**Introduction**

According to the World Health Organization (WHO), trauma is one of the leading causes of death worldwide, with road traffic collisions, suicides, and homicides accounting for the majority of injury-related deaths. Since trauma mainly affects young age groups, it has been recognized as a serious social and economic threat, as annually, almost 16,000 posttrauma individuals are expected to lose their lives and many more to end up disabled. The purpose of this research is to summarize current knowledge on factors predicting outcome – specifically mortality risk – in severely injured patients. Development of this review was mainly based on the systematic search of PubMed medical library, Cochrane database, and advanced trauma life support Guiding Manuals. The research was based on publications between 1994 and 2016. Although hypovolemic, obstructive, cardiogenic, and septic shock can all be seen in multi-trauma patients, hemorrhage-induced shock is by far the most common cause of shock. In this review, we summarize current knowledge on factors predicting outcome – more specifically mortality risk – in severely injured patients. The main mortality-predicting factors in trauma patients are those associated with basic human physiology and tissue perfusion status, coagulation adequacy, and resuscitation requirements. On the contrary, advanced age and the presence of comorbidities predispose patients to a poor outcome because of the loss of physiological reserves. Trauma resuscitation teams considering mortality prediction factors can not only guide resuscitation but also identify patients with high mortality risk who were previously considered less severely injured.

**Keywords:** Injury, mortality, predicting factors, trauma

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**Abstract**

Trauma is one of the leading causes of death worldwide, with road traffic collisions, suicides, and homicides accounting for the majority of injury-related deaths. Since trauma mainly affects young and productive age groups, it has been recognized as a serious social and economic threat, as annually, almost 16,000 posttrauma individuals are expected to lose their lives and many more to end up disabled. The purpose of this research is to summarize current knowledge on factors predicting outcome – specifically mortality risk – in severely injured patients. Development of this review was mainly based on the systematic search of PubMed medical library, Cochrane database, and advanced trauma life support Guiding Manuals. The research was based on publications between 1994 and 2016. Although hypovolemic, obstructive, cardiogenic, and septic shock can all be seen in multi-trauma patients, hemorrhage-induced shock is by far the most common cause of shock. In this review, we summarize current knowledge on factors predicting outcome – more specifically mortality risk – in severely injured patients. The main mortality-predicting factors in trauma patients are those associated with basic human physiology and tissue perfusion status, coagulation adequacy, and resuscitation requirements. On the contrary, advanced age and the presence of comorbidities predispose patients to a poor outcome because of the loss of physiological reserves. Trauma resuscitation teams considering mortality prediction factors can not only guide resuscitation but also identify patients with high mortality risk who were previously considered less severely injured.

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may lead a trauma patient to die at the scene of the incident, excessive blood loss that causes hypovolemic shock is of major concern during initial assessment and resuscitation, as it greatly influences the patient’s vital signs, tissue perfusion, body temperature, and the adequacy of clotting. Fortunately, early diagnosis of hemorrhage, along with the development of management guidelines based on massive transfusion protocols, have reduced mortality rates.\(^{[7-9]}\) The objectives of this collective review are to summarize current knowledge on factors predicting outcome – specifically mortality risk – in severely injured patients.

**Methods**

This systematic review utilized a search of PubMed medical library, Cochrane database, and advanced trauma life support (ATLS) Guiding Manuals. “Mortality,” “trauma outcome,” “predicting factors,” “coagulopathy,” “trauma scores,” “trauma and shock,” “vibrinogen and mortality,” “base deficit and lactate,” “vital signs,” “hemorrhagic shock,” “electrolytes in trauma,” “hematocrit and platelets,” “blood transfusions,” “biochemistry in trauma,” “patient factors and mortality,” “age and gender in trauma,” “arterial blood gases,” “guidelines and trauma,” “ATLS,” were all used as key words. The research was based on publications between 1994 and 2016. Summarizing, most (but not all) of the predicting factors describe patient’s status of physiology, coagulation, vital signs, and trauma scores.

**Vital signs**

Conventionally, vital signs assessment has been described as a useful index of the intravascular volume status. Indeed heart rate (HR) is considered to be a sensitive marker of blood loss, in patients not taking bradycardia-inducing medication. Trauma patients are expected to primarily present with tachycardia, and eventually, hypotension as the process of blood loss continues.\(^{[4]}\) A review of 30 studies (19 of which reported on traumatic hemorrhage) assessed the relationship between blood loss and vital signs. No specific relation between a given vital sign and expected amount of blood loss was proved. A HR-specific area under curve (AUC) ranging from 0.56 to 0.74 was actually shown to be the factor with the lowest sensitivity.\(^{[10]}\) The Los Angeles County Trauma System database\(^{[11]}\) presented a retrospective evaluation of 130,906 adult trauma patients, 3727 of whom were hypotensive (systolic blood pressure [BP] <90 mmHg) on admission and almost half of them (44%) had relative bradycardia (HR <90 bpm). Besides, patients with bradycardia had increased mortality risk when compared to tachycardic patients, with low HR to be an independent risk factor for mortality with an odds ratio of 1.60.\(^{[11]}\) Similar studies support that tachycardia is independently associated with hypotension.\(^{[12]}\) Accordingly, injured patients with normal HR (<80 bpm) are expected to have poor prognosis independently of trauma severity, especially when lactate level and base deficit (BD) are increased. The greater mortality odds ratio (4.11) was found when a discrepancy between HR and lactate levels existed.\(^{[13]}\) A retrospective study of 70 trauma patients failed to prove any difference between vital signs and in-hospital survival, with the latter being correlated with lactate levels as a sensitive marker of tissue perfusion.\(^{[14]}\) It has also been postulated that elevated lactate levels and BD, when combined with normal BP in blunt trauma patients, predict a poor outcome suggesting that tissue blood flow and occult hypoperfusion is far more important than systolic BP per se.\(^{[15]}\) Moreover, low baseline (preinjury) BP seems to have a negative impact on elderly trauma patient’s survival resulting in a 3-fold increase in mortality.\(^{[16]}\)

The relative lack of sensitivity of vital signs to predict outcome can be explained under basic physiology principles. Delivery of oxygen to tissues depends on cardiac output (CO), hemoglobin levels, and oxygen saturation. BP is the product of CO multiplied by Systemic Vascular Resistance (SVR) and given by the equation BP = CO × SVR. BP can be maintained at the expense of elevated SVR when CO and consequently tissue oxygen delivery are critically low.\(^{[4]}\) The shock index (SI) (HR divided by systolic BP – HR/BP) or the modified SI (MSI) (HR divided by mean artery pressure – HR/MAP) are by far the most sensitive markers of hypoperfusion and strong predictors of outcome. The results from several studies indicate that patients with SI >0.9–1 are more likely to die within 28 days after trauma or need massive transfusions to keep an adequate perfusion pressure.\(^{[17-19]}\) SI can be safely used for the identification of patients who will require massive transfusion or exploratory laparotomy or suffer complications and increased mortality. Admission in level I trauma facilities is therefore advised for trauma patients with SI >1.\(^{[20]}\) Kristensen et al.\(^{[21]}\) reported on the association between mortality and SI in 111,019 patients of their cohort study. They found a positive correlation between SI >1 and 30-day mortality, although age, preexisting hypertension, and calcium or b-blockers intake, were found to modify that relationship.\(^{[21]}\) The results of a recent large prospective study of 9860 adult trauma patients showed that an MSI higher than 1.3 or lower than 0.7 strongly predicted increased mortality and hospital stay. SI had lower mortality predicting value than MSI, implying that mean and not systolic BP ensures tissue perfusion.\(^{[22]}\)

Hypothermia (namely, body core temperature below 35°C [95°F]) is a well-known predictor of poor outcome in trauma patients. As part of the so called “lethal triad” along with acidosis and coagulopathy, may potentially exert harmful effects on the patient’s physiological response to trauma, leading even to death.\(^{[4]}\) Hypothermia is considered to be rather an epiphenomenon during physiological alterations induced by severe trauma and as such, often eludes clinical attention. The incidence of hypothermia among trauma patients may be found as high as 65%.\(^{[23]}\) Severe injury can indeed make trauma patients almost 6 times more susceptible to heat loss, increasing thus the risk of hypothermia.\(^{[24]}\) On the other hand, low environmental temperature, resuscitation using cold fluids, and the anesthesia per se are all predisposing factors for the development of hypothermia. The detrimental physiologic effects of hypothermia on organic function

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are well known and include arrhythmogenesis, depression of cardiac muscular activity, impairment of platelet (PLT) function, fibrinogen and other clotting factors depletion, decrease in liver drug metabolism and up to 50% decrease in glomerular filtration rate. Central nervous system function is also influenced by core temperature, making neurologic assessment of hypothermic trauma patients, unreliable.\textsuperscript{[23]} In a retrospective study of 701491 trauma patients with recorded temperature on admission, Martin \textit{et al.}\textsuperscript{[26]} reported a 1.57% incidence of hypothermia (core temperature below 35°C) with hypothermic patients to exhibit significantly increase in mortality risk (25.5\% vs. 3.0\% in normothermic patients). Hypothermia not only proved to be an independent risk factor for increased mortality but also had a negative impact in ICU and ventilator days.\textsuperscript{[26]} Interestingly, the harmful side effects of hypothermia seem to persist longer that hypothermia itself. Balvers \textit{et al.}\textsuperscript{[27]} concluded that the presence of hypothermia during ICU admission in a level I trauma center is associated with increased 1-day, as well as 1-month, mortality risk (odds ratio 2.72 and 2.82, respectively).\textsuperscript{[27]}

Despite the previous wide use of mild hypothermia (32°C–35°C) for its “neuroprotective” effects in TBI patients, recent human studies not only failed to demonstrate any advantage of hypothermia but also proved an association between low body core temperature and increased risk of death, both in TBI and non-TBI patients.\textsuperscript{[28]} Indeed, in a large multi-center randomized trial (Eurotherm 3235 trial), worse neurologic outcome, increased complication rates, and higher mortality risk were observed in TBI patients who were offered therapeutic hypothermia.\textsuperscript{[29]} Consequently, hypothermia should no longer included in modern guidelines for the management of severe TBI.\textsuperscript{[30]}

**Lactate levels and base deficit**

By definition, hemorrhage-induced hypovolemic shock is closely related either to tissue hypoxia because of a decrease in levels of saturated hemoglobin or to tissue hypoperfusion due to elimination of CO. Cellular metabolism shifts toward anaerobic pathways to maintain homeostasis with lactate acid being its major byproduct. BD represents a numerical value that can be modified by oxygen tension into the blood stream, minute ventilation, administration of medications, and resuscitation with fluids and blood products. Since arterial lactate acid level is closely related to tissue perfusion, it represents a valuable marker of the outcome in severe trauma patients.\textsuperscript{[4]}

Gale \textit{et al.}\textsuperscript{[31]} reported on 1829 blunt trauma patients with elevated lactate on admission, in a large multi-centre prospective cohort study. Both, lactate levels and BD were higher in nonsurvivors. A 1 mmol/L increase in lactate levels was related to a 17% increase in mortality risk, while a 1 meq/L increase in BD caused the mortality risk to increase up to approximately 4%. After adjustment for Injury Severity Scores (ISSs), GCS, age and vital signs, Odom \textit{et al.}\textsuperscript{[32]} in a large retrospective trial of 4472 trauma patients at a level I trauma center found a proportional relationship between lactate blood levels and mortality risk. Trauma patients with normal lactate levels (that is below 2.5 mmol/L) had an odds ratio of 1 for mortality risk, whereas patients with moderately elevated (2.5–3.9 mmol/L) and high (>4 mmol/L) lactate levels had an odds ratio of 1.5 and 3.8, respectively, for death probability. After analyzing the subgroup of trauma patients with high lactate levels and profound shock, the authors concluded that lactate clearance during the first 6 h greatly predicts mortality.\textsuperscript{[33]} That means that failure to reverse tissue hypoxia and consequent cellular derangement during the first 6 h following severe trauma is an indisputable marker of poor outcome. Interestingly, normotensive patients with elevated lactate blood levels are at high risk of dying because of their injury, thus questioning the true value of “normal” vital signs.\textsuperscript{[32]} In 2014, Heinonen \textit{et al.} conducted a retrospective study of 615 patients, 493 of which had complete lactate data. The survival rate of the patients with lactate values <2.5 mmol/L was 88%. Of the patients with high lactate levels that cleared within 24 and 48 h the survival rate were 81% and 71\%, respectively. The survival rate among patients not achieving a normal lactate within 48 h was 46\% but was higher in those with penetrating as opposed to blunt injury (67\% versus 38\%). The overall survival was 81\%. The authors concluded that prolonged lactate clearance predicts increased mortality in severely injured trauma patients.\textsuperscript{[33]} Lactate clearance has been proposed as a guide to resuscitation protocols in several studies.\textsuperscript{[34–36]}

Furthermore, inotropic agents may play a role in increasing the lactate levels. Aerobic glucose metabolism to lactate may be a preferred way to rapidly produce significant energy amounts. Therefore, stimulating increased aerobic glucose metabolism has been shown to increase lactate levels in the absence of tissue hypoxia. Most notably, the administration of epinephrine has long been shown to result in a dose-dependent increase in lactate levels.\textsuperscript{[37]}

There are conflicting reports about the effect of alcohol intoxication on lactate levels measurement and interpretation. It is well known that in patients abusing alcohol, found in almost one third of trauma cases, may cause metabolic acidosis.\textsuperscript{[38,39]} According to a large retrospective study by Gustafson \textit{et al.},\textsuperscript{[40]} excessive ethanol consumption is related to lower mortality in patients with elevated lactate blood levels and lactic acidosis, presumably because of the ethanol-induced increase in lactate blood levels that produces false-positive laboratory results. The authors suggest a readjustment of low lactate threshold values used for the diagnosis of lactic acidosis in alcohol abused trauma patients.\textsuperscript{[40]}

**Coagulopathy**

Clotting deficiency exerts a profound effect on trauma patient’s outcome.\textsuperscript{[4]} Coagulopathy is erroneously equated with hypocoagulopathy and bleeding diathesis which is partially true. Mechanisms of hemostasis are built on a sensitive balance between coagulation (hypocoagulation vs. hypercoagulation) and fibrinolysis (hyperfibrinolysis vs. early shutdown), which
can be dissociated by trauma-induced metabolic effects. Trauma-induced coagulopathy (TIC) is a well-known mortality predicting factor.\[41,42\]

In their study of over 20,000 injured patients from a trauma cohort registry, MacLeod et al.\[43\] reported a substantial prevalence of coagulopathy, with 28% of trauma patients having abnormal prothrombin time (PT >14 s) and 8% abnormal partial thromboplastin time (APTT >34 s) before transfusion or fluid resuscitation. After adjustment for other risk factors as age, ISS, BP, hematocrit, and BD, patients with an abnormal PT had 35%, while those with elevated APTT, 326% increased risk of death.\[43\] On the other hand, in a study of 65 posttrauma ICU patients, Schreiber et al.\[44\] found, using thrombelastograph analysis (TEG), that 62% of patients exhibited hypercoagulation by the 1\textsuperscript{st} day of ICU admission, although clotting times and PLT count were within normal range. Similarly, subclinical deep vein thrombosis was detected in 58% of asymptomatic trauma patients through contrast venography.\[45\]

Polymerization of fibrinogen into fibrin, along with PLT adhesion constitutes the final step for clot formation. Following bleeding control, and during fibrinolysis, a plasmin-mediated degradation of fibrin, secures vascular patency and prevents uncontrolled diffuse intravascular coagulation. Trauma interferes in both, formation and degradation of fibrinogen, causing major imbalance of clotting mechanism.\[41\] According to European guidelines on the management of major bleeding and coagulopathy following trauma, fibrinogen levels should always be assessed. The presence of fibrinogen levels below 1.5–2 g/L justifies administration of supplemental fibrinogen,\[46\] as low fibrinogen levels on admission, associated with hypotension (<90 mmHg) and increased lactate blood levels on hospital arrival, cause mortality risk to increase both at 24 h and 28 days.\[46\] Severe trauma patients may present with hyperfibrinolysis in up to 11%, are usually hypotensive during admission, have prolonged PT and APTT, are candidates for massive transfusion (odds ratio [OR], 19.1), and more prone to die during hospital stay (OR: 55.5).\[47\]

The CRASH-2 study, reported on more than 20,000 trauma patients and assessed the effect of administration of tranexamic acid (TXA) on the risk of bleeding, as well as the probability of hemorrhage-induced mortality.\[48\] Early administration of TXA resulted in significant reduction in bleeding risk, especially when applied within the 1\textsuperscript{st} h after injury. Importantly, the authors found that administration of TXA three or more hours following trauma, did not reduce the mortality risk, but instead, led to increase in probability of death.\[48\] Failure of TXA administration to reduce mortality in trauma patients presented with coagulopathy-related hemorrhage has also been reported in several recent studies.\[49,50\] Understanding the spectra of TIC, Moore et al.\[51\] categorized 2540 trauma patients according to fibrinolysis phenotype on TEG. Fibrinolysis shut down (inhibited fibrinolysis and inadequate fibrin degradation) was the most common phenotype (46%) followed by physiologic fibrinolysis (36%) and hyperfibrinolysis (18%). Hyperfibrinolysis was the phenotype with the higher mortality risk (OR: 3.3) versus fibrinolysis shut down (OR: 1.6).\[51\] Viscoelastometric assays (Thromboelastography and Rotational Thromboelastography), may prove useful in diagnosing specific derangements of coagulation in trauma patients, guide blood transfusion and predict mortality.\[52\]

PLT aggregation plays a critical role in coagulation cascade and the formation of clot. Keeping PLT count above 100,000/\textmu L in trauma patients presenting with ongoing bleeding or TBI and above 50,000/\textmu L in those without hemorrhage helps to reduce blood loss and improve survival.\[53\] It has been proved that a 50,000/\textmu L increase in PLT absolute number results in approximately 12% drop in hemorrhage-related death risk, whereas the need for red blood cells (RBCs) transfusion lowers by 0.7 units at the same time.\[53\] On the other hand, trauma patients presented with PLT counts of more than 300,000/\textmu L had 24-h mortality risk of 14%, compared with those with PLT counts of <100,000/\textmu L, who carried a 24-h death risk of 33%.\[53\] According to Definitive Surgical Trauma Care Guidelines, PLT levels must be kept 50K for bleeding patients and 20K for those not actively bleeding patients.\[54\] Efforts should thus be made to keep PLT counts as higher as indicated for the higher the PTL count the better the survival.\[53,55\]

**Blood transfusion**

Indisputably, blood transfusion can be proved a lifesaving procedure in severely bleeding trauma patients, although carrying several life-threatening complications, such as transfusion-related acute lung injury and transfusion-related immunomodulation, which may in turn increase morbidity and mortality.\[56-58\] Indeed, it has been shown that blood transfusion within the first 24 h following admission is correlated with a 6-fold increase in systemic inflammatory response syndrome (SIRS), making thus blood transfusion an independent predictor for either ICU admission (OR: 4.62) or mortality (OR: 4.23).\[59\] Blood transfusion was also proved to be a strong dose-dependent risk factor for the development of postinjury MOF.\[60\] It has also been recognized as a strong predictor of the length of hospitalization and mortality, with the latter increased by 16% for each unit of transfused RBC.\[61\]

After Perel et al.\[62\] classified trauma patients according to their mortality risk based on Glasgow Coma Scale (GCS), age, HR, systolic BP, time since injury, and type of injury, they found that blood transfusion increased the risk of death in low-risk patients (<20% mortality risk), while carried significant benefits in high risk patients, that is, those who had mortality risk above 50%.\[62\]

**Age, gender, and comorbidities**

Excluding patients who die at the trauma scene or soon after admission from severe TBI or heavy bleeding, development of cardiovascular and respiratory complications, along with sepsis, ARDS, and MOF is strongly related to in-hospital mortality.\[47,63,64\] As respiratory and cardiovascular impairment inevitably follows aging, trauma patients older than 65 years of
age exhibit a 5-fold increase in mortality risk even following minor trauma (ISS <16). Two recent meta-analyses on mortality in geriatric trauma patients concluded that age, along with the presence of comorbidities and other injury-related factors, is one of the strongest predictors of mortality. Indeed, trauma patients older than 75 years of age had 50%–67% higher possibility of dying compared to younger ones.

Morbidly obese patients with body mass index exceeding 35–40 kg/m² are known to be more susceptible to cardiovascular and respiratory comorbidities. Obesity and morbid obesity have been found to be independent risk factors for longer hospitalization and increased mortality in trauma patients. Moreover, physical status per se seems to greatly predict inpatient morbidity and in-hospital mortality in severe trauma patients, as mortality odds ratio significantly differs between ASA II and ASA I patients.

As shown in a recent meta-analysis by Liu et al., males are more prone to posttrauma complications, have longer hospital stay and exhibit higher mortality rates than females. Female trauma patients are also at lower risk for sepsis and MOF, according to a recent analysis on a large number of injured patients registered in Trauma Register DGU.

**Scores and scales**

As brain injury is the leading cause of death in trauma patients, assessment of severity and potential neurologic outcome is of utmost importance. The GCS has been designed to globally evaluate the individual's neurologic status by assessing motor, verbal, and eyes responses. Although a low-GCS score on admission does not necessarily predict poor neurological outcome, GCS assessment 15 days after injury is a strong predictor of outcome and mortality risk. Indeed, several studies showed that a low initial GCS (3/15) is related to an almost 50% survival rates and a 13.2% good neurological outcome. Pupil size and response proved to be stronger predicting factors of mortality than motor response, since almost 80% of patients with bilaterally fixed dilated pupils, eventually died.

Currently, there are multiple trauma scoring systems, aiming at the classification of injuries according to their severity and the health status of the injured patients. Scoring systems such as Revised Trauma Score, Acute Physiology and Chronic Health Evaluation score, Sequential Organ Failure Assessment, and SIRS score, are all used to assess homeostasis, physiology, and organ function in trauma patients, whereas scoring systems such as ISS, new ISS, and ICD-based ISS are targeting mainly at the severity of the injury itself. Currently, there are numerous studies comparing scoring systems. Yet, their clinical application in everyday practice has been questioned, as more data are needed to be published to extract powerful and safe results.

SIRS criteria (temperature >38°C or <36°C, HR >90 bpm, respiratory rate >20 breaths per minute, and number of neutrophils >12,000/ml or <4000 ml) are usually used to assess critical illness. Combining SIRS criteria with other trauma severity markers allows for more accurate prognosis, regarding both morbidity and mortality in trauma patients. As shown in a large series of trauma patients, Physiologic Trauma Score that combines the assessment of SIRS, evaluation of GCS and patient’s age, is easy to calculate, superior to ISS, and efficient to predict mortality with an AUC of 0.95.

**Other markers**

Calcium is a key element for coagulation cascade and vessel contraction process, and as such, is expected to have significant impact on resuscitation and outcome in injured patients. Magnotti et al. showed that the presence of low (<1 mmol/L) ionized calcium levels on admission cause mortality rates to double (from 8.7% up to 15.5%). These results were confirmed by other studies, that showed that ionized calcium levels are also associated with hypotension, as well as, severe calcium depletion is closely related to an up to 30% increase in mortality rates.

Acute gastrointestinal injury is considered the gastrointestinal onset of MOF due to critical illness independently of cause. Indeed, in severely ill patients, blood circulation shifts away from the gut, thus preserving functional integrity of the heart, kidneys, and brain. Ischemia follows allowing MOF process to commence. Consequently, even in the absence of overt pancreatic or bowel trauma, serum amylase levels may be found elevated in trauma patients with massive bleeding. Hyperamylasemia (serum amylase levels above 250 U/L) has been shown to associate with higher risk of developing MOFS and increased mortality rates. Amylase-induced autodigestion process seems to be one of the main predisposing factors for increase mortality in hypovolemic trauma patients presenting with hyperamylasemia.

Accordingly, serum S 100B protein, which is a brain-specific protein, has been found to correlate with inflammation processes and tissue hypoperfusion, even in non-TBI patients. Elevated serum S 100B protein levels serve as a marker of poor survival. Peripheral tissue oxygenation monitoring is a novel method for the early detection of tissue hypoperfusion and identify the patients who are susceptible to develop MOF.

Finally, trauma is well known to cause metabolic and hormonal alterations. Growth hormone and glucagon-like peptide 2 levels were found to be higher in nonsurviving trauma patients in a small observational study.

**Conclusions**

Most of the studies assessing mortality predicting factors in severely injured patients were retrospective or observational, and as such, they produced low levels of evidence. Although most contributing factors were excluded during regression and multivariate analysis of mortality risk, the risk of bias was still present, emphasizing thus the need for randomized trials. Currently, the main mortality-predicting factors in trauma
patients are those associated with basic human physiology and tissue perfusion status (lactate levels, temperature), coagulation adequacy (clot formation and fibrinolysis), and resuscitation requirements (massive transfusions). On the other hand, advanced age and the presence of comorbidities predispose patients to a poor outcome because of the loss of physiological reserves. The clinician should pay great attention in identifying those factors, so to accordingly apply resuscitation and final treatment.

Compliance with Ethical Standards
“The authors (Emmanuel Lilitsis, Sofia Xenaki, Elias Athanasakis, Eleftherios Papadakis, Pavlina Syriogianni, George Chalkiadakis, Emmanuel Chrysos) declare that they have no competing interests.”

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