

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

[View Online](#)

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

A Code of Practice for the Diagnosis and Confirmation of Death - Academy of Medical Royal Colleges.

<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'. New England Journal of Medicine, vol. 350, no. 22, May 2004, pp. 2247-56, <https://doi.org/10.1056/NEJMoa040232>.

A European One Health Action Plan against Antimicrobial Resistance.

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'. The New England Journal of Medicine, vol. 370, pp. 1683-93, <https://search.proquest.com/docview/1520423050?pq-origsite=summon>.

Acute Upper Gastrointestinal Bleeding in over 16s: Management | Guidance and Guidelines | NICE. <https://www.nice.org.uk/guidance/cg141/chapter/1-guidance>.

Alhashemi, Jamal A., et al. 'Cardiac Output Monitoring: An Integrative Perspective'. Critical Care, vol. 15, no. 2, 2011, <https://doi.org/10.1186/cc9996>.

American Journal of Physiology-Regulatory, Integrative and Comparative Physiology. <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.

<http://www.aomrc.org.uk/publications/reports-guidance/ethical-framework-controlled-donation-circulatory-death-executive-summary/>.

Angus, D. C., et al. 'A Systematic Review and Meta-Analysis of Early Goal-Directed Therapy for Septic Shock: The ARISE, ProCESS and ProMISe Investigators'. Intensive Care Medicine, vol. 41, no. 9, Sept. 2015, pp. 1549-60, <https://doi.org/10.1007/s00134-015-3822-1>.

Angus, Derek C., and Tom van der Poll. 'Severe Sepsis and Septic Shock'. New England Journal of Medicine, vol. 369, no. 9, Aug. 2013, pp. 840-51, <https://doi.org/10.1056/NEJMra1208623>.

Antonelli, Massimo, and Claudio Sandroni. 'Hydroxyethyl Starch for Intravenous Volume Replacement'. JAMA, vol. 309, no. 7, Feb. 2013, <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. <https://www.atsjournals.org/doi/10.1164/rccm.201504-0781OC>.

Association of Anaesthetists of Great Britain and Ireland. <http://www.aagbi.org/>.

Aya, Hollmann D., Andrew Rhodes, et al. 'Hemodynamic Effect of Different Doses of Fluids for a Fluid Challenge'. Critical Care Medicine, vol. 45, no. 2, Feb. 2017, pp. e161-68, <https://doi.org/10.1097/CCM.0000000000002067>.

Aya, Hollmann D., Irina Chis Ster, et al. 'Pharmacodynamic Analysis of a Fluid Challenge'. Critical Care Medicine, vol. 44, no. 5, May 2016, pp. 880-91, <https://doi.org/10.1097/CCM.0000000000001517>.

Blackstock, Murray J., and David C. Ray. 'Organ Donation after Circulatory Death'. European Journal of Emergency Medicine, vol. 21, no. 5, Oct. 2014, pp. 324-29, <https://doi.org/10.1097/MEJ.0000000000000082>.

Booth, Ronald A., et al. 'Performance of BNP and NT-proBNP for Diagnosis of Heart Failure in Primary Care Patients: A Systematic Review'. Heart Failure Reviews, vol. 19, no. 4, Aug. 2014, pp. 439-51, <https://doi.org/10.1007/s10741-014-9445-8>.

Brohi, Karim, et al. 'Acute Coagulopathy of Trauma: Mechanism, Identification and Effect'. Current Opinion in Critical Care, vol. 13, no. 6, Dec. 2007, pp. 680-85, <https://doi.org/10.1097/MCC.0b013e3282f1e78f>.

Burch, V. C., et al. 'Modified Early Warning Score Predicts the Need for Hospital Admission and Inhospital Mortality'. Emergency Medicine Journal, vol. 25, no. 10, Oct. 2008, pp. 674-78, <https://doi.org/10.1136/emj.2007.057661>.

Cannon, Jeremy W., et al. 'Damage Control Resuscitation in Patients with Severe Traumatic Hemorrhage'. Journal of Trauma and Acute Care Surgery, vol. 82, no. 3, Mar. 2017, pp. 605-17, <https://doi.org/10.1097/TA.0000000000001333>.

Cecconi, Maurizio, et al. 'Fluid Challenges in Intensive Care: The FENICE Study'. Intensive Care Medicine, vol. 41, no. 9, Sept. 2015, pp. 1529-37, <https://doi.org/10.1007/s00134-015-3850-x>.

Chappell, Daniel, et al. 'Hypervolemia Increases Release of Atrial Natriuretic Peptide and Shedding of the Endothelial Glycocalyx'. Critical Care, vol. 18, no. 5, Oct. 2014, <https://doi.org/10.1186/s13054-014-0538-5>.

Circulation. <https://www.ahajournals.org/doi/10.1161/CIR.0000000000000509>.

Clarke, Damian L., et al. 'Mortality Rates Increase Dramatically below a Systolic Blood Pressure of 105-Mm Hg in Septic Surgical Patients'. The American Journal of Surgery, vol. 212, no. 5, Nov. 2016, pp. 941-45, <https://doi.org/10.1016/j.amjsurg.2016.01.042>.

Cook, Ifor, et al. '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*, vol. 3, Jan. 2017, <https://doi.org/10.1177/2333721417713422>.

De Backer, Daniel, et al. 'Challenges in the Management of Septic Shock: A Narrative Review'. *Intensive Care Medicine*, Feb. 2019, <https://doi.org/10.1007/s00134-019-05544-x>.

Elliott, Peter. 'Rational Use of Inotropes'. *Anaesthesia & Intensive Care Medicine*, vol. 7, no. 9, Sept. 2006, pp. 326–30, <https://doi.org/10.1053/j.mpaic.2006.06.007>.

EMCrit Blog - Emergency Department Critical Care & Resuscitation. <https://emcrit.org/>.

Gayet-Ageron, Angèle, et al. '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*, vol. 391, no. 10116, Jan. 2018, pp. 125–32, [https://doi.org/10.1016/S0140-6736\(17\)32455-8](https://doi.org/10.1016/S0140-6736(17)32455-8).

Glassberg, Elon, et al. 'Freeze-Dried Plasma at the Point of Injury'. *Shock*, vol. 40, no. 6, Dec. 2013, pp. 444–50, <https://doi.org/10.1097/SHK.0000000000000047>.

Glassford, NJ, et al. 'Physiological Changes after Fluid Bolus Therapy in Sepsis: A Systematic Review of the Contemporary Literature'. *Critical Care*, vol. 18, no. S2, Apr. 2014, <https://doi.org/10.1186/cc14037>.

Gonzalez, Ernest A., et al. 'Fresh Frozen Plasma Should Be Given Earlier to Patients Requiring Massive Transfusion'. *The Journal of Trauma: Injury, Infection, and Critical Care*, vol. 62, no. 1, Jan. 2007, pp. 112–19, <https://doi.org/10.1097/01.ta.0000250497.08101.8b>.

Gray, Alasdair, et al. 'Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema'. *New England Journal of Medicine*, vol. 359, no. 2, July 2008, pp. 142–51, <https://doi.org/10.1056/NEJMoa0707992>.

Guidelines | British Society for Haematology. <http://www.b-s-h.org.uk/guidelines/>.

Guidet, Bertrand, and Hafid Ait-Oufella. 'Fluid Resuscitation Should Respect the Endothelial Glycocalyx Layer'. *Critical Care*, vol. 18, no. 6, Dec. 2014, <https://doi.org/10.1186/s13054-014-0707-6>.

Guyton, Arthur C., and John E. Hall. *Guyton and Hall Textbook of Medical Physiology*. Thirteenth edition, Elsevier, 2016, <https://www-vlebooks-com.ezproxy.library.qmul.ac.uk/Vleweb/Product/Index/748473?page=0>.

Haemodynamic Monitoring: ESICM EDIC PACT Study Tool. <https://www.esicm.org/education/>.

Handbook of Transfusion Medicine. <https://www.transfusionguidelines.org/transfusion-handbook>.

Helmerhorst, Hendrik J. F., et al. 'Association Between Arterial Hyperoxia and Outcome in Subsets of Critical Illness'. *Critical Care Medicine*, vol. 43, no. 7, July 2015, pp. 1508–19, <https://doi.org/10.1097/CCM.0000000000000998>.

Hogshire, Lauren, and Jeffrey L. Carson. 'Red Blood Cell Transfusion'. *Current Opinion in Hematology*, vol. 20, no. 6, Nov. 2013, pp. 546–51, <https://doi.org/10.1097/MOH.0b013e32836508bd>.

Holcomb, John B. 'Reconstitution: Reverse Engineering'. *The Journal of Trauma: Injury, Infection, and Critical Care*, vol. 70, May 2011, pp. S65–67, <https://doi.org/10.1097/TA.0b013e31821a609c>.

---. '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*, vol. 313, no. 5, Feb. 2015, <https://doi.org/10.1001/jama.2015.12>.

Howell, Michael D., et al. 'Occult Hypoperfusion and Mortality in Patients with Suspected Infection'. *Intensive Care Medicine*, vol. 33, no. 11, Oct. 2007, pp. 1892–99, <https://doi.org/10.1007/s00134-007-0680-5>.

Hutchings, Sam D., et al. '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*, vol. 4, no. 1, Dec. 2016, <https://doi.org/10.1186/s40635-016-0088-z>.

Jhanji, Shaman, Amanda Vivian-Smith, et al. 'Haemodynamic Optimisation Improves Tissue Microvascular Flow and Oxygenation after Major Surgery: A Randomised Controlled Trial'. *Critical Care*, vol. 14, no. 4, 2010, <https://doi.org/10.1186/cc9220>.

Jhanji, Shaman, Clement Lee, et al. 'Microvascular Flow and Tissue Oxygenation after Major Abdominal Surgery: Association with Post-Operative Complications'. *Intensive Care Medicine*, vol. 35, no. 4, Apr. 2009, pp. 671–77, <https://doi.org/10.1007/s00134-008-1325-z>.

Jhanji, Shaman, Sarah Stirling, et al. 'The Effect of Increasing Doses of Norepinephrine on Tissue Oxygenation and Microvascular Flow in Patients with Septic Shock*'. *Critical Care Medicine*, vol. 37, no. 6, June 2009, pp. 1961–66, <https://doi.org/10.1097/CCM.0b013e3181a00a1c>.

Jiwaji, Zueb, et al. 'Emergency Department Management of Early Sepsis: A National Survey of Emergency Medicine and Intensive Care Consultants'. *Emergency Medicine Journal*, vol. 31, no. 12, Dec. 2014, pp. 1000–05, <https://doi.org/10.1136/emmermed-2013-202883>.

Kilgannon, J. Hope. 'Association Between Arterial Hyperoxia Following Resuscitation From Cardiac Arrest and In-Hospital Mortality'. *JAMA*, vol. 303, no. 21, June 2010, <https://doi.org/10.1001/jama.2010.707>.

Laine, Loren, MD. 'Blood Transfusion for Gastrointestinal Bleeding'. *The New England Journal of Medicine*, vol. 368, no. 8, pp. 75–76, <https://search.proquest.com/docview/1266235512?pq-origsite=summon>.

Lee, Young Kun, et al. 'Prognostic Value of Lactate and Central Venous Oxygen Saturation after Early Resuscitation in Sepsis Patients'. PLOS ONE, vol. 11, no. 4, Apr. 2016, <https://doi.org/10.1371/journal.pone.0153305>.

Lord, Janet M., et al. 'The Systemic Immune Response to Trauma: An Overview of Pathophysiology and Treatment'. The Lancet, vol. 384, no. 9952, Oct. 2014, pp. 1455-65, [https://doi.org/10.1016/S0140-6736\(14\)60687-5](https://doi.org/10.1016/S0140-6736(14)60687-5).

Lucas, Charles E., and Anna M. Ledgerwood. 'FFP:RBC Resuscitation Ratio and Post-Shock Fluid Uptake'. JAMA Surgery, vol. 148, no. 3, Mar. 2013, <https://doi.org/10.1001/jamasurg.2013.623>.

Maitland, Kathryn, Elizabeth C. George, et al. 'Exploring Mechanisms of Excess Mortality with Early Fluid Resuscitation: Insights from the FEAST Trial'. BMC Medicine, vol. 11, no. 1, Dec. 2013, <https://doi.org/10.1186/1741-7015-11-68>.

Maitland, Kathryn, Sarah Kiguli, et al. 'Mortality after Fluid Bolus in African Children with Severe Infection'. New England Journal of Medicine, vol. 364, no. 26, June 2011, pp. 2483-95, <https://doi.org/10.1056/NEJMoa1101549>.

---. 'Mortality after Fluid Bolus in African Children with Severe Infection'. New England Journal of Medicine, vol. 364, no. 26, June 2011, pp. 2483-95, <https://doi.org/10.1056/NEJMoa1101549>.

Major Trauma: Assessment and Initial Management | Guidance and Guidelines | NICE. <https://www.nice.org.uk/guidance/ng39>.

Marik, Paul E., et al. 'Does Central Venous Pressure Predict Fluid Responsiveness?*: A Systematic Review of the Literature and the Tale of Seven Mares'. Chest, vol. 134, no. 1, July 2008, pp. 172-78, <https://doi.org/10.1378/chest.07-2331>.

Masip, Josep, et al. 'Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema'. JAMA, vol. 294, no. 24, Dec. 2005, <https://doi.org/10.1001/jama.294.24.3124>.

Mebazaa, Alexandre, et al. 'Levosimendan vs Dobutamine for Patients With Acute Decompensated Heart Failure'. JAMA, vol. 297, no. 17, May 2007, <https://doi.org/10.1001/jama.297.17.1883>.

Mellhammar, Lisa, et al. 'Sepsis Incidence: A Population-Based Study'. Open Forum Infectious Diseases, vol. 3, no. 4, Oct. 2016, <https://doi.org/10.1093/ofid/ofw207>.

Monge García, Manuel Ignacio, et al. 'Effects of Fluid Administration on Arterial Load in Septic Shock Patients'. Intensive Care Medicine, vol. 41, no. 7, July 2015, pp. 1247-55, <https://doi.org/10.1007/s00134-015-3898-7>.

Monnet, Xavier, et al. 'Passive Leg Raising Predicts Fluid Responsiveness in the Critically Ill*'. Critical Care Medicine, vol. 34, no. 5, May 2006, pp. 1402-07, <https://doi.org/10.1097/01.CCM.0000215453.11735.06>.

Morelli, Andrea, Abele Donati, Christian Ertmer, Sebastian Rehberg, Tim Kampmeier, et al. 'Effects of Vasopressinergic Receptor Agonists on Sublingual Microcirculation in

Norepinephrine-Dependent Septic Shock'. *Critical Care*, vol. 15, no. 5, 2011, <https://doi.org/10.1186/cc10453>.

Morelli, Andrea, Abele Donati, Christian Ertmer, Sebastian Rehberg, Matthias Lange, et al. 'Levosimendan for Resuscitating the Microcirculation in Patients with Septic Shock: A Randomized Controlled Study'. *Critical Care*, vol. 14, no. 6, 2010, <https://doi.org/10.1186/cc9387>.

Myburgh, John A., et al. 'Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care'. *New England Journal of Medicine*, vol. 367, no. 20, Nov. 2012, pp. 1901-11, <https://doi.org/10.1056/NEJMoa1209759>.

Myles, Paul S., et al. 'Tranexamic Acid in Patients Undergoing Coronary-Artery Surgery'. *New England Journal of Medicine*, vol. 376, no. 2, Jan. 2017, pp. 136-48, <https://doi.org/10.1056/NEJMoa1606424>.

Napp, L. C., et al. 'ECMO in Cardiac Arrest and Cardiogenic Shock'. *Herz*, vol. 42, no. 1, Feb. 2017, pp. 27-44, <https://doi.org/10.1007/s00059-016-4523-4>.

---. 'ECMO in Cardiac Arrest and Cardiogenic Shock'. *Herz*, vol. 42, no. 1, Feb. 2017, pp. 27-44, <https://doi.org/10.1007/s00059-016-4523-4>.

Nevin, D. G., and K. Brohi. 'Permissive Hypotension for Active Haemorrhage in Trauma'. *Anaesthesia*, Sept. 2017, <https://doi.org/10.1111/anae.14034>.

Nunes, Thieme Souza Oliveira, et al. 'Duration of Hemodynamic Effects of Crystalloids in Patients with Circulatory Shock after Initial Resuscitation'. *Annals of Intensive Care*, vol. 4, no. 1, Dec. 2014, <https://doi.org/10.1186/s13613-014-0025-9>.

O'Grady, Naomi P., et al. 'Guidelines for the Prevention of Intravascular Catheter-Related Infections'. *American Journal of Infection Control*, vol. 39, no. 4, May 2011, pp. S1-34, <https://doi.org/10.1016/j.ajic.2011.01.003>.

Ospina-Tascon, Gustavo, et al. 'Effects of Fluids on Microvascular Perfusion in Patients with Severe Sepsis'. *Intensive Care Medicine*, vol. 36, no. 6, June 2010, pp. 949-55, <https://doi.org/10.1007/s00134-010-1843-3>.

Oyeniya, Blessing T., et al. 'Trends in 1029 Trauma Deaths at a Level 1 Trauma Center: Impact of a Bleeding Control Bundle of Care'. *Injury*, vol. 48, no. 1, Jan. 2017, pp. 5-12, <https://doi.org/10.1016/j.injury.2016.10.037>.

Perel, Pablo, et al. 'Colloids versus Crystalloids for Fluid Resuscitation in Critically Ill Patients'. *Cochrane Database of Systematic Reviews*, Feb. 2013, <https://doi.org/10.1002/14651858.CD000567.pub6>.

Physiology of Ageing.
<https://www.sciencedirect.com/science/article/abs/pii/S1357303916302298>.

Piehl, Mark D., et al. 'Pulse Contour Cardiac Output Analysis in a Piglet Model of Severe Hemorrhagic Shock*'. *Critical Care Medicine*, vol. 36, no. 4, Apr. 2008, pp. 1189-95, <https://doi.org/10.1097/CCM.0B013E31816592A3>.

Pierrakos, Charalampos, et al. 'Can Changes in Arterial Pressure Be Used to Detect Changes in Cardiac Index during Fluid Challenge in Patients with Septic Shock?' *Intensive Care Medicine*, vol. 38, no. 3, Mar. 2012, pp. 422–28, <https://doi.org/10.1007/s00134-011-2457-0>.

---. 'Can Changes in Arterial Pressure Be Used to Detect Changes in Cardiac Index during Fluid Challenge in Patients with Septic Shock?' *Intensive Care Medicine*, vol. 38, no. 3, Mar. 2012, pp. 422–28, <https://doi.org/10.1007/s00134-011-2457-0>.

Pranskunas, Andrius, et al. 'Microcirculatory Blood Flow as a Tool to Select ICU Patients Eligible for Fluid Therapy'. *Intensive Care Medicine*, vol. 39, no. 4, Apr. 2013, pp. 612–19, <https://doi.org/10.1007/s00134-012-2793-8>.

Prytherch, David R., et al. 'ViEWS—Towards a National Early Warning Score for Detecting Adult Inpatient Deterioration'. *Resuscitation*, vol. 81, no. 8, Aug. 2010, pp. 932–37, <https://doi.org/10.1016/j.resuscitation.2010.04.014>.

Reinhart, Konrad, et al. 'Recognizing Sepsis as a Global Health Priority — A WHO Resolution'. *New England Journal of Medicine*, vol. 377, no. 5, Aug. 2017, pp. 414–17, <https://doi.org/10.1056/NEJMp1707170>.

Reynolds, H. R., and J. S. Hochman. 'Cardiogenic Shock: Current Concepts and Improving Outcomes'. *Circulation*, vol. 117, no. 5, Feb. 2008, pp. 686–97, <https://doi.org/10.1161/CIRCULATIONAHA.106.613596>.

Rhodes, Andrew, et al. 'Surviving Sepsis Campaign'. *Critical Care Medicine*, vol. 45, no. 3, Mar. 2017, pp. 486–552, <https://doi.org/10.1097/CCM.0000000000002255>.

Rincon, Fred, et al. 'Association Between Hyperoxia and Mortality After Stroke'. *Critical Care Medicine*, vol. 42, no. 2, Feb. 2014, pp. 387–96, <https://doi.org/10.1097/CCM.0b013e3182a27732>.

Rodriguez, Robert M., et al. 'A Prospective Study on Esophageal Doppler Hemodynamic Assessment in the ED'. *The American Journal of Emergency Medicine*, vol. 24, no. 6, Oct. 2006, pp. 658–63, <https://doi.org/10.1016/j.ajem.2006.02.006>.

Sackner-Bernstein, Jonathan D., et al. 'Short-Term Risk of Death After Treatment With Nesiritide for Decompensated Heart Failure'. *JAMA*, vol. 293, no. 15, Apr. 2005, <https://doi.org/10.1001/jama.293.15.1900>.

Sammy, Ian, et al. 'Factors Affecting Mortality in Older Trauma Patients—A Systematic Review and Meta-Analysis'. *Injury*, vol. 47, no. 6, June 2016, pp. 1170–83, <https://doi.org/10.1016/j.injury.2016.02.027>.

Sampson, Hugh A Muñoz-Furlong, Anne Campbell, Ronna L Adkinson, N Franklin Bock, S Allan. '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*, vol. 117, no. 7, pp. 391–97, <https://search.proquest.com/docview/1504744658?pq-origsite=summon>.

Shackelford, Stacy A., et al. 'Association of Prehospital Blood Product Transfusion During

Medical Evacuation of Combat Casualties in Afghanistan With Acute and 30-Day Survival'. JAMA, vol. 318, no. 16, Oct. 2017, <https://doi.org/10.1001/jama.2017.15097>.

Shoemaker, William C., et al. 'Prospective Trial of Supranormal Values of Survivors as Therapeutic Goals in High-Risk Surgical Patients'. Chest, vol. 94, no. 6, Dec. 1988, pp. 1176–86, <https://doi.org/10.1378/chest.94.6.1176>.

Sieck, Gary C. 'Physiology of Aging'. Journal of Applied Physiology, vol. 95, no. 4, Oct. 2003, pp. 1333–34, <https://doi.org/10.1152/jappphysiol.00718.2003>.

Solomon, Caren GLaine, Loren. 'Upper Gastrointestinal Bleeding Due to a Peptic Ulcer'. The New England Journal of Medicine, vol. 374, no. 4, pp. 2367–76, <https://search.proquest.com/docview/1798243079?pq-origsite=summon>.

Spinella, Philip C., et al. 'Whole Blood for Hemostatic Resuscitation of Major Bleeding'. Transfusion, vol. 56, Apr. 2016, pp. S190–202, <https://doi.org/10.1111/trf.13491>.

Starodub, Roksolana, et al. 'Association of Serum Lactate and Survival Outcomes in Patients Undergoing Therapeutic Hypothermia after Cardiac Arrest'. Resuscitation, vol. 84, no. 8, Aug. 2013, pp. 1078–82, <https://doi.org/10.1016/j.resuscitation.2013.02.001>.

Stub, Dion, et al. 'Air Versus Oxygen in ST-Segment–Elevation Myocardial Infarction'. Circulation, vol. 131, no. 24, June 2015, pp. 2143–50, <https://doi.org/10.1161/CIRCULATIONAHA.114.014494>.

Tachon, Guillaume, et al. 'Microcirculatory Alterations in Traumatic Hemorrhagic Shock*'. Critical Care Medicine, vol. 42, no. 6, June 2014, pp. 1433–41, <https://doi.org/10.1097/CCM.0000000000000223>.

Tackling Drug-Resistant Infections Globally.
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.
https://www.esge.com/assets/downloads/pdfs/guidelines/2015_s_0034_1393172.pdf.

Thiele, Holger, Uwe Zeymer, et al. 'Intraaortic Balloon Support for Myocardial Infarction with Cardiogenic Shock'. New England Journal of Medicine, vol. 367, no. 14, Oct. 2012, pp. 1287–96, <https://doi.org/10.1056/NEJMoa1208410>.

Thiele, Holger, Alexander Jobs, et al. 'Percutaneous Short-Term Active Mechanical Support Devices in Cardiogenic Shock: A Systematic Review and Collaborative Meta-Analysis of Randomized Trials'. European Heart Journal, vol. 38, no. 47, Dec. 2017, pp. 3523–31, <https://doi.org/10.1093/eurheartj/ehx363>.

Trzeciak, Stephen, et al. 'Early Microcirculatory Perfusion Derangements in Patients with Severe Sepsis and Septic Shock: Relationship to Hemodynamics, Oxygen Transport, and Survival'. Annals of Emergency Medicine, vol. 49, no. 1, Jan. 2007, pp. 88–98.e2, <https://doi.org/10.1016/j.annemergmed.2006.08.021>.

Tuma, Mazin, et al. 'Trauma and Endothelial Glycocalyx'. SHOCK, vol. 46, no. 4, Oct. 2016,

pp. 352–57, <https://doi.org/10.1097/SHK.0000000000000635>.

Vincent, Jean Louis. 'Anemia and Blood Transfusion in Critically Ill Patients'. JAMA, vol. 288, no. 12, Sept. 2002, <https://doi.org/10.1001/jama.288.12.1499>.

World Population Ageing 2015.

http://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2015_Report.pdf.

Xu, Jiefeng, et al. 'Fluid Resuscitation Guided by Sublingual Partial Pressure of Carbon Dioxide During Hemorrhagic Shock in a Porcine Model'. Shock, vol. 39, no. 4, Apr. 2013, pp. 361–65, <https://doi.org/10.1097/SHK.0b013e31828936aa>.

Young, Pampee P., et al. 'Massive Transfusion Protocols for Patients With Substantial Hemorrhage'. Transfusion Medicine Reviews, vol. 25, no. 4, Oct. 2011, pp. 293–303, <https://doi.org/10.1016/j.tmr.2011.04.002>.

Young, Paul, et al. 'Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit'. JAMA, vol. 314, no. 16, Oct. 2015, <https://doi.org/10.1001/jama.2015.12334>.

---. 'Effect of a Buffered Crystalloid Solution vs Saline on Acute Kidney Injury Among Patients in the Intensive Care Unit'. JAMA, vol. 314, no. 16, Oct. 2015, <https://doi.org/10.1001/jama.2015.12334>.