical Care Medicine, 45(3), pp. 486–552. Available at: https://doi.org/10.1097/CCM.0000000000002255.

Rincon, F. et al. (2014) 'Association Between Hyperoxia and Mortality After Stroke', Critical Care Medicine, 42(2), pp. 387–396. Available at: https://doi.org/10.1097/CCM.0b013e3182a27732.

Rodriguez, R.M. et al. (2006) 'A prospective study on esophageal Doppler hemodynamic assessment in the ED', The American Journal of Emergency Medicine, 24(6), pp. 658–663. Available at: https://doi.org/10.1016/j.ajem.2006.02.006.

Sackner-Bernstein, J.D. et al. (2005) 'Short-term Risk of Death After Treatment With Nesiritide for Decompensated Heart Failure', JAMA, 293(15). Available at: https://doi.org/10.1001/jama.293.15.1900.

Sammy, I. et al. (2016) 'Factors affecting mortality in older trauma patients—A systematic review and meta-analysis', Injury, 47(6), pp. 1170–1183. Available at: https://doi.org/10.1016/j.injury.2016.02.027.

Sampson, Hugh AMuñoz-Furlong, AnneCampbell, Ronna LAdkinson, N FranklinBock, S Allan (no date) 'Second symposium on the definition and management of anaphylaxis: Summary report--Second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium', Journal of Allergy and Clinical Immunology, 117(7), pp.

391–397. Available at: https://search.proquest.com/docview/1504744658?pq-origsite=summon.

Shackelford, S.A. et al. (2017) 'Association of Prehospital Blood Product Transfusion During Medical Evacuation of Combat Casualties in Afghanistan With Acute and 30-Day Survival', JAMA, 318(16). Available at: https://doi.org/10.1001/jama.2017.15097.

Shoemaker, W.C. et al. (1988) 'Prospective Trial of Supranormal Values of Survivors as Therapeutic Goals in High-Risk Surgical Patients', Chest, 94(6), pp. 1176–1186. Available at: https://doi.org/10.1378/chest.94.6.1176.

Sieck, G.C. (2003) 'Physiology of aging', Journal of Applied Physiology, 95(4), pp. 1333–1334. Available at: https://doi.org/10.1152/japplphysiol.00718.2003.

Solomon, Caren GLaine, Loren (no date) 'Upper Gastrointestinal Bleeding Due to a Peptic Ulcer', The New England Journal of Medicine, 374(4), pp. 2367–2376. Available at: https://search.proquest.com/docview/1798243079?pq-origsite=summon.

Spinella, P.C. et al. (2016) 'Whole blood for hemostatic resuscitation of major bleeding', Transfusion, 56, pp. S190–S202. Available at: https://doi.org/10.1111/trf.13491.

Starodub, R. et al. (2013) 'Association of serum lactate and survival outcomes in patients undergoing therapeutic hypothermia after cardiac arrest', Resuscitation, 84(8), pp. 1078–1082. Available at: https://doi.org/10.1016/j.resuscitation.2013.02.001.

Stub, D. et al. (2015) 'Air Versus Oxygen in ST-Segment–Elevation Myocardial Infarction', Circulation, 131(24), pp. 2143–2150. Available at: https://doi.org/10.1161/CIRCULATIONAHA.114.014494.

Tachon, G. et al. (2014) 'Microcirculatory Alterations in Traumatic Hemorrhagic Shock*', Critical Care Medicine, 42(6), pp. 1433–1441. Available at: https://doi.org/10.1097/CCM.0000000000000223.

'Tackling drug-resistant infections globally' (no date). Available at: https://amr-review.org/sites/default/files/160518_Final%20paper_with%20cover.pdf.

'The European Society of GI Endoscopy (ESGE) Guideline on the diagnosis and management of nonvariceal UGI haemorrhage' (no date). Available at: https://www.esge.com/assets/downloads/pdfs/guidelines/2015_s_0034_1393172.pdf.

Thiele, H. et al. (2012) 'Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock', New England Journal of Medicine, 367(14), pp. 1287–1296. Available at: https://doi.org/10.1056/NEJMoa1208410.

Thiele, H. et al. (2017) 'Percutaneous short-term active mechanical support devices in cardiogenic shock: a systematic review and collaborative meta-analysis of randomized trials', European Heart Journal, 38(47), pp. 3523–3531. Available at: https://doi.org/10.1093/eurheartj/ehx363.

Trzeciak, S. et al. (2007) 'Early microcirculatory perfusion derangements in patients with severe sepsis and septic shock: Relationship to hemodynamics, oxygen transport, and

survival', Annals of Emergency Medicine, 49(1), pp. 88-98.e2. Available at: https://doi.org/10.1016/j.annemergmed.2006.08.021.

Tuma, M. et al. (2016) 'Trauma and Endothelial Glycocalyx', SHOCK, 46(4), pp. 352–357. Available at: https://doi.org/10.1097/SHK.0000000000000635.

Vincent, J.L. (2002) 'Anemia and Blood Transfusion in Critically Ill Patients', JAMA, 288(12). Available at: https://doi.org/10.1001/jama.288.12.1499.

'World Population Ageing 2015' (no date). Available at: http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf.

Xu, J. et al. (2013) 'Fluid Resuscitation Guided by Sublingual Partial Pressure of Carbon Dioxide During Hemorrhagic Shock in a Porcine Model', Shock, 39(4), pp. 361–365. Available at: https://doi.org/10.1097/SHK.0b013e31828936aa.

Young, P. et al. (2015a) 'Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit', JAMA, 314(16). Available at: https://doi.org/10.1001/jama.2015.12334.

Young, P. et al. (2015b) 'Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit', JAMA, 314(16). Available at: https://doi.org/10.1001/jama.2015.12334.

Young, P.P., Cotton, B.A. and Goodnough, L.T. (2011) 'Massive Transfusion Protocols for Patients With Substantial Hemorrhage', Transfusion Medicine Reviews, 25(4), pp. 293–303. Available at: https://doi.org/10.1016/j.tmrv.2011.04.002.