

Multidisciplinary Collaboration In Emergency Medical Services

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Abstract

Healthcare is the delivery of care and service to the patient; therefore, it is important to relate this care delivery and/or service to patient outcomes. Outcomes can be seen from two perspectives: positive, in which the service/care provided resulted in improvement to the patient's well-being, and negative, in which the service/care provided did not meet the patient's needs and requirements, resulting in no improvement or a deterioration in the patient's well-being. The latter is often referred to as an adverse event, and its impact can be both short-term (through exacerbation of a condition or further injury) and long-term (in which the patient's confidence and trust in the healthcare system have been affected). High-quality patient care is our goal, and an improvement in patient outcomes is what we aim to achieve. The very model of EMS in the UK is multi-disciplinary, consisting of different professions in primary and secondary care. A profession can be defined as a vocation founded on specialized educational training. The purpose of the profession is to apply the training and knowledge to an area of need, and it has a code of ethics for its members. The current modernization of the NHS, with changes in the role of primary care, has blurred the boundaries of professional practice. Some professions in EMS are autonomous in nature, with direct access to patients and their diagnosis and treatment. An example of this would be a paramedic. Others may have a dependent role with indirect patient contact. An example of this would be a veterinary nurse working in the helo-vet service. Each profession has its own professional identity and values, and there is potential scope for adverse outcomes if conflict with patient management and/or need occurs between professions. With today's focus on inter-professional care between professions and patient healthcare having a direct relationship to professional practice, now is the time to examine multi-disciplinary interventions between professions in EMS and their impact on patient care and outcomes.

Emergency medical services (EMS) are an essential part of any healthcare system. Efficient and timely patient care is paramount at the scene of a medical or trauma incident, and in many cases, the quality of patient outcomes depends on the speed and efficiency with which care is delivered. This paper will focus on the different elements and complex relationships that occur between the primary services

(ambulance, helo-vet, and first response) and the potential impact that these can have on the overall patient care and outcome. By the very nature of their jobs, healthcare is a collaboration between professionals from a wide variety of disciplines, each of whom brings a different body of knowledge and perspective to the care of the patient. The complexity of healthcare needs often surpasses the skills of one profession; patient needs can be wide-ranging and diverse. EMS is a unique healthcare system in that it provides immediate care to a patient and then an avenue in which to further transport and access further care. Often in the hospital setting, there is a multi-disciplinary approach to care; however, in many cases, in the pre-hospital setting, this can be disjointed and occur between different service plans and the handover of patient care. This paper will conclude by considering the potential impact of changes to multi-disciplinary clinical governance and the potential for standardizing educational outcomes between professions to improve overall patient care and experience in the pre-hospital setting.

Keywords: *The purpose of the profession is to apply the training and knowledge to an area of need, and it has a code of ethics for its members.*

I. Introduction

In the absence of evidence showing the superiority of any one strategy, it is recognised that there are a variety of tools and resources available to enhance the quality of pre-hospital emergency care. These include the administration of specific treatments and drugs to patients and the adoption of systems-based approaches (such as implementing a care pathway) to improve patient outcomes. In view of this, the paper will discuss the role of a specific treatment provided by paramedics in the clinical setting, in this case high-flow oxygen therapy for suspected acute myocardial infarction. Using this as a platform, the discussion will provide clinical evidence and apply medical knowledge to assist and educate paramedics in making decisions about the implementation of this treatment to ultimately improve patient care. High-flow oxygen therapy is a simple yet crucial intervention provided by paramedics in a variety of conditions and is still considered the default therapy for breathlessness or suspected myocardial ischaemia. Such treatments, which are more or less nurse-led and a relatively independent action by the paramedic, are an area in which protocols are often developed with the contribution of other medical professionals. This leads to a greater need for understanding the treatment in terms of indication, possible adverse effects, monitoring, and when to cease the intervention. (Tibullo et al.2020)

The introduction presents collaborative practices and the multidisciplinary approach as they pertain to the provision of optimal patient care through the examination of emergency medical services (EMS). EMS systems function as elements within the wider framework of healthcare delivery and are designed to provide heart attack victims with rapid and definitive treatment to stem heart muscle damage, restore normal heart rhythm, and improve their chances of survival. The effectiveness of emergency cardiac care is directly related to the prompt recognition of symptoms and activation of the medical system to facilitate early entry into the healthcare system and, in turn, early reperfusion therapy. These interventions must take place in a pre-hospital environment provided by EMS personnel. It is suggested that coordinated systems of care incorporating the spectrum of services from community education to advanced treatment by a variety of healthcare providers will be most effective in reducing the morbidity and mortality associated with acute coronary syndromes.



1.1. Importance of Collaboration in Emergency Medical Services

Basically, all services have a main purpose for the customer. The success of performing the operation or providing a particular service can be measured by the result. This also applies to providing medical service in emergency incidents. Potential causes of an incident in all medical emergency cases, such as disease, deadly injury, childbearing, and risky behavior, have been serious considerations and complicated problems in the effort to prevent and decrease the problems, morbidity, and mortality. These conditions have been referred to as medical, treatment, and behavior-conducive efforts to decrease the problems, which are categorized as services for people who have the problems. The success of the entire effort can be seen in the positive impact on the customer, who is free from the problem and in optimum condition. In the end, it all comes down to the healing process. However, not all medical emergency cases can achieve optimum healing. To achieve the goal of the healing process, a particular medical service is needed. The success of the service can be measured by achieving the best condition for the patient themselves. (Filip et al.2022)

Mutual discussions and work between personnel from different disciplines are very important. This is due to having more information and ideas, which can provide a clear view and improve any service. The collaboration must be supported by any side to provide information and its usage in the field. Each person in a discipline has a main duty and tasks, but it can be negotiated with the duties and tasks of other

disciplines to work at the same time and place. A similar perception between the same place and time can avoid collisions and hasten appraisals when providing a particular service.

1.2. Overview of Multidisciplinary Approach

So we can see that today's engineers must use a multidisciplinary approach for technical problem-solving because it provides a more extensive and insightful analysis of complex problems.

In today's scenario, where technology is changing continuously, we don't know what is going to be the future of one system. In this case, the multidisciplinary approach can be the best solution because it avoids putting constraints on one system. If, for example, a technology is developed for improving the healthcare system of society and a mathematical model is to be made, different academic disciplines can provide different constraints in terms of changes in technology and the method of taking care of patients. By integrating all constraints, a single system can be developed to simulate the world's healthcare system, and then this system can be adapted to the technology and methods defined in the constraints.

This approach leads to getting a multifaceted alternative to resolve an issue, and then these alternatives can be compared with each other in terms of effectiveness, efficiency, and economic feasibility. This helps to choose the best alternative. Now, if we look at complex socio-technical systems at the macro level, they are being run by the integration of a number of subsystems. Subsystems are somewhat independent systems. All the methods and transitions of such methods that have an effect on such systems can be simulated by integrating different mathematical methods from various academic disciplines to get a clearer idea about the effects of one system on the other. This helps to find the best solution that has the fewest negative effects and the best positive results.

A multidisciplinary approach is an approach that is used to solve problems in a way that constraints, if any, are tackled by integrating knowledge from multiple academic disciplines. The multidisciplinary approach points to

integrated technical solutions to solve problems and also provides better alternatives that are economical. This approach is really helpful in tackling complex socio-technical problems. If an issue has to be solved that is directly or indirectly related to human beings, then this approach can serve as the best option because it allows wider investigations of such factors as those from the medical, natural, and social sciences, as well as the humanities.

2. Role of Paramedics in Trauma Case Management

The paramedics provide patients with first-hand medical facilities prior to reaching a hospital. Trauma victims are treated immediately to stabilize their condition. How dependent the patient is on pre-hospital care and his condition post-treatment has always been a matter of ambiguity. However, the recent concept stems from the notion that early treatment of trauma victims will save more lives. Pre-hospital care has revolutionized many factors in trauma care, such as improving transportation techniques and providing the earliest and most appropriate treatment at the site of injury. Transportation of the patient is a vital component in the system of care, providing initial injury assessment and triage at the scene, followed by transfer to the most appropriate facility. Often, the severity of the patient's trauma may not be properly evaluated, leading to an overestimation of a trauma victim's condition and full activation for trauma teams at the receiving hospital. This can lead to the superfluous use of hospital resources. If an accurate evaluation of the patient's condition is done the first time around, it would certainly benefit the patient in terms of better resource allocation and appropriate treatment. Triage of a trauma victim at the scene also plays a vital role in identifying the nature of the injury and the requirement for transfer to a specialty center. Triage of patients with specific injuries has been shown to significantly reduce morbidity and mortality as these patients are preferentially transported to an appropriate hospital, bypassing the nearest hospital. (Battaloglu and Porter2024)

2.1. Pre-hospital Care and Triage

The last point to address is that in many cases that are more severe, it is necessary to convey essential patient information to hospital teams so as to either ensure the correct resources are to be met or that the patient can have immediate treatment and avoid waiting. An example highlighted was related to head injury patients, where over an eight-year period in the UK, 54% of head injury patients were misusing computed tomography (CT) (18), which is classified as high risk and above the appropriate recommendation.

An argument regarding the improvement of patient survival from severely injured patients to patients with battlefield trauma. In the second scenario, civilian medicine has in many cases adopted new techniques and treatments for severe injury on the basis of their effectiveness in military combat casualties. This has led to raising the possibility that civilians with similar injuries can be salvaged with newer and more aggressive treatment. This is an example of how the development of specialized treatment may be of benefit to the severely injured and largely takes place between some of the most basic interventions (e.g., wound dressings and splinting techniques) and higher-level specialist treatment.

An article by Sleigh et al. published in 2016 introduces the concept of 'scoop and run' patient (17). These are patients with lower-severity injuries who do not need definitive treatment in the hospital. It is said that 'scoop and run' is an economically and time-efficient method, possibly more paramedical interventions to increase the severity of injury in these patients will result in better outcomes.

The model of care the patient will receive following the injury will depend greatly on the severity of the injury. As mentioned before, the treatment of the severely injured patient in many cases does not require a specialist, but specific treatments do require specialist care. Using trauma and orthopedic injuries as examples, a patient with multiple fractures following a RTA may well be treated by a general orthopedic surgeon and managed very well. However, if an

open fracture with significant soft tissue injury is treated by a specialist in this field, the outcome is more likely to be improved. Injuries such as dislocations and ligament/tendon ruptures often require surgery to fix the problem. This type of injury often has a delayed presentation to the hospital, as at the time of injury there may be no pain or only moderate pain to signify a severe problem. It has been said that these injuries are often missed as pre-hospital teams are not thorough enough in their assessment (16). This sort of injury would benefit from the presence of a medical team that is able to perform a more detailed assessment and plan elective surgery. (Rakhra et al., 2022)

2.2. Stabilization and Basic Life Support

Here, the structure of the interaction between the paramedics and the hospital team changes. If the patient requires emergent surgery and/or resuscitation on arrival, the paramedic will be required to give a very concise handover while all team members are still assessing and treating the patient. Some important information may be missed by the team receiving the patient, especially if there are multiple injuries. This may jeopardize the patient in cases where the injuries are not obvious. Cardboard and audio recordings of the pre-hospital phase have been suggested as a means to improve the handover by allowing the hospital team to get a better understanding of the events leading to hospital admission. This step in the patient journey is an area that has shown great improvement in recent years. The hospital phase of the journey is obviously the most familiar to the medical community, but efforts have been made to replicate hospital treatments in the pre-hospital environment, particularly time-critical interventions for trauma and medical cases. This has been termed 'scoop and run' to definitive care. In these cases, the patient receives the treatment in situ and during transport that they would have received at the hospital. A good example of this is anesthesia and surgery at the scene of injury for a patient who would not survive if taken to the hospital. The above steps in pre-hospital care take place in what would be described as life- or limb-threatening-situations. Care may differ in cases where urgency is not defined by the need to resuscitate or prevent

further deterioration of a patient's condition. An example is a back injury sustained by an elderly person. These patients often fall into the category of non-urgent but require some form of low-acuity interventional care to prevent long-term disability. This case and others like it are often best managed by a referral to an alternative pathway at the scene or to a primary care provider. A recent publication has described these alternatives to the 999 system as a way to improve unscheduled care for certain patient groups. Alternative care pathways are essentially a diversion from taking the patient to an emergency department. These pathways are variable and will be determined by what is most suitable for the patient. An elderly faller with minor injuries may be best referred to a falls and fractures service run by physiotherapists and occupational therapists. The aim, other than treatment, is to prevent repeat offenses and further injury. (Tandon et al., 2023)



2.3. Communication and Handover to Hospital Team

Research has shown that written forms are much more valuable than oral handovers. This is because of the increased levels of disposable information, and this ensures that it is all passed on. On top of this, it can be placed with the patient notes and used as a reference document if there are any concerns about the treatment given by paramedics in comparison to the treatment that the patient needed. Unfortunately, it is rare that an allocated time for a written handover is possible, and this is in contention with its supposed high value. During busy periods or major incidents, there may not be a handover at all, and in these situations, paramedics must ensure to pass on all relevant information as an oral handover will provide only basic details, often leaving a lot of information uncovered.

Unfortunately, one of the biggest problems with communication between pre-hospital and hospital care teams is the disparity in medical terminology and language used. Just as multidisciplinary teamwork is proven to improve patient outcomes, there needs to be a clear, concise universal language that is understood by all levels of care providers. Although this is not realistic and would take a long time to implement, it would be an effective way to prevent misunderstandings and ensure that all relevant information is passed on.

Once a patient has been stabilized by paramedics, the most important task in ensuring that the patient gets the best care is the thoroughness of the handover to the hospital team. This involves communicating all important information about what has occurred and the condition of the patient. The most effective way to do this is to provide a written or oral brief to the most responsible person within the emergency department; however, this is not always possible. In situations where there is no "handover" due to increased workload in emergency departments, paramedics are expected to spend extra time to ensure that all relevant information is passed on. (van et al.2021)

3. Role of Social Services in Trauma Case Management

Social workers have a presence in several aspects of a trauma patient's care. Although significant work has begun in the field of social work in trauma care, many continue to see this discipline as secondary to the medical management of injuries. Because trauma care is closely linked to acute care medicine and surgery, there is often a perception that the management of trauma patients' emotional and socioeconomic problems will just happen as part of the medical care. This is due, in part, to the fact that many medical practitioners have not had exposure to social workers who specialize in trauma care. In recent years, though, there has been an increase in awareness of the need for psychosocial management of trauma patients, largely due to the Veterans Administration

system and the care of injured war veterans. This is supported by several publications exploring various aspects of social work in trauma care, and social work is now recognized as an integral part of the comprehensive care of injured patients. The role of social work in trauma care is multi-faceted and encompasses several areas, the scope of which is beyond the limits of this article. This issue can be strengthened with enhancement of social services at trauma centers from the micro level (individual patient and family) to the macro level (influence on trauma system policy). Emergency Medical Services (EMS) Data highlights the fact that the severity of incidents is not only based on the trauma a patient sustains, but also on the patient's socioeconomic status and available support systems. Social workers assess and address the psychosocial and material needs that jeopardize the recovery and mental health of trauma patients and their families. This in turn can affect a patient's length of stay and potential for long-term disability, hence altering the resources needed for both inpatient and outpatient care. By linking social service intervention and improved outcomes, trauma centers may be able to obtain increased funding and resources for social work programs. This is very much in line with the philosophy of proving the cost-effectiveness of medical interventions, and has been demonstrated by the allocation of additional funding from the National Institutes of Health to trauma care research in recent years. Achieving improved patient outcomes and prognosis through psychosocial intervention will require specific research into the areas in which social services have the greatest effect on patient care. An intriguing idea described by Zatzick and Jurkovich is a study based on PRO (patient-rated outcomes) instruments used to quantify patients' perceptions of social service interventions and how they affect recovery from injury. In then examining the extent of the efforts to place injured patients into appropriate rehabilitation facilities, another issue arises as to trauma patient access to post-acute care. With the recent closure of many state-run rehabilitation facilities, there has been a trend for these patients to be placed in nursing homes rather than appropriate rehabilitation centers. This is particularly true for the elderly, who are an

increasingly significant proportion of trauma patients. While there exist specific discharge criteria for critically injured patients in need of inpatient rehabilitation, anecdotally many social workers report difficulties in obtaining such placement slots. This is an area where social work and case management efforts on individual patients may need to be translated into advocacy on a higher level, in order to influence healthcare policy and resource allocation for post-acute care. (Verma et al., 2023)

3.1. Psychosocial Support for Patients and Families

In times of disaster, patients and their families may suffer from profound psychological stress and emotional disturbances. The unexpected and often violent way that traumatic events disrupt and shatter lives frequently results in a wide range of emotional and psychological difficulties. In a study funded by the National Institute of Mental Health, more than 25% of injured trauma survivors experienced stress symptoms that met the diagnostic criteria for posttraumatic stress disorder (PTSD). This was at a 3-month follow-up, with 15% continuing to suffer with symptoms at 12 months post-injury. Considering that each year in the US there are around 2.5 million traumatic injuries resulting in hospitalization and approximately 500,000 requiring inpatient care, these percentages translate to a substantial number of individuals in need of mental health services. PTSD is just one of many emotional problems that individuals may experience following a traumatic event. Others include anxiety, depression, anger, cognitive dysfunctions, grief, and behavioral changes. Although many trauma survivors have natural resilience and the psychological disturbances are often temporary, research indicates that early intervention aimed at providing emotional support and preventing further psychological deterioration is beneficial. Connect with a mental injury lawyer for immediate legal support. (Wallace et al.2020)

role of social services in trauma case management Psychosocial support for patients and families Coordination of post-trauma care Advocacy and resource referrals

3.2. Coordination of Post-Trauma Care

Through the coordination of patient care, social workers contribute to a smooth transition from hospital to home or to alternative living arrangements. This can involve facilitating the patient's access to needed services, equipment, and/or modifications to the home. Such services can include home health, medical equipment, counseling, and transportation. Social workers can also play a key role in linking patients to financial assistance programs, such as Medicaid or Supplemental Security Income. Advocacy is often an important tool in helping patients to secure resources to meet their post-discharge needs. This can involve anything from assisting patients to obtain insurance coverage for needed services to testifying before a legislative or policy-making body for improved services on behalf of targeted patient populations. Coordination of care can also involve the arrangement of a post-acute placement for patients requiring further rehabilitation prior to returning home. This may be in the form of an inpatient rehabilitation hospital, a skilled nursing facility, or placement in a transitional living setting. Social workers can help determine the most appropriate placement for patients based on their medical and psychosocial needs and will often continue to follow patient progress and advocate for needed services throughout subsequent transitions in care. (Solomon et al., 2020)

3.3. Advocacy and Resource Referrals

Method: A study on the barriers to accessing mental health services for inner-city children and their caregivers in the United States indicates the many barriers faced by vulnerable populations. These can include structural barriers, such as a scarcity of competent providers, and financial barriers due to lack of appropriate insurance coverage. The study notes that "families often give up in despair after encountering an array of discouraging barriers, both outside and within the mental health sector." (Hoagwood K, et al., "Family Advocacy, Support and Education in Children's Mental Health: Results of a National Survey." *Admin Pol Ment Health* 2007; 34(1):23–39.) While the manuscript does not provide specific

examples, it is well recognized that addressing social determinants of health and illness often requires persistent and long-term effort to navigate through complex and fragmented systems. This may involve prolonged and repeated efforts to communicate with a multitude of providers and agencies while repeatedly defending the needs and rights of the patient and his family. (Byrow et al., 2020)

Clinical case managers are regularly faced with the challenge of acquiring necessary resources for their patients with complex medical and psychosocial needs. These resources might include necessary medical equipment, appropriate housing, financial support, and a variety of medical and mental health services. Advocacy on behalf of the patient is frequently required to negotiate the complexities of insurance coverage and social welfare programs. In the absence of an advocate, the case manager may assume this role by directly working with the patient and the patient's family and making phone calls to various agencies while empowering the patient to help himself. The provision of effective advocacy has been proven to enhance access to care and improve health outcomes for the disadvantaged. (Lurie N. et al., "The Role of Social Services in Treating the Chronically Ill." *Health Serv Res* 1988; 23(3 Pt 2):469–486)

4. Role of Radiology Team in Trauma Case Management

Interventional Radiology Procedures Various interventional procedures may be required by the trauma patient and these are often performed by specialists from other clinical disciplines under radiological guidance. One common example is the drainage of hemothorax or pneumothoraces with CT fluoroscopy-guided chest drainages. Often the simplest radiological procedure may have a substantial impact on the patient outcome. An interesting area within interventional radiology for trauma is the urological procedures and the patient with genitourinary injuries. In some cases, low-grade renal injuries may be managed conservatively. However, high-grade injuries or those

accompanied by large hematomas can lead to prolonged hospitalization if the high-grade renal injury is treated with a nephrectomy. In contrast, it is now possible to perform embolizations of renal arteries to certain areas of the kidney and the choice of material and the location to which it is packed can mean the difference in recovering some kidney function and requiring dialysis for renal failure. The pat

Diagnostic Imaging for Initial Assessment The aim of diagnostic imaging in trauma is to quickly and accurately determine the extent of injury to various organ systems thus guiding the clinicians in formulating a management plan. As stated, the decisions made at this stage may well affect the eventual patient outcome. Plain radiography is still important as it can diagnose many fractures and is easy to perform. However, many trauma patients will now undergo a primary survey whole body CT. This is especially the case for patients who are haemodynamically stable and with multiple injuries. The whole body CT follows a structured protocol and can diagnose both life-threatening and non-life-threatening injuries. In some cases, further imaging with individual body part CTs or MRIs may be required. MRI is useful for imaging brain and spinal cord injuries and continues to take on a larger role in assessment of non-acute musculoskeletal injuries. An example of the benefit of modern imaging technology in the trauma patient is a 35-year-old male involved in a high-speed motor vehicle accident who is found to have a fractured pelvis and acute urinary retention. A whole body CT reveals that he has a liver laceration and left-sided adrenal hematoma and will therefore require a blood transfusion. His pelvis fracture is diagnosed as stable and not requiring surgery. The detection of the unknown adrenal hematoma has impacted the management plan for this patient who will also require a follow-up CT for later screening of the hematoma. (Umemura et al.2021)

There are many key components to the optimal care of the traumatically injured patient. Initial assessment of the extent of injury and correct decisions regarding what therapeutic surgical and ICU interventions are most appropriate are crucial. Radiology has a very important role

both in the initial assessment phase and in ongoing assessment of the patient. It is during the initial assessment of the trauma patient that the extent of injury is estimated and decisions are made as to what surgical and medical resources are best invested in the patient. Making the correct decisions at this phase will obviously affect the eventual patient outcome. With modern technology such as helical CT scanning and fast MRI, radiology has much to offer the acute trauma patient. This article will define the role of radiology in trauma case management focusing on the various CT and MRI examinations and interventional procedures commonly performed.

4.1. Diagnostic Imaging for Initial Assessment

Radiology has evolved significantly in the past two decades, with advancements in technology that have expanded the scope of diagnostic possibilities. The traditional role of radiography has been augmented with the advent of CT and MRI, leading to improved diagnostic accuracy with finer anatomic details, which is often a necessity in the multi-system polytrauma patient. While advanced imaging studies are invaluable in the successful management of the trauma patient, it is vital to understand that plain film radiography is often all that is required in the initial assessment and is most frequently the best study to guide further imaging if necessary. Advanced studies such as CT should be reserved for hemodynamically stable patients and those in whom the diagnosis remains uncertain despite adequate plain film studies. This approach is particularly relevant for the monitoring of head injuries, where serial neurological examinations can be correlated with serial plain film studies of the skull. In patients with isolated limb injuries, the correlation of clinical examination findings with plain film x-rays is often sufficient in aiding decisions on appropriate management and avoiding unnecessary advanced studies that may not necessarily influence the treatment plan. Following the RES study, proposed guidelines on the appropriate use of CT for head injuries will provide a useful platform for developing a similar approach to other injuries. Full implementation of such strategies is likely to reduce the number of unnecessary advanced studies, resulting in cost savings and reduced

radiation exposure for patients. (Kjelle et al., 2021)

4.2. Interventional Radiology Procedures

The goal of the radiology intervention in trauma is to contribute to a decrease in the mortality and morbidity of the trauma victim. This involves the enhancement of traditional diagnostic imaging techniques and the development of methods to guide therapeutic procedures. The trauma community has become much more aware of the role of interventional radiology over the past 10 years. A survey of members of the Eastern Association for the Surgery of Trauma demonstrated a substantial increase in the use of interventional radiology techniques by trauma surgeons. This finding resulted in the development of a specific session devoted to interventional radiology at the annual meeting of the American Association for the Surgery of Trauma. The Radiologic Society of North America has also fostered relationships between radiologists and trauma surgeons. During the past 3 years, the Society has held a number of sessions devoted to interventional radiology at the annual meeting and has developed a special interest group in trauma radiology. These developments are a reflection of the implementation of interventional techniques by radiologists and the desire of the trauma community to harness these technologies. (Kaufman et al.2020)

4.3. Timely Reporting and Communication of Findings

Once a diagnostic imaging procedure has been performed for a trauma patient, the clinical team involved requires information about the findings and their relevance to the patient's current medical condition. This can have a significant impact on decisions regarding the best course of management for the patient. There is evidence to suggest that delayed communication of radiological findings can lead to inappropriate treatment and potentially adverse outcomes for patients. A study by Manser et al. investigated the transfer of information during the resuscitation of trauma patients and identified multiple instances of omitted information and delays in communication. One of the primary

causes of this problem was lack of integration between the various specialties involved in trauma patient care. In instances where radiologists are not fully aware of the clinical scenario and treating team are not aware of the radiological findings, certain decisions concerning the patient's management may be made in isolation and without the best information available. To address this issue and optimize the relevance of radiological findings to the clinical management of the patient, there needs to be a free-flowing exchange of information between the treating team and the radiology department. This can be best achieved by the implementation of regular interdisciplinary team meetings specifically for trauma cases. These meetings can be used as a forum for discussion on the relevance of specific radiological findings and include decisions on the best course of action for the patient. The availability of the radiologist to provide information and answer questions at this time is also beneficial to the clinical team. (Rockall et al.2022)

5. Role of Anesthesia Team in Trauma Case Management

The initial priority of the anesthesia team is airway management. In the unconscious trauma patient, airway reflexes are often obtunded and in the presence of blood or secretions aspiration is a significant risk. A definitive secure airway must be established and for patients undergoing inter-hospital transfer this may necessitate prolonged intubation. A variety of airway adjuncts are available to the anesthesiologist and choice is largely determined by clinical circumstance and operator preference. Rapid sequence induction (RSI) is an established technique for emergency airway management which combines induction of general anesthesia and concurrent neuromuscular blockade to facilitate endotracheal intubation. The objective of RSI is to minimize risk of aspiration and optimize conditions for endotracheal intubation however it is not without risk in the trauma patient. The potential for hypotension and hypoxia during RSI is a concern and should be anticipated and rapidly corrected. Patients with

head injury or reduced conscious state may require emergency intubation though not all of these patients will benefit from immediate induction of general anesthesia and this decision must be made on a case by case basis. Timing and choice of airway intervention in trauma patients has significant impact on patient outcome and current teaching of these skills is an important aspect of pre-hospital and anesthesia related trauma care education. (Behrens et al.2020)

The anesthesia team is a vital component of the trauma patient's management. Anesthesiologists are primarily concerned with airway management and ventilation, vital organ perfusion, and preserving homeostasis. In the context of the multiply injured patient, these objectives must be achieved while rapid transport to a definitive care facility is facilitated. The role of the anesthesiologist in trauma resuscitation often extends beyond the immediate perioperative setting, encompassing a wide variety of interventions and anesthetic techniques.

5.1. Airway Management and Sedation

Sedation increases the risk of pulmonary aspiration of gastric contents. Researchers have repeatedly pointed out the frequent failure of trauma case RSI to be conducted in a manner consistent with the expert recommendations. This raises concerns about negative consequences, as mentioned above. In light of the well-documented advanced airway management expertise of anesthesiologists, it is proposed that in certain cases involving the most severe head injuries and in which RSI is deemed necessary by the emergency physician, the anesthesiologist should perform the RSI. This may be the safest way to optimally carry out RSI in trauma cases. Following the lead of other specialized team members in the current care of trauma cases, it may be that the anesthesiologist should become involved in an early or pre-hospital setting. However, given the wide range of patient injury severities and comorbidities, it is likely that this portion of care would be best determined on a case-by-case basis. Due to the fact that the SGA is a recommended airway device for out-of-hospital RSI, its use on trauma

patients may become more frequent. A study comparing SGA and endotracheal intubation found that while there was no difference in Glasgow Coma Scale at 1 hour between groups, the intubated patients had a higher mortality and a lower GCS at 24 hours. This makes the issue of proper airway management in mild to moderate head injuries an important one to address in future recommendations for trauma case RSI. (Russotto et al.2022)

5.2. Pain Management during Procedures

The use of locoregional techniques has come to the forefront in pain management for trauma victims undergoing medical and surgical procedures. Regional anesthesia offers some advantages over systemic analgesia in that it provides specific analgesia for a well-defined anatomical location. Thus, the patient may still be able to cooperate in neurological testing following treatment. It also has a lower risk of altering the patient's level of consciousness and hemodynamic instability. These advantages are particularly beneficial when dealing with head injuries and polytraumatized patients. Local anesthetics have been shown to inhibit the inflammatory response, improve dysfunction of cell membranes around injury sites, decrease the release of substance P, and have direct and indirect neuroprotective effects. This is particularly relevant when considering postoperative pain and patients requiring ongoing physiotherapy. However, balanced against these considerations is the time taken to perform regional techniques and the expertise required by the clinician, which must be considered during busy clinical sessions in the emergency radiology or operating suite.

The aim of trauma patients is to be evaluated and treated rapidly and efficiently from the time of injury until they are discharged from the hospital, while also minimizing morbidity and mortality. A multidisciplinary approach is essential to attain the above-mentioned goal. Insertion of invasive medical devices and procedures can be extremely painful for trauma victims, which may subsequently lead to a delay or failure in the necessary treatment. Analgesia and sedation provided by anesthesiologists are

vital parts in ensuring that these procedures are well tolerated.

5.3. Anesthetic Care during Surgery

Finally, the anesthesiologist's role does not end in the operating room. Postoperatively, pain and sedation will need to be addressed in specific traumatically injured patients in the ICU, and the same principles mentioned above will apply to these scenarios.

A newer concept is resuscitative endovascular balloon occlusion of the aorta (REBOA), which is done in patients with non-compressible trunkal hemorrhage. There are various levels of REBOA with different catheter placements, and it could be done in an operative or IR suite. Overseas, anesthesiologists are trained to perform this procedure in austere environments with or without guidewires and fluoroscopy. This is a potentially life-saving procedure, and it may become necessary for anesthesiologists to become proficient in the near future.

Anesthetic care during surgery is essential for the successful outcome of the operative procedure. Often, patients with severe trauma are in profound states of physiological instability. The anesthesiologist's main priorities are to support and maintain vital organ function during the high stress of surgery. Damage control surgery is now widely practiced for trauma victims. This involves the surgeon performing only what is necessary to control bleeding and contamination. This may mean leaving the abdomen open or only partially closing a wound. This type of surgery necessitates different anesthetic goals. When abdominal packing is planned, deliberate hypotension can be induced to minimize blood loss. The anesthesiologist must be aware of the surgical plan and be adaptable. Sugammadex may also play a role in reversing rocuronium-induced paralysis in these patients. This is a new drug with high affinity for encapsulating rocuronium, making it a useful tool for when rapid reversal is necessary.

6. Role of Pharmacy Team in Trauma Case Management

The final category of practice, managed, is defined by the pharmacy's joint participation in collaborative medication review and monitoring. This occurs through direct patient care services by clinical pharmacists or collaborative drug therapy management with professional pharmacy staff. Clinical pharmacists utilize their professional judgment and skills to analyze patient-specific data, assess and prevent medication-related problems, and make recommendations to adjust drug therapy regimens. The following is a detailed description of all pharmacy practices using a hypothetical trauma case example.

The second practice category, supportive, is seen in drug interactions and allergy management. The pharmacy is responsible for gathering and documenting accurate medication lists, past medical history, and allergies for admitted trauma patients. Allergy and medication data is maintained in the hospital computer system to provide readily available information for all healthcare providers taking part in patient care. During the patient's hospital stay, the pharmacy works to prevent adverse drug events resulting from improper medication administration in patients with known drug allergies. An advanced form of resulting in improved patient outcomes.

The pharmacist plays an intricate role in the trauma process, working under all three categories of practice within trauma case management. Initially, the pharmacy will manage and dispense medications used in the treatment of trauma. They are involved in the selection of drug therapy, determining what will be stocked and used within the hospital for the treatment of trauma cases. The medications used in traumas are often dictated by formulary restrictions, and the pharmacist works to provide an equivalently effective alternative in cases where non-formulary medications are requested. Medication procurement is followed by dispensing, where the pharmacy provides the correct medications and doses in a timely fashion. In future studies, it would be worth analyzing the effect of pharmacist involvement

in obtaining emergent medications on patient outcomes. Patient safety and quality care start with the pharmacy procurement and dispensing process, and its implications deserve further review.

6.1. Medication Management and Dispensing

Medication management and dispensing: When tasked with medication management and dispensing, paramedics may often make medication errors due to various factors. Such errors may result in dire consequences, thereby making it a topic warranting discussion. Medication errors can occur at various stages ranging from the physician's prescription to the administration of the medication. The paramedic is often involved in a loop of medication self-education and training in an attempt to stay updated with drugs and indications. The fast-paced changes can often overwhelm the paramedic and result in a knowledge deficit that affects the administration of medications. In addition to this, the autonomy of the paramedic has a huge impact on medication errors in that the paramedic often has to make on-the-spot decisions without contacting medical control, sometimes resulting in errors in judgment. One study examined paramedics by simulating scenarios necessitating the administration of specific drugs. Video recording showed that the paramedics often made procedural errors, and upon conclusion of the scenario, many were unaware that they had made an error in drug or its administration. This study highlighted a significant issue that exists in the administration of medications by paramedics; an issue that has potential for harm to the patient. (Sedlár2022)

6.2. Drug Interactions and Allergy Management

Drug interactions can be affected through a variety of different mechanisms, which makes prediction and detection difficult. Some drugs act directly to change the activity of other drugs. For example, our study of lidocaine and procainamide infusions revealed that lidocaine increased the rate of procainamide metabolism to N-acetyl procainamide, increasing the effect of procainamide and potentially causing toxicity. Changes in drug metabolism are a common source of drug interactions because

several drugs are metabolized via the same cytochrome P450 enzyme systems in the liver. One drug can act as a competitive or noncompetitive inhibitor of the metabolism of another drug. For example, glucocorticoids induce the metabolism of exogenous insulin and oral hypoglycemic agents, requiring an increase in the dosage of the hypoglycemic drugs. Insulin and oral hypoglycemic agents are also subject to interactions from a third mechanism, as they increase the effects of sulfonylurea drugs and thiazide diuretics by causing hypokalemia, greatly increasing the risk of adverse effects or acute toxicity from these drugs. Any change in the physiologic state of the patient carries the potential to change the efficacy or toxicity of a drug. For example, the initiation of an antibiotic therapy can invert the neutrophil and bacteria counts in a patient with an infectious disease, causing antibiotic adherence to be less effective and possibly leading to infection worsening.

When two or more drugs are present in the body at the same time, they can interact in a way that changes the way the body uses or breaks down the drugs. Drug interactions can result in unwanted side effects, reduce the drugs' effectiveness, and cause changes in the way the body functions. EMS patients are especially at risk due to the use of multiple medications and the necessity of drug therapy to manage a broad array of acute and chronic conditions. It is estimated that 20% of patients have the potential for a drug-drug interaction, and 2% of EMS transports may experience a critical event related to a drug-drug interaction.

6.3. Collaborative Medication Review and Monitoring

The most common and traditional method of managing medications consists of a physician evaluating a patient-placed medication and deciding whether or not the medication should be adjusted, discontinued, or maintained. In a more complex system, greater than 20 to 30 medications, the recommendation is to employ the methods of a clinical pharmacist reviewing and managing medication. The medical literature lists several benefits to incorporating a pharmacist to review and manage medications. These benefits include reduction in medication

errors, decrease in drug interactions and adverse drug events, improvement in prescribing practices, and improved patient outcomes. These benefits coincide with the primary goal of preventing and decreasing adverse events and improving patient outcomes. This method can take place at the inpatient or outpatient setting and is quite feasible due to the increasing availability of clinical pharmacists around the country. Although implementation in the outpatient setting leaves few patients with its greatest impact on the aging population and patients with extensive medication regimens. In the context of a trauma patient, the role of a pharmacist concentrating on medication reduction can improve rehabilitation potential and decrease mortality for seriously injured patients. The significance of collaboration between EMS physicians and clinical pharmacists can aid in targeting trauma patients that could benefit from medication reduction in the inpatient or outpatient setting. This can take place through a weekly case management meeting and a standard procedure where specific trauma cases can be evaluated post-injury and an assessment can be made regarding whether the trauma patient needs a medication therapy intervention. The most effective method would be to concentrate on the patient's past medical history and prescriber's practices, while doing so in accordance with the recommendation made by an emergency physician or trauma specialist.

7. Collaborative Decision-making in Trauma Case Management

In analyzing decision-making processes during the management of trauma cases, it is clear that decisions are often complex and the stakes are high. Decision-making does not occur in isolation; clinicians often seek support and advice from others. The decisions made in the prehospital setting can have significant implications on patient outcomes and the subsequent workload of hospital-based teams. Paramedics often make decisions on the destination of the patient to the most appropriate facility to manage the patient's needs. For example, a patient with a head injury may need to be conveyed to a neurosurgical unit. This

decision relies on the paramedics' skill in assessing the severity of the injury and knowledge of the services provided at each facility. These decisions can be difficult, and paramedics often report limited or no contact with emergency department staff to obtain advice or guidance on the most appropriate destination for the patient. This highlights a significant lack of involvement in shared decision-making between pre-hospital and hospital teams. In certain cases involving the care of polytrauma patients, advanced communication between the prehospital and hospital teams is required to make decisions relating to the anticipated needs of the patient and the services available to best manage the patient. An example would be the activation of a trauma team by the emergency department to meet the patient on arrival and facilitate rapid assessment by a variety of specialists. This type of decision would greatly benefit from involvement of the prehospital team in direct discussion with relevant hospital staff. A study by Meisel et al. that interviewed clinicians on the decision-making processes for two RCTs offered a useful framework for understanding the nature of clinical decisions. He defined a RCT as "a trial where professionals compare at least two different evaluation or treatment policies being considered for a specific clinical problem in order to select the one that is most appropriate." Using this definition, decisions for recruitment of the patient to the RCT as well as the decisions involved in the specific criteria Meisel has outlined are, in themselves, comparisons of two treatment policies. The criteria being whether the patient meets the definition of unconscious and whether administration of the intervention, these decisions are key in determining which patients are eligible, and it is these patients who may derive the most benefit from the intervention. Though the RCT coordinators and involved consultants made these decisions independently in the respective cases, both felt unsure about the best course of action and mentioned the potential benefit of discussing the eligibility and criteria at a later time between the prehospital and emergency department teams. Consideration of establishing regular meetings between the teams is also seen as a method of enhancing shared

decision-making. In establishing the processes made during complex decisions, it becomes evident that there is potential to significantly influence the decisions themselves, and this is an appropriate point to consider methods of improving the decision quality. (Phillips, 2020)

7.1. Multidisciplinary Team Meetings and Discussions

The process by which decisions are made during trauma patient management can greatly affect patient outcomes and run the gamut from well-thought-out and organized to implicit and fraught with error. Discussions and decisions about what is best for the patient often lead to disagreements between providers and, at times, result in implicit decisions made by a single provider, which may not be in the best interest of the patient. In a comprehensive study on team effectiveness and patient outcomes, it was determined that an effective team is one where the members advocate on behalf of the patient; in essence, a good team puts the patient first. (Koike,1) One could argue that the best way to make decisions about what is best for a patient is to convene a multidisciplinary team meeting. This is a detailed discourse that would involve all providers caring for the patient in a location or forum where decisions can be made to affect a patient's clinical trajectory. Though this type of structured discussion has not been studied directly in the realm of EMS and patient outcomes, it is clear that the concept of getting all relevant decision-makers together to converse on what is best for a patient is something that would likely improve patient care.

When a patient suffering from a traumatic injury enters the system, it is imperative to move quickly to initiate the crucial decision-making process, which will affect patient outcomes. Decisions made during the initial trauma management phase, including whether to transfer a patient to a higher level of care or to a rehabilitation facility, greatly impact patient outcomes. Teams that function effectively during these critical moments inevitably influence what happens next. This means that team effectiveness is critical when considering the importance of the decisions made in the

patient management continuum. The method by which decisions are made depends on the specific situation. It may be a quick collective decision between several EMS providers on the scene of an accident or a well-thought-out decision with significant medical oversight and consultation within a hospital setting. In both situations, the inclusion of a patient's family and shared decision-making are important and should not be overlooked.

7.2. Consensus Building and Conflict Resolution

Just like many other collaborative processes, consensus building in trauma management is used to both reduce and make decisions about its problems. The ideal approach to consensus building would involve creative brainstorming about solutions to problems, an agreement on a solution that all parties can accept, and a commitment by all parties to support the decisions made. Unfortunately, consensus-building is difficult to achieve in trauma care and can often be followed by conflict. Disagreements between team members, the use of aggressive behavior, and reluctance to adhere to decisions made can all sabotage the consensus-building process. Conflict is disruptive to the trauma team, can lead to poor decisions, can cause a lack of adherence by team members to decisions made, and can negatively affect team morale. While conflict cannot always be avoided and can sometimes be a useful process to clear the air, in some cases it can lead to serious problems, such as team members carrying out "covert behaviors" to undermine decisions made, or, in a worst-case scenario, lead to an unproductive, hostile working environment. When conflicts arise within trauma teams, strong leadership is required to take control of the situation and attempt to resolve the issue. By using a style of conflict resolution known as "compromising," conflicting party members can be encouraged to seek and give concessions, looking for a fast mutually acceptable solution to the dispute. This method is well-suited to solve complex problems that have an integrative solution, where there is a high interdependence between the parties involved. An understanding is reached when all parties see the outcome as the

best possible solution. This process can sometimes be difficult to achieve and compromised agreements may not always be popular with all parties, but in most cases, it achieves to resolve the issue.

7.3. Patient-Centered Care and Shared Decision-making

The second phase, 'collaboration', is characterized by the design and execution of research and changes to the structure and delivery of emergency care and improvements in patient outcomes. Engagement of leaders and change agents across multiple professions in research and the ECRI conference were key events that signaled a new phase in the development of emergency care in the realization of need for multi-disciplinary care. These were tied together by a common interest in improving patient outcomes, the utilization of evidence-based medicine and research results, and shared learning across professional boundaries and changes in organizational systems to facilitate these. An example of multi-disciplinary interpersonal interaction is the creation of the Australasian College for Emergency Medicine (ACEM) and the Australasian Society for Emergency Medicine (ASEM) by emergency physicians and doctors in other roles in 1993, with the specific purpose of improving emergency care. This provides evidence of a complex intervention which could potentially lead to significant changes in emergency care systems. This led to the contemporary situation in which many hospitals have numerous non-specialist and specialist doctors providing emergency care, with the model of definitive care by specialists being reserved for the most acute cases and the critically ill or injured. Considerable progress has been made to date, but this phase is expected to last for the better part of a decade if not more.

The history of EMD can be divided into two distinct phases. The first, 'silo' phase is characterized by traditional hierarchical systems in healthcare. Internal motivations and actions of various professional groups meant that there was little attempt at meaningful collaboration. Within the ambulance service, physicians provided medical oversight and directed

paramedic scope of practice in the prehospital setting, but there was little coordination with emergency nurses and staff in receiving hospitals. There were instances of nurses 'training' emergency medical technicians to provide them information obtained from patients at the scene. Paramount in the minds of both nurses and paramedics was the safety of their patients and themselves, directed within their own professional paradigms. This situation served to perpetuate the status quo with little effective change for a number of years.

8. Communication and Information Sharing in Trauma Case Management

In the management of trauma cases, communication among pre-hospital and hospital-based providers is clearly essential. Information about the patient's condition, the events leading to the injury, and the pre-hospital care provided is important for the receiving physician to understand the severity of the injuries and the care needed. Throughout the following discussion, it becomes clear that clear, concise information transfer is vital at all stages of multidisciplinary trauma management. Emerging communications technologies hold great promise for improving communication and information sharing in trauma case management. Although a large proportion of information transfer in trauma management has traditionally been by word of mouth or paper-based, electronic databases are increasingly being used to store and forward information about injured patients between pre-hospital and hospital-based providers. Modern paging systems and mobile phones provide rapid access to key personnel. Audio and video-conferencing technologies are beginning to be used to facilitate real-time communication between team members separated by distance. These technologies have the potential to make geographic location less of a barrier to involvement in multidisciplinary trauma management and to improve the accuracy and detail of information transfer, particularly by allowing the transfer of visual information (e.g., wound images, diagnostic imaging results). Documentation of patient information and the

care provided is important at all stages of the patient journey. For the individual patient, it provides a record that can be reviewed at a later date if there is deterioration in their condition or if they suffer a similar injury in the future. In a research context, high-quality documentation facilitates an audit of the care provided and research into the outcomes of specific treatments. In the context of quality assurance, it enables providers to identify and rectify deficiencies in care. High-quality record-keeping is particularly important in the pre-hospital and acute hospital phases of trauma care, where information is transferred between different team members and where patients may be incapable of providing their own medical history. In the prehospital setting, the development of electronic patient care records (ePCR) to replace paper-based systems has the potential to improve the quality of documentation by guiding providers through the data entry process and improving the legibility and detail of patient information. Throughout the acute and post-acute hospital phases, the use of electronic databases to store and retrieve patient information is becoming the norm. An ideal information sharing system would enable seamless transfer of patient records and imaging results between all providers involved in a patient's care and allow real-time access to this information in any location. However, there are substantial barriers to achieving this in the current era of disparate paper and electronic systems, concerns about sharing sensitive data between organizations, and protecting patient privacy and confidentiality. (Alenoghena et al.2023)

8.1. Effective Communication Channels and Technologies

Some of the more established technologies include computerized dispatch systems which can provide detailed information about the location and nature of a case, as well as provide directions to the crew. Audio and video recording devices have the potential to capture important clinical information as well as serve an educational role. Mobile and internet technologies such as broadband and wireless have the potential to bring data and information resources to the paramedic's fingertips. For

example, it might be possible for a paramedic to look up an up-to-date clinical guideline or contact the base hospital for medical advice from the field. At the trauma team level, technologies such as telemedicine have the potential to bring the expertise of a specialist to a trauma resuscitation or to allow an outlying hospital to obtain expert advice on a management or transfer decision.

There are many new and emerging technologies that have the potential to enhance communication in the prehospital and in-hospital trauma teams, as well as communication from the field to the receiving facility. Many of these technologies have not yet been subjected to rigorous research and validation and thus currently represent the ideal rather than the reality of prehospital communication.

Traditional two-way radio has been the standard for prehospital communication, and in many services, it is still the primary means of communication. What has changed is that many teams are now carrying mobile phones as well as two-way radios, while dispatch centers may now have the ability to directly contact paramedics on a mobile number. Telephone communication is still an important means of communication from the field to the receiving doctor, especially in a delayed or interhospital transfer situation.

Effective communication plays an important role in the management of trauma patients, especially in the initial stages when time is critical and decisions have to be made quickly. Communication between team members, prehospital providers, and from the field to the medical direction and receiving facility is a key factor in providing the most appropriate and timely care to trauma patients.

8.2. Documentation and Record-Keeping

The documentation and recording of clinical information is a core component of almost all healthcare interactions. Information is the currency of the health service, and clinical documentation is a key tool for communication between health professionals who contribute to the care of an individual. Clinical documentation

is also needed to support continuing care of the patient and to provide a legal record of the treatment and care provided. A range of clinical information technologies have been introduced to EMS environments, including electronic patient care records, computerized decision support systems, telemedicine, and various mobile devices. These technologies offer great potential to improve patient care quality and enable the multifaceted information sharing that is characteristic of multidisciplinary and interorganizational healthcare. However, the successful integration of these technologies into routine practice remains a distant goal. Paper-based systems still dominate, and the development, application, and evaluation of new technologies for information capture, classification, storage, and retrieval are in their infancy. Understanding and shaping the ways in which information technologies are used in multidisciplinary trauma care is a critical task for future research. The impact of these technologies on information sharing and the quality of patient outcomes will be context dependent and may have unintended consequences.

8.3. Privacy and Confidentiality Considerations

Ensuring the privacy and confidentiality of patient information is a core ethical duty in health care and a legal requirement in many countries. EMS providers, with their unique access to patients in the home and at the scene of illness or injury, are faced with a number of specific challenges related to patient privacy. The traditional practice of radioing patient information ahead to the receiving hospital, while the transmitting physician provides advice on patient management, poses a risk of inappropriate disclosure of patient information. While this radio communication is efficient and often of great educational value to prehospital providers and the hospital staff, it should be reserved for non-sensitive cases. Measures should be taken to ensure that patient information divulged in this manner is limited to healthcare providers who are involved in the patient's care or are using the information for purposes of medical education. Encryption of radio transmissions may be necessary to prevent unwanted interception of patient information.

Written or electronic transmission of patient care records to the receiving hospital for cases involving medical consultation and all patients who remain unidentified (treating such a patient as if they were identified) is a preferable alternative to radio transmission of information. Measures should be taken to ensure that care records are not lost, stolen or inappropriately disclosed. As prehospital providers commonly assist law enforcement personnel in tending to injured suspects or victims of violence, it is important to inform such patients that their interactions with prehospital providers are part of the medical record and thus not confidential from law enforcement officers. This notification will allow these patients to make informed decisions about the information that they divulge to prehospital providers.

9. Training and Education for Multidisciplinary Collaboration

The most effective method of preparing for a change in actual patient care is by engaging in frequent deliberate practice in a supportive and risk-free environment. This is recognized in the development of simulation-based training and teamwork exercises in healthcare. Training involved with simulation can occur at several different levels. High-fidelity simulations are life-sized, computerized mannequins that can mimic a number of different emergency situations. This type of training is useful in that it exposes the learners to rare or critical events that they may not see during their regular field work and provides a controlled environment to learn from mistakes. This type of training can be costly and may not be readily available to all EMS disciplines. Medium-fidelity simulations involve hands-on, interactive, case-based scenarios that can be facilitated just about anywhere, from the classroom to the dispatch center. These types of scenarios can involve other disciplines and are flexible in that they can be tailored according to the needs of the learners. Finally, low-fidelity simulations can be done using tools as simple as printed case scenarios. Each method of simulation can be useful in its own right and can involve learners from all the different EMS disciplines. Simulation-based

training can also involve the use of audio and video recording which can be a valuable tool in self-reflection or as a method for providing feedback to the learner. Simulation facilitators can also incorporate feedback using the advocacy-inquiry technique and debriefing sessions can be a good forum for learners to discuss learnings and experiences. Overall, simulation-based training has been shown to improve individual and team performance during patient care and can move on to address patient outcomes if executed properly. (Ayed et al.2023)

9.1. Interprofessional Training Programs

There are relatively few interprofessional training programs that involve EMS providers, notably the recent work of NESTS and resource management training conducted with medical students. One of the barriers to the development of such programs in the past has been the strict educational segregation between EMS and other healthcare professions. EMS providers have had little opportunity to participate in educational settings with other healthcare providers and have often been relegated to the role of educating other healthcare providers about what EMS is and does, sometimes to the detriment of patients. With the development of degree programs for paramedics and the increasing professionalization of the field, it should become much easier for EMS providers to participate in interprofessional training programs. This represents a significant opportunity to advance the role of EMS within the healthcare system. An exemplar for future interprofessional education involving EMS might begin with a simulated mass casualty event on a university campus. Medical, nursing, and allied health students would respond to the event and care for simulated patients who would then be transferred to an EMS crew and transported to an emergency department staffed with other students and perhaps an EMS medical control physician.

Interprofessional education and collaborative team training programs in healthcare have garnered increased attention and support in recent years. Many disciplines recognize the value of team-based care and understand that

students in most healthcare professions are educated in silos, with little or no opportunity to experience, never mind understand, the dynamic interprofessional collaborative process. Continuing with the theme of EMS as an integral part of the larger healthcare system, it is time to bring to EMS education the concepts of interprofessional education and team-based training. Systematically developed and evaluated interprofessional training programs serve to improve communication and relational skills, which are the very foundation of team performance.

9.2. Continuing Education and Skill Development

It is anticipated that professionals will not retain facility for multidisciplinary work solely through initial training and education. Therefore, in order to maintain and develop the skills learned through interprofessional training, continuing educational opportunities must be made available. There is a dearth of literature regarding continuing education in the context of multidisciplinary collaboration in healthcare, and virtually no empirical work. However, there is thorough literature which indicates that continuing education and professional development activities aimed at an interprofessional audience can influence healthcare practices. For example, Reid et al. studied the effects of continuing education on self-reported and observed clinical practice of health professionals. The study found that interactive multifaceted educational interventions significantly improved reported clinical practice in some areas and significantly improved observed clinical practice in others. Although the authors did not explicitly state that their work was based around continuing education for interprofessional groups, it is plausible to suggest that the nature of the intervention, which included workshops and tailored visual educational material, would be suitable for a multidisciplinary audience. This study and others show that continuing education can improve healthcare practices, thus it is reasonable to suggest that continuing education for professionals involved in multidisciplinary collaboration can serve to maintain and develop the skills required for such work. A recent

systematic review by the World Health Organisation provides further evidence that continuing professional development activities can have an impact on health professional practice and patient outcomes. The review investigated the effectiveness of various types of continuing professional development activities on the practice and patient outcomes for different health professionals. Although not specific to interprofessional groups, the evidence provided does suggest that various educational activities would be effective for maintaining and improving the practice of professionals working in multidisciplinary teams. (Staicu et al.2020)

9.3. Simulation-based Training and Teamwork Exercises

High-fidelity simulation-based exercises are being implemented across the professions in EMS. Using scenarios designed to reflect reality, involving working in teams to manage adverse events, simulation-based training creates a safe environment for learning. By allowing professionals to learn from their mistakes without risk to patient safety, it provides a way to improve team skills and manage complex presentations. High-fidelity simulation has been shown to improve a wide range of clinical and non-technical skills at individual, team and whole service levels, with variable long-term outcomes. An area such as anesthesia has shown that training methods of this type combined with establishing standardised competencies can improve patient outcomes. The potential for improvement is huge, with evidence showing that exercise participation rates and favourable learning experiences can produce sustained changes in practice over time. It has been suggested that we are yet to see the best of simulation-based training in health, indicating that it is underused and there is potential for greater outcomes.

The concept of using simulation-based or experiential learning to improve safety was first identified in high-risk work environments. It has been recognised that experiential learning is a valuable, if not essential, way for professionals to learn about teamwork, communication, and how to handle complex and ambiguous tasks.

This is particularly important for health professionals, whose skills are often obtained and then refined 'on the job'. There is now evidence from a variety of high-risk industries that simulation-based learning can be effective for learning about and improving safety and can lead to improvements in skills, work practices, and most importantly, patient outcomes. This area of learning has also been highlighted as a priority by Australasian health and safety organisations.

10. Quality Improvement and Patient Outcomes in Multidisciplinary Collaboration

Multidisciplinary teamwork is the current focus of many researchers and practitioners. The principle of multidisciplinary teamwork in the healthcare environment is both simple and logical. The complexity of contemporary healthcare has witnessed the emergence of numerous specialties and professional groups, each with a focus on specific aspects of patient care. Multidisciplinary healthcare is not limited to a team consisting of primary caretakers, such as general practitioners and practice nurses. It is a collaborative approach to healthcare that seeks to involve all relevant health professionals working with the patient to make joint clinical decisions and shared management plans. The involvement of the patient in such decisions is vital. This will enable the patient to understand the multiple perspectives of their health situation and the treatment options available, providing a well-informed and active role in their own care. The logic behind multidisciplinary healthcare is sound. It is widely believed that the joint expertise of a range of professional groups will ultimately provide a higher standard of care in a situation where complex problems can be addressed by an appropriate specialist. The combined efforts of different professions will help to find the most appropriate treatment and management of a particular case through the free flow of information and ideas. Joint decision-making and management planning are more comprehensive and carried out at a higher level when compared with those of a single profession, and the patient will directly benefit

from the collective knowledge and skills of the team. An informed patient who is actively involved in their own care will feel supported by the team in making specific decisions that enhance their health outcomes. (Flores-Sandoval et al.2021)

10.1. Performance Metrics and Data Analysis

The development of performance metrics for the purpose of quality improvement and research at this time is investigational. It is not yet well linked to definitions of specific desired changes in care, and very few changes in care have well-defined performance metrics to assess their impact. An example of a specific desired change in care is the interval from arrival on scene to the delivery of a specific treatment. An example of a poorly defined change in care is the impact of becoming a paramedic level ambulance service vs remaining an EMT-I level service. Recommended practice and the complexity of medical calls have changed such that there are wide regional variations in what level of provider and skills are needed to best serve the patient. It is likely that the impact of prehospital provider level will best be assessed studying the differential outcomes of specific types of patients treated by providers with different skills. At present, the best performance metrics for this are not known. A challenge in studies of changes in care and performance metrics is avoidance of creating an undue administrative burden on agencies and ensuring that analyses are focused on the study of care and not simply comparison of agencies for purposes of ranking or pay for performance.

Currently, an EMS-specific model of research quality improvement using NEMSIS data is being developed by the National Association of State EMS Officials (NASEMSO) and the National Association of EMS Physicians. The goal is to enable local agencies to securely analyze their own data for continuous quality improvement and participate in multi-center studies using de-identified data from many agencies. An example of a simple before and after NEMSIS data analysis would be a study of the impact of a change in a statewide protocol on the rate of on-scene termination of resuscitation for out-of-hospital cardiac arrest. An example of

a more complex study would be the use of propensity score matching to compare outcomes for patients with traumatic brain injury transported to different types of facilities (i.e., comprehensive vs non-comprehensive) with an analysis of matched pairs of patients that controls for differences in case mix in an observational study. This type of research is important because there are several widespread changes in EMS care that have been based on expert opinion or extrapolation from studies done in other settings, that have never had their impact on patient outcomes effectively assessed.

Performance metrics and data analysis are the backbone of quality improvement. To determine if a change has led to an improvement, there must be a way to measure the effect. While considerable research has been done on quality improvement in specific hospital-based medical conditions, there are relatively few published studies looking at the process of quality improvement and its impact within the interface of prehospital and in-hospital care. Studies have looked at specific interventions such as thrombolytics, using time to treatment as a performance measure and demonstrating an association with improved survival and functional outcomes. A controlled before and after study has demonstrated that implementation of a continuous quality improvement initiative could alter the pattern of in-hospital after resuscitation care in a manner that was associated with a 27% increase in the probability of surviving to hospital discharge.

10.2. Continuous Quality Improvement Initiatives

An approach to try and standardize certain treatments through national guidelines may be the key to begin showing positive clinical outcomes from quality improvement initiatives. National guidelines provide a starting point for evidence-based practice. Variability can be reduced by having different systems implement specific protocols and then measuring outcomes between them. This allows for comparison to determine the best course of action. Continuing to measure and compare outcomes is fundamental in determining the effectiveness of

treatments and thus quality improvement in the long run.

A lack of personnel educated in research techniques and theory, in addition to minimal access to resources, has resulted in slow progression. Unlike in areas such as cardiology or trauma, the transition of research evidence to actual clinical practice is lacking. This is due to the high variability in both patient presentations and available resources to deal with them. The same treatment for a specific condition may not be appropriate in different systems or situations.

Continuous quality improvement initiatives can be substantial and effectively ongoing if an environment is in place to support them. The nature of EMS research and the development of an evidence-based approach are both quality improvement initiatives in themselves. Implementation of innovative programs and measuring results are additional examples of how quality improvement is taking place. Despite the fact that an evidence-based approach has started to take form in EMS, it is apparent that the industry has a long way to go.

10.3. Impact on Patient Satisfaction and Clinical Outcomes

Findings from studies examining multidisciplinary collaboration on patient satisfaction have been mixed. While some work suggests that paramedic-involved referral systems were perceived as beneficial by patients, 10 other work suggests that patients often do not know nor understand the role of paramedics and therefore expected some form of treatment or diagnostic testing by a physician. 3 An early analysis of the IMPACT model demonstrated that patients in the full IMPACT group (acute and alternative care with referral services) were more satisfied with their health care than patients in the conventional care group. 9 The difference in patient satisfaction was not significant between the acute-care only and alternative care groups. Measures of patient satisfaction have ranged from reports of patient-perceived stress levels during the transportation and referral process, 12 to patients' reports of satisfaction with their healthcare provider and perceived effectiveness of receiving care. 6

Because patient satisfaction reflects an individual's general experience of care, some of the effects of increased or decreased satisfaction due to prehospital care or referral decisions may be difficult to measure. Stepwise improvements from changes in care may affect patients' overall perception of care, yet go undetected when specifically examining patient satisfaction with recent medical encounters. Measures of patient satisfaction and perceived effectiveness of care are essential in determining whether changes in prehospital transport and referral have a positive effect from the patient's perspective. Measuring and understanding the relationship between prehospital or emergency care decisions and patient satisfaction with medical care is perhaps more straightforward than determining the effects of such decisions on a patient's clinical outcomes. Clinical outcomes often involve complex sequences of events and may be confounded by many variables. Yet good measures of medical care effectiveness should relate to improvements in specific clinical conditions and overall health. 6 Although many studies have been observational in nature, some have involved experimental or quasi-experimental designs to determine the effects of specific interventions on clinical outcomes. (Jetty et al.2022)

11. Challenges and Barriers in Multidisciplinary Collaboration

When multiple professionals come together from different disciplines to work as a team, challenges arise. Interprofessional communication often causes quite a few problems. It is confusing enough when two people from different disciplines use the same word and mean different things. An example of this would be the word "head". A paramedic using this word would be talking about the patient being in the front area of an accident or the "head" of the accident. For a physician, this could be interpreted that there is a head injury involved. These misunderstandings could be detrimental in a patient case. Research shows that the quality of information transfer from one health professional to another is quite poor. This again could be another dangerous situation

involving a patient. The paramedic may not fully understand a set of orders he has received from a physician, and in turn, the physician will assume that they have been carried out. This could lead to medical errors and adverse effects for a patient. Another factor that needs to be addressed is the language barriers that are present in many different countries. With medical terminology complex enough in its own right, when trying to speak a second language, there is massive room for error. Inaccurate use of medical terminology could have dire consequences. An example of this was seen in the late 90s with Japan Airlines flight 634. A communication error involving radio silence and misunderstanding a clearance to descend led to a mid-air collision. Utilizing an airline example goes to show simple misunderstanding from the use of standard English in the aviation industry, let alone mixing languages in a healthcare environment.

11.1. Interprofessional Communication Challenges

Interprofessional communication, both oral and written, is vital to the success of patient care. It allows for the exchange of thoughts and ideas among disciplines, prevents duplication of services, and facilitates effective and efficient use of resources. Poor communication is cited as the number one cause of all sentinel events in healthcare system failure (Gaba, 2000). Communication errors leading to such events most often occur at points of 'handoff' of patients from one caregiver to another. These handoffs occur frequently in the EMS system, both at the scene and at the emergency department, and are a point of vulnerability in the continuity of care of the patient. Another communication vulnerability in the EMS system is the lack of familiarization among various types of providers (i.e. fire, police, hospital-based, private, nurses, physicians) because many rarely interact except at points of patient handoff. Given the wide range of educational levels within the EMS system, there are often disparities in medical knowledge and a failure to communicate in a way that is understood by all parties. This is particularly true when the paramedic must contact the input hospital physician's order and the paramedic is seeking

clarification of the order because it might not have been completely understood.

11.2. Hierarchical Structures and Power Dynamics

A hierarchical structure is an arrangement of items (objects, names, values, categories, etc.) in which the items are represented as being "above," "below," or "at the same level as" one another. The higher the level, the greater the degree of influence in decision making and in controlling resources; in other words, the amount of power increases as one moves up the hierarchy. Power is the ability to get things done the way an individual wants them to be done, by influencing or commanding the decision making processes, the behavior of others, or by the exercise of brute force. In the context of EMS and disaster response, the medical community is used to working within their own hierarchical structures, which can be a barrier to cooperation, coordination, and communication within the multidisciplinary environment. Each discipline expects to stay within their scope of practice, which is defined in part by their position within their own hierarchy, and may become anxious when unsure of how to interact with other professionals outside of their own area of expertise. This can lead to a lack of assertiveness, a fear of challenging the decisions of others, or being reluctant to pass critical information up or down the chain of command. Power struggles between disciplines may also result in some trying to assert their authority over the decisions of others that affect their own practice. The result may be decisions which are made based on what is best for a particular discipline, rather than what is best for the patient. Such behavior can have potentially disastrous effects in the dynamic and time critical environment of disaster response. At the individual level, higher power individuals have been shown to be less receptive to the input of others, and more resistant to changing their decisions.

11.3. Resource Limitations and Time Constraints

In other instances, the unavailability of various specific healthcare professionals at different

times of the day may lead to a lack of respect for their importance in the overall management of a patient's condition or a specific condition. For example, the unavailability of a neurologist at major and crucial times of patient diagnosis and assessment of overall condition and prognosis at any stage during the acute phase of a stroke may prevent the development of timely and effective management for stroke patients.

The departmentalisation of work and absence of shared goals and vision among different healthcare professionals can act as a significant barrier to the delivery of effective care and timely patient outcomes. The presence of both time and non-severe patients may also affect the amount of time and willingness given to a situation by some healthcare professionals, thus affecting the delivery and outcome of care. The deadline-driven nature of the response of emergency services translates to stress and pressure for the varied healthcare professionals involved, often resulting in poor interpersonal relationships and an unsatisfactory team climate provided.

12. Future Directions and Innovations in Multidisciplinary Collaboration

The text only for section "12. Future Directions and Innovations in Multidisciplinary Collaboration". S.M. Boyd, B.C. Agostini and J.P. Davey

12.1. Integration of Telemedicine and Remote Consultations

Telemedicine is the use of electronic communication and information technologies to provide clinical services when participants are at different locations. It has been used in various ways to improve patient care by increasing access to medical information, allowing remote consultations, and remote patient monitoring. This can be of great interest and help to an EMS system. It could provide better and more immediate medical control to paramedics in the field. For instance, in a system that uses physician medical control with online medical control, the online physician could consult a specialist for a particular patient's needs, all the

while the paramedic is still in the field with the patient. This consultation could take place without the need to transport the patient to a hospital that has the same specialist. With telemedicine, there could be better access to up-to-date treatment protocols for various conditions from the receiving hospital physician. This can be accomplished with a database of protocols that the physician has access to during a remote consultation with the online physician or the paramedic in the field. Finally, the monitoring of patients with chronic diseases can greatly decrease the number of repeat emergency calls by these patients. With home monitoring devices such as blood pressure cuffs, blood sugar monitors, or even devices to check heart rhythm, paramedics can consult a patient's physician while assessing the patient and using findings to update the patient's medical record which the physician has access to. All of this can be done without the need to transport the patient and can greatly improve the care of these patients. (Kim et al., 2020)

12.2. Artificial Intelligence and Decision Support Systems

There are several challenges standing in the way of clinicians as they attempt to translate the complex and expansive body of biomedical knowledge on the bedside into successful assessment, treatment, and therapeutic decision making. Part of the difficulty comes from the necessity to draw on basic science knowledge from a number of different disciplines, to incorporate this information into the patient assessment, and finally to choose the best treatment strategy based on the assimilated knowledge. The increasing volume of medical literature available to guide clinical decision making is almost as daunting a task as the literature itself – it is estimated that a conscientious researcher would need to read 19 articles a day, every day, just to stay abreast of relevant literature. Finally, the sheer volume and complexity of diverse information that clinicians must assimilate makes it difficult to know what information to apply, to weigh the information against possible courses of action, and to make the best decision. All of these cognitive tasks are done under the constraints of time and in an environment of information

overload. Artificial intelligence and decision support systems have the potential to improve medical decision making by facilitating the translation of biomedical knowledge to clinical knowledge and by providing support in evidence assessment and weighing the balance of probability for different treatment options.

12.3. Interdisciplinary Research and Evidence-Based Practice

In the UK, particularly fruitful areas for such research are the interface with primary care and the role and effects of accident and emergency departments. Some work has recently been undertaken in these areas by nurses, general practitioners, social scientists, and health service researchers. Our studies of handover and the management of older people presenting with falls at the ambulance and emergency department interface exemplify the additional insights to be gained from mixed disciplinary approaches. The future reorganisation of emergency and urgent care services proposed by the NHS plan offers an ideal focus for a concerted research effort involving researchers from diverse disciplines and encompassing a wide range of outcome measures. High-quality methodological work is also needed to develop and test tools for the evaluation of the complex interventions typical of emergency care.

Previous research and strategies for evaluation of emergency medical services systems are based largely upon perspectives and outcome measures developed within individual clinical disciplines. There has been little interdisciplinary exchange and few studies based on mixed teams of researchers. Given the complexities of the organisation and delivery of emergency care, the lack of a multidisciplinary approach is a major deficiency. Clinical, behavioural, and organisational scientists from relevant disciplines need to come together in the pursuit of a fuller understanding of the issues involved and the development and testing of innovative strategies.

13. Conclusion

In conclusion, the concept of teamwork in the context of the healthcare arena is a complex and difficult variable to measure. However, the increased focus in recent years specifically on the quality of patient care and patient outcomes in EMS has brought to light the importance of effective collaboration of the various professionals within the EMS system. EMS, as an emerging component of the healthcare system, has been dramatically influenced by the managed care environment which has caused an increased awareness by providers of the need for interdisciplinary teamwork, education and research. These efforts hold great promise for improving the consistency and quality of care in the prehospital phase and the significant impact that prehospital care has on patient outcomes in the acute care setting. However, there is much work to be done in identifying the specific factors which make teamwork such an essential component of high quality care and in the methods to enhance the various components of teamwork. A great deal can be learned from other industries and from what is known about teamwork in the acute care setting. Findings from this work will be critical in guiding the continuing development of the prehospital and emergency medical system and in improving outcomes for a broad range of emergency conditions. This paper has provided an overview of what is known on this topic and has suggested a framework for future research to bridge the gap in knowledge.

13.1. Summary of Multidisciplinary Collaboration in EMS

Recent healthcare policy has emphasized the importance of multidisciplinary and collaborative care in improving patient outcomes. There is a growing awareness of the limitations of uniprofessional care and a movement towards more team-based models of care, particularly for patients with complex and high acuity health issues. This is an era of increased professional regulation and specialization which has led to a greater emphasis on defining which provider is most qualified to deliver a particular aspect of care. While this tendency towards task allocation

based on professional skill-set is an important component of developing an efficient system of care, it is necessary to ensure that it is done in a way that does not compromise the need for providers in different fields to understand and respect one another's roles and to communicate and coordinate care with a shared patient-centered goal. Awareness of the need to balance specialization and division of labor with the preservation of effective collaboration is a key issue for EMS and one which should be addressed in team development and education. Step one to building a collaborative multidisciplinary system will be to define the various providers as members of the same team, with a common identity and clear understanding of respective roles. This will prepare the ground for shared leadership and further refinement of team processes and interactions.

The collaboration of multidisciplinary teams has been increasingly recognized as an important factor in the provision of quality patient care in the field of emergency medical services (EMS). Despite increased interest in developing the science of multidisciplinary collaboration in EMS, there is much yet to be learned from research in other fields such as teamwork, leadership, and communication. There are many opportunities for EMS researchers to contribute to the broader body of knowledge on multidisciplinary collaboration and to use that knowledge to enhance the safety, quality, and efficiency of care provided to acutely ill and injured patients.

13.2. Importance of Continued Collaboration and Improvement

Continued collaboration among EMS and trauma care disciplines is critical for improving patient outcomes. The adoption of multidisciplinary teams in trauma care has facilitated an improvement in quality of care for injured patients. Research has shown that the quality of care given to injured patients can be directly linked to the patients' outcome. This evidence has guided trauma systems to develop organized and efficient methods of caring for the injured patient from the injury scene, through the acute resuscitative phase, through to rehabilitation and reintegration into society.

Continued quality improvement process in trauma care, beginning with prehospital care, through to rehabilitation, is an essential aspect of providing the best possible care for injured patients. A constructive multidisciplinary team approach recently has been proposed as a way in which improvements in patient care can be accomplished. This methodology focuses on the specific needs of injured patients and their injuries and addresses care management as a continuous cycle with the patient always in mind. This concept is congruent with the overall objectives of the EMS Agenda for the Future and the National Highway Traffic Safety Administration 1998 Agenda for the Future, in that it strives to improve acute and chronic care of injured and ill patients and enhance the EMS systems of care, with the ultimate goal of improving patient outcomes. An evidence-based approach using data-driven decisions can provide accountability in improving patient outcomes and injuries. This has been successful in the acute trauma setting and has also shown promise in the management of specific injuries and medical conditions in the prehospital and EMS setting. Continuing research and evidence-based guideline development in the management of specific injuries and conditions can further improve care of patients in the EMS system.

Reference

- [1] Tibullo, L., Vargas, N., & Esquinas, A. M. (2020). Oxygen Therapy: Liberal Versus Conservative in Older Patients with COVID Disease. Covid-19 Airway Management and Ventilation Strategy for Critically Ill Older Patients, 135-139. [HTML]
- [2] Filip, R., Gheorghita Puscaselu, R., Anchidin-Norocel, L., Dimian, M., & Savage, W. K. (2022). Global challenges to public health care systems during the COVID-19 pandemic: a review of pandemic measures and problems. *Journal of personalized medicine*, 12(8), 1295. [mdpi.com](https://doi.org/10.3390/jpm12081295)
- [3] Battaloglu, E., & Porter, K. (2024). Advances in Pre-Hospital Care. Major Incidents, Pandemics and Mental Health: The Psychosocial Aspects of Health Emergencies, Incidents, Disasters and Disease Outbreaks, 79. [HTML]
- [4] Rakhra, K. S., Delorme, J. P., Sanders, B., & Liew, A. (2022). The diagnostic accuracy of MRI for evaluating the posterolateral corner in acute knee dislocation. *European Radiology*. [HTML]
- [5] Tandon, A., Gül Ünal, Z., & Behar, C. (2023). Urban search and rescue at heritage sites: guidance note. Version 9.0–31 March 2023. [icomos.org](https://www.icomos.org/)
- [6] van Doorn, S. C., Verhalle, R. C., Ebben, R. H., Frost, D. M., Vloet, L. C., & de Brouwer, C. P. (2021). The experience of non-conveyance following emergency medical service triage from the perspective of patients and their relatives: a qualitative study. *International emergency nursing*, 54, 100952. [sciencedirect.com](https://doi.org/10.1016/j.ien.2021.100952)
- [7] Verma, S., Wilson, F., Wang, H., Smith, L., & Tak, H. J. (2023). Impact of Community Socioeconomic Characteristics on Emergency Medical Service Delays in Responding to Fatal Vehicle Crashes. *AJPM focus*. [sciencedirect.com](https://doi.org/10.1016/j.ajpmf.2023.100952)
- [8] Wallace, D., Jallat, E., & Jetly, R. (2020). Post-Traumatic Stress Disorder or Post-Traumatic Stress Injury: What's in a name?. *Journal of Military and Veterans Health*, 28(1), 39-44. [jmvh.org](https://doi.org/10.1002/jmvh.1001)
- [9] Solomon, E. M., Wing, H., Steiner, J. F., & Gottlieb, L. M. (2020). Impact of transportation interventions on health care outcomes: a systematic review. *Medical care*. [HTML]
- [10] Byrow, Y., Pajak, R., Specker, P., & Nickerson, A. (2020). Perceptions of mental health and perceived barriers to mental health help-seeking amongst refugees: A systematic review. *Clinical psychology review*. [HTML]
- [11] Umemura, Y., Watanabe, A., Kinoshita, T., Morita, N., Yamakawa, K., & Fujimi, S. (2021). Hybrid emergency room shows maximum effect on trauma resuscitation when used in patients with higher severity. *Journal of Trauma and Acute Care Surgery*, 90(2), 232-239. [HTML]

- [12] Kjelle, E., Schanche, A. K., & Hafskjold, L. (2021). To keep or reject, that is the question-A survey on radiologists and radiographers' assessments of plain radiography images. *Radiography*. sciencedirect.com
- [13] Kaufman, J. A., Barnes, G. D., Chaer, R. A., Cuschieri, J., Eberhardt, R. T., Johnson, M. S., ... & Gillespie, D. L. (2020). Society of Interventional Radiology clinical practice guideline for inferior vena cava filters in the treatment of patients with venous thromboembolic disease: developed in collaboration with the American College of Cardiology, American College of Chest Physicians, American College of Surgeons Committee on Trauma, American Heart Association, Society for Vascular Surgery, and Society for Vascular Medicine. *Journal of vascular and interventional radiology*, 31(10), 1529-1544. portailvasculaire.fr
- [14] Rockall, A. G., Justich, C., Helbich, T., & Vilgrain, V. (2022). Patient communication in radiology: moving up the agenda. *European Journal of Radiology*, 155, 110464. sciencedirect.com
- [15] Behrens, N. H., Fischer, M., Krieger, T., Monaco, K., Wnent, J., Seewald, S., ... & Bernhard, M. (2020). Effect of airway management strategies during resuscitation from out-of-hospital cardiac arrest on clinical outcome: a registry-based analysis. *Resuscitation*, 152, 157-164. [HTML]
- [16] Russotto, V., Rahmani, L. S., Parotto, M., Bellani, G., & Laffey, J. G. (2022). Tracheal intubation in the critically ill patient. *European Journal of Anaesthesiology| EJA*, 39(5), 463-472. [HTML]
- [17] Sedlár, M. (2022). Work-related factors, cognitive skills, unsafe behavior and safety incident involvement among emergency medical services crew members: relationships and indirect effects. *International journal of occupational safety and ergonomics*, 28(2), 1281-1290. [HTML]
- [18] Phillips, J. S. (2020). Paramedics' perceptions and experiences of NHS 111 in the south west of England. *Journal of Paramedic Practice*. [HTML]
- [19] Alenoghena, C. O., Ohize, H. O., Adejo, A. O., Onumanyi, A. J., Ohihoin, E. E., Balarabe, A. I., ... & Alenoghena, B. (2023). Telemedicine: A survey of telecommunication technologies, developments, and challenges. *Journal of Sensor and Actuator Networks*, 12(2), 20. mdpi.com
- [20] Ayed, A., Malak, M. Z., Alamer, R. M., Batran, A., Salameh, B., & Fashafsheh, I. (2023). Effect of high fidelity simulation on clinical decision-making among nursing students. *Interactive Learning Environments*, 31(4), 2185-2193. [HTML]
- [21] Staicu, M. L., Vyles, D., Shenoy, E. S., Stone, C. A., Banks, T., Alvarez, K. S., & Blumenthal, K. G. (2020). Penicillin allergy delabeling: a multidisciplinary opportunity. *The Journal of Allergy and Clinical Immunology: In Practice*, 8(9), 2858-2868. nih.gov
- [22] Flores-Sandoval, C., Sibbald, S., Ryan, B. L., & Orange, J. B. (2021). Healthcare teams and patient-related terminology: a review of concepts and uses. *Scandinavian journal of caring sciences*, 35(1), 55-66. [HTML]
- [23] Jetty, A., Jabbarpour, Y., Pollack, J., Huerto, R., Woo, S., & Petterson, S. (2022). Patient-physician racial concordance associated with improved healthcare use and lower healthcare expenditures in minority populations. *Journal of Racial and Ethnic Health Disparities*, 1-14. [HTML]
- [24] Kim, H., Kim, S. W., Park, E., Kim, J. H., & Chang, H. J. (2020). The role of fifth-generation mobile technology in prehospital emergency care: An opportunity to support paramedics. *Health Policy and Technology*. [HTML]