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Review Article

" Transforming Emergency Care: An In-Depth Review of the Latest Advances in Emergency Medications"

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Abstract

The specialty of medicine that deals with primary diagnosis and immediate treatment of sudden illness and/or accidental injury is called emergency medicine (EM). EM is an extremely crucial and dynamic specialty of healthcare systems that treats the most critical patients brought to hospitals. It has been presented as the most significant field since its inception, and to date, it is still evolving and adapting to better cope with the changing needs of healthcare. The start of EM can be traced back to the mid-20th century when the need for special medical care grew in cases of emergency. During 1960-70, EM developed into a distinguished specialization for medical practitioners. The advancement and innovations in the field of medical technology have built the backbone for the evolution of modern EM that has led to various treatments for patients that are life-saving and risk-free for emergency patients. Emergency Medications are commonly classified as analgesics, antiarrhythmics, anticoagulants, antidotes, antihypertensives, antimicrobials, bronchodilators, vasopressors, and notropes. The Challenges in EM are due to the interactions between drugs and food. Another concern is to follow the Regulatory Issues and Guidelines set for EM. In ensuring the survivability and better health of patients, EM is vital for all emergency patients. The medical landscape is evolving with better resources, and thus EM needs to evolve according to the innovations and trends that are introduced in the field of medicine, such as nanotechnology, Telemedicine, Personalized Medicine, the use of AI, and remote monitoring.

Keywords: Emergency Medications, Telemedicine, Personalized Medicine

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INTRODUCTION

The specialty of medicine that deals with primary diagnosis and immediate treatment of sudden illness and/or accidental injury is called emergency medicine (EM). EM is a field that is based on practical knowledge and skills that are required for the diagnosis, treatment, and management of every aspect of the disease or injury affecting individuals of any age or group with a spectrum of both physical and psychological disorders. In EM, the most critical aspect is timing. A patient brought to the emergency room (ER) would appreciate the medical care provided in such a complex and usually turbulent environment. The practice of EM involves a basic evaluation of the patient, diagnosis, and severity check of the emergency, and then the treatment of the patient accordingly. EM also deals with recommending the patient to any surgical, medical, and/or psychiatric facility if needed[1].

In many hospitals, EM is practiced in a special department called the Emergency Department (ED), which only deals with emergency patients. In addition to hospitals, these EDs can also be present independently, as in emergency care clinics. EDs have their own response vehicles for patients in emergencies. An on-site emergency care facility can also be constructed in the event of a disaster[2].

EM is not just a need for patients, but nowadays it has also become a popular choice for medical graduates to opt for EM as their specialty. However, in the emergence of EM as a specialized field, there was resistance. But with the realization that it's the best consultation field and other medical specialists won't be harmed by it but rather, there would be less disruption for them by elimination of emergency patients from them[3].

Medical professionals are present in these departments to provide their clinical and administrative expertise so that the best healthcare can be delivered. These may include roles such as Medical response coordination, Authorization of medical response, Preparation for disaster teams, Participation in patient admission in the Emergency wards, Participation in approval for equipment admission needed for emergencies in the department, Participation in staffing in ED, Participation in making policies in the ED, Participation in making budgets in ED, Participation in the continuation of studies in staff, Coordination among departments and health care clinics in case of patient referral[4].

1. IMPORTANCE OF EMERGENCY MEDICATIONS IN HEALTHCARE

EM is extremely important for several reasons.

a) Timely care and Versatility:

The primary benefit of emergency medicine (EM) is its capacity to offer immediate healthcare to patients who are in urgent need of care and who require immediate supervision. EM significantly enhances the prospects for successful treatment and recovery, thereby increasing the chances of survival. In an emergency, every second counts, and the medical staff of the ED are trained to do so[5]. Emergency rooms in medical facilities must be equipped to deal with any type of patient or illness, as they are responsible for providing emergency care in a wide range of situations. This flexibility distinguishes these hospitals from other medical systems and makes them invaluable in crises and disaster situations. Medical staff must be prepared to handle any condition and be equipped to provide necessary care[6].

b) Gateway, Education and training:

The majority of patients who report themselves to hospitals with acute illnesses are normally taken to the ED, which acts as a reception point for those patients, irrespective of their financial means. If they require other specialized attention, these patients are discharged from the ED to other departments[7]. Nurses and physicians working in the ER have specialized education and training to handle emergency patients and, therefore, acquire important knowledge and skills to evaluate and care for the medical conditions of such patients when they arrive[8].

c) Research and innovation

The ED treats many medical conditions and different patient health complexities, which require individualized approaches. Hence, most innovations and subsequent advancements in healthcare stem from ED. In addition, the experimental and piloting of new technologies and treatments can be seen in this context due to the severity of some cases; healthcare providers may have to gamble with the lives of fatal patients in intensive care in search of innovative treatment[9].

2. SCOPE OF THE REVIEW ARTICLE.

EM is an extremely crucial and dynamic specialty of healthcare systems that treats the most critical patients brought to hospitals. It has been presented as the most significant field since its inception, and to date, it is still evolving and adapting to better cope with the changing needs of healthcare. This field specializes in the treatment of any type of emergency that makes it relevant and irreplaceable by any other healthcare specialist. They provide effective and rapid treatment, which requires experts to be quick in making effective decisions under a lot of pressure and work as the first line of treatment for patients[10].

3. HISTORICAL PERSPECTIVE.

3.1. Evolution of Emergency Medications.

In 1961, James D. Mills M.D., along with three other physicians suspended their private medical practices to become the first private group in Alexandria, Virginia to staff an Emergency Department (ED). Simultaneously, in Pontiac, Michigan 23 physicians spearheaded a comparable endeavor that ultimately resulted in the "Pontiac and Alexandria Plans" for emergency medicine. This represented the culmination of separate efforts by a handful of visionary doctors throughout the planet to establish an emergency specialist who could be summonable at any time night or day. However, they are the physicians who

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lit "the flame in the lamp" of the modern specialty, so others all over can benefit from its light[11].

The start of EM can be traced back to the mid-20th century when the need for special medical care grew in cases of emergency. Before this, the immediate care of emergency patients was also performed by general medical experts, interns, or surgeons, but due to the lack of training and standardization of these professionals, there was a gap to be filled. However, as the science of medicine grew along with the expansion in technological advances, it became evident that there is a need to fill this gap and form a new field that is dedicated to emergencies only so that EM experts can provide the unique needs of emergency care for patients[12].

During 1960-70, EM developed into a distinguished specialization for medical practitioners. This special field was formally established after the American Board of Emergency Medicine was established, which provided the groundwork to standardize special training along with certifications. Since its establishment, EM has continued to evolve with medical advancements and technological incorporation[13].

4. MILESTONES IN EMERGENCY MEDICINE

The milestone of EM involves a matrix of skills, knowledge, attitudes, abilities, and experiences that must be acquired during EM training. These milestones provided an evaluation for EM residents after six months.

These milestones were created in association with the Accreditation Council for Graduate Medical Education (ACGME) and the American Board of Emergency Medicine[14].

These milestones are designated to be designed through representatives of the organization i.e.,

4.1. Founding of the American College of Emergency Physicians

The conversation started one day between two Michigan doctors who had previously worked in emergency medicine, Dr. John Wiegenstein and Dr. John Rupke," said Kurt Spijkers, CEO of Meijer Village Medical Centerricane Gathering Place and Clinic. "Where we end up is probably as a specialty. This may be a specialty of this study. We need to get more into this area of expertise." The American College of Emergency Physicians (ACEP) was founded on 16 August 1968 by eight emergency physicians from Lansing, Michigan. John G. Wiegenstein founded the organization. A similar event occurred in Fairfax, Virginia, and afterward, these physicians became members of the ACEP.

4.2. Recognization by the American Medical Association

There was also some political activity within the House of Medicine, which was quite effective. Just four years after the founding of the ACEP, in 1972, the American Medical Association acknowledged emergency medicine as a specialty and developed the AMA Section of Interest in Emergency Medicine. To develop the specialty, the early leaders had to rebut the following claims: "There is no distinctive body of knowledge", "There are no research findings", "You will take away our patients", and "There are already too many specialties". With this victory in their pocket, the task shifted to campaigning for certification by the American Board of Medical Specialties (ABMS). Therefore, the ACEP created standards for residencies through the creation of the Liaison Residency Endorsement Committee (LREC), which was later transformed into a Residency Review Committee (RRC). The following year, 1973, witnessed the Federal Emergency Medical Services Systems Act (Public Law 93-154) that authorized the money to be given to regional and local EMS operations. In the private sector, the ACLS and ATLS were Initiated in the early 1970s. At the same time, public expectations were shifted with the help of a television show called Emergency, which introduced new Los Angeles paramedic ambulances and the doctors they delivered their patients to and the paramedical services with many pilots coming back from Vietnam have increased the programs of aeromedical transport services, which is over 500 in the present USA[13].

4.3. Founding of the International Federation of Emergency Medicine

The genesis of emergency medicine as a distinct clinical discipline can be delineated by a series of pivotal junctures and evolutionary milestones. Notably, the International Federation for Emergency Medicine (IFEM) has played a seminal role in formulating the contemporary definition of emergency medicine, which encompasses the comprehensive management of acute illnesses and injuries across diverse patient demographics and care settings, spanning pre-hospital and in-hospital domains. While the archetype of emergency medicine in the United States is widely acknowledged, there exists a spectrum of practice paradigms across global landscapes, with variations observed in exclusive pre-hospital practice or the intensive care milieu within hospital precincts. Central to the IFEM framework is the accentuation of emergency care provision within the reception nexus of healthcare institutions, commonly denoted as the "Emergency Department" (ED), a focal point within the American healthcare schema[15].

A watershed moment occurred in 1970, with the initiation of the first emergency medicine residency program at the University of Cincinnati under the tutelage of Dr. Bruce Janiak. Subsequent to this milestone, in 1971, the University of Southern California in Los Angeles established its emergency medicine residency program, heralding it as the "oldest continuously operational program" of its kind. Further, the inception of the emergency medicine program at the Medical College of Pennsylvania in 1972 epitomized the burgeoning geographic ubiquity of this discipline, endowing it with a comprehensive "coast-to-coast" presence. Initially, these nascent programs were of a two-year duration, typically following an internship phase. However, by 1980, standardization efforts had propelled these programs to a minimum of 24 months dedicated to emergency medicine training, constituting a total training period of 36 months. It is noteworthy that the evolution towards a heightened emphasis on emergency medicine training, with the late 1980s delineating a requisite minimum training duration of 36 months, with select programs extending to a duration of four

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years. The focus on the development of residency was given in 1980. Consequently, there was a realization in the field of medicine that caused the advocacy of EM in Congress. This led to the formation of the ACEP in 1985[16].

5. IMPACT OF TECHNOLOGICAL ADVANCEMENTS ON EMERGENCY MEDICATIONS

The field of emergency medicine and critical care has remained committed to change and improvement, where aggression toward the search for results has translated into positive and revolutionary consequences and, at the same time, raises questions for debate. The advancement and innovations in the field of medical technology have built the backbone for the evolution of modern EM that has led to various treatments for patients that are life-saving and risk-free for emergency patients. The integration of technology into healthcare facilities has influenced the management and dissemination of information. Some of the areas affected include diagnosis, therapy, and surgery among others[17]. The use of technology in medicine has helped minimize mortality and morbidity due to human errors in different processes by offering electronic prescriptions that include drug interactions and contraindications with foods[18].

The Internet has been used strategically when it comes to technology in healthcare facilities because it provides current information. The patient can now study the symptoms and treatments to be given to him or her to be treated appropriately[19]. These advancements enhance decision-making for both givers and takers of care in the emergency room. Automated drug delivery systems have been adopted to deliver medication to patients without delay and to minimize substance misuse.

Technological advancements have led to remarkable improvements in information processing. For example, medical practitioners can arrange the order of treatment by employing electronic medical health records, telehealth services, and other programs that can be accessed on phones. This has enabled the interaction between the practitioners with each other as well as with the patients. These have modernized several areas of medicine to help in giving enhanced techniques to offer quality health care to improve the field of medicine all over the world[20].

Integrated technologies, such as POCUS, telemedicine models, and enhanced monitoring devices, have enriched the diagnostic potential and patient outcomes of emergency care. These advancements enable healthcare providers to make more efficient and accurate assessments, make provisions for the right interventions, and correspondingly achieve better results. POCUS, for instance, covers the visual analysis of internal organs and tissues and can be useful in detecting essential conditions like cardiac emergencies or trauma[21].

The implementation of EHR systems in emergency medicine means that formalized structured information about patients is now more easily retrievable. Specifically, EHRs enable patient care decisions, teamwork coordination as well as patient histories, medications, and allergies to be documented in real-time. This integration makes it possible for a holistic view of patient care to be achieved and minimizes the chances of developing wrong diagnoses or treatment plans. The use of new technologies and new treatment approaches in emergency scenarios requires concerns about training, model adaptability, and data security. Such challenges indicate the need for extensive staff development to include continuing medical education, proper integration of emerging technologies in the health care system, and appropriate measures to increase information security to protect the patient's personal information[21]. Advancement in technology and consideration of a multi-disciplinary model is favorable to patient's health, including survival rates and time to treatment. Optimized diagnostics and immediate actions lead to enhanced rates of health for patients who are in critical conditions.

6. CLASSIFICATION OF EMERGENCY MEDICATIONS

6.1. Analgesics and Pain Management

Pain relievers are drugs that help to tame the feeling of pain in the body. Different from anesthetics that are used in surgery, analgesics do not stop signals from nerves, prevent the ability to feel your surroundings, or affect your consciousness level. They are sometimes referred to as analgesics, which means they are painkillers or pain relievers.

Analgesic opioids, also known as narcotics, relieve pain by altering the ways that the brain interprets pain signals. An opioid can be any drug of natural or synthetic origin. Some of them are morphine but newer opioids not derived from the opium poppy have also been synthesized in the laboratory[22].

There are many forms of analgesics and they include tablets and syrups, gels and patches to be applied on the skin. Some of them can be purchased without any prescription while others need a prescription from the healthcare provider. These medicines are used to give the patient relief from severe pain and/or inflammation. For instance, cases like: Surgery, Injury, Acute pain like headache, Chronic pain like arthritis[23]

The main medications that are used in the management of pain are; anti-inflammatory drugs, Paracetamol, Opioids, Hydrocodone, Aspirin, Ibuprofen, Diclofenac, Naproxe, and Oxycodone[24].

Painkillers work in various ways depending on their composition type i.e;

6.2. COX-2 inhibitors

Cyclooxygenase or COX includes two subtypes namely; COX 1 and COX 2. Both enzymes make prostaglandins. Prostaglandins are chemical compounds that have the properties of hormones that are responsible for inflammation, pain, and fever.

The prostaglandins synthesized by these two unique enzymes have somewhat different impacts on your body.

The COX-2 enzymes synthesize prostaglandins that are mostly pro-inflammatory. The majority of COX-2 inhibitors mostly act on inflammation. Several types of NSAIDs are available in the

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market, but the ones that selectively block COX-2 enzymes are referred to as COX-2 inhibitors[25].

6.3. Opioids

Opioids are fundamentally used as analgesics due to their ability to block pain signals by emulating the instinctive pain regulation systems of the human body. Peripheral neurons responsible for pain, attach to CNS neurons in the dorsal horn of the spinal cord. In the synaptic cleft of the pain synapse, the pain neurons release substance P, which is a pain neurotransmitter. It assists in relaying the pain signals to the CNS neurons which transmit those signals to the brain. The spinal interneurons are supposed to release endogenous opiates in response to stimulation from the descending neurons found within the CNS. These opiates act peripherally to block the release of substance P by binding with the pain neurons and to reduce the rate of pain signals[26].

6.4. Antiarrhythmics

Antiarrhythmic drugs are those that are used for the prevention and treatment of a fast or irregular heart rate commonly referred to as arrhythmias. Arrhythmia means there is something wrong within the electrical framework of the heart. It may race or pound, become still or flutter, and move irregularly. Antiarrhythmics are used for the management of arrhythmias including atrial fibrillation, atrial flutter, ventricular tachycardia, and ventricular fibrillation[27].

In general, antiarrhythmic drugs restore the heart to normal beats or prevent a recurrence of arrhythmia as they; Prevent an irregular, extra electrical activity in your heart and Avoid ectopic rhythms or aberrant electrical signals in the heart muscle.[28].

The common drugs administered as anti-arrhythmics are; Atenolol, Flecainide, Amiodarone, Propranolol, Metoprolol, Disopyramide, Quinidine, and Mexiletine[29].

These types of medicine are categorized into 4 classes:

Class I; works by blocking sodium channels by slowing the heart's electrical conduction.

Class II; works as beta-blockers that directly block all the impulses that may be causing irregularities in the rhythm of the heart. These medicines also affect the hormonal effects that work on cardiac cells and thus they are also helpful in the reduction of BP.

Class III; works by blocking potassium channels consequently slowing the electrical impulses of the heart.

Class IV; is similar to class III but instead of K-channels, these medicines block calcium channels of the heart[30].

6.5. Anticoagulants

These drugs are used in patients who have had cases of stenosis in their arterials and are being treated in the emergency health care facility. The drugs also play a crucial role in minimizing the chances of stroke, or, in some instances, a heart attack.

Coagulation is a normal response that is enacted by the body when a scab forms over the injured site to minimize bleeding. However, when a clot is formed in a blood vessel it restricts blood supply to a particular organ and therefore causes organ Dysfunction. Anti-coagulant drugs are then administered to prevent any formation of any more blood clots by making the blood thinner[31].

Key medications used as anti-coagulants are; Rivaroxaban, Dabigatran, Heparin, Apixaban, Warfarin, Vitamin K antagonist, Lovenox, Thrombin inhibitors, and Edoxaban[32].

These types of drugs work by affecting various sites in the blood coagulation cascade. They may act by inhibiting enzymes (thrombin) that produce blood clotting or they might bind with antithrombin as well as stopping the production of these enzymes[33].

The primary mechanisms of action for anticoagulants include,

6.6. Inhibition of clotting factors:

Anticoagulants can act directly on clotting factors, which play a role in blood clot development. For instance, heparin and other related molecules prevent the action of thrombin which is a significant component of the clotting process. Warfarin works by displacing vitamin K which is required for the production of clotting factors II, VII, IX, and X.

6.7. Platelet aggregation inhibition:

Aspirin and clopidogrel, for instance, inhibit platelet aggregation, and hence reduce the chances of clotting[34].

6.8. Antidotes

If a patient is admitted to the emergency room with toxins in his or her body, the treatment that should be offered is called an antidote. Antidotes can be classified as those that block the action of toxins from being absorbed into the body or as those that neutralize and excrete them. Antidotes are commonly known as agents that neutralize poisons; however, they are also used in the modulation of some toxic effects. Although the antidotes are designed to counter poisons, they are not used mostly for the management of these toxins but to manage certain indications of poisoning[35].

Besides, an antidote is also used in other diseases, for instance, insulin, an antidote used for diabetes. Sometimes insulin is used in the treatment of toxins and such cases, insulin is administered in large doses. Some of the ordinary medications given as an antidote include Flumazenil, Digoxin, Pralidoxime, Naloxone, Acetylcysteine, Fomepizole, Idarucizumab, Methylene blue, and Deferoxamine[36,37].

The primary goal of antidotes is to decrease the concentration of toxins in the body, and this can either be by the use of drugs that may either chelate the toxins inhibit them from the body, or decrease their potency. One of the most well-known antidotes is charcoal, which is nonselective and may be used against different types of toxins. Other specific binders are immunotherapy, chelating agents, and bio-scavenger therapy[38].

Indeed, the binding of antidotes is critical, but releasing the toxins from the body is just as pivotal. Some antidotes counteract the poison by making the urine less acidic so that

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the poison is removed easily. Antidotes can also work by competitively interacting with various enzymes, like methanol toxins[35].

6.9. Antihypertensives

Antihypertensive are types of drugs that are commonly administered in patients with hypertension; this is a condition characterized by high blood pressure. They are meant to prevent other cardiovascular issues like a heart attack, a stroke, or in its worst form, heart failure. From the quantitative research studies, it was found that a 5 mm Hg decrease in blood pressure levels has decreased the risk of stroke by 34% and that of ischemic heart disease by 21%. The probability of other risks, for instance, dementia or death due to heart-related issues, also decreases[39,40].

Some of the chief drugs that are administered to clients with hypertension consist of Diuretics, Calcium Channel blockers, ACE inhibitors, Alpha-blockers, Beta-blockers, Angiotensin II receptor blockers, Amlodipine, Clonidine, and Atenolol. These drugs work in several ways and include drugs that exert their effects through central or peripheral acting. Central-acting drugs block the outflow via vasomotor whereas peripheral-acting drugs use up or block the formation of catecholamines through nerve terminals or alter the responsiveness at the receptor site of both alpha-1 and alpha 2 category[41,42].

6.10. Antimicrobials

These are medicine substances that slow down or stop the growth of microorganisms and they are classified into different groups depending on the kind of pathogen which they act against. For example, antibacterial agents are used to eliminating bacteria causing infectious diseases, while antifungal agents are used in managing fungal diseases. Bacteriostatic therapy is the treatment of bacterial infections, while bacteriostatic prevention is the use of antibacterial drugs to prevent infections. Different cleaning materials including bleaching can be used on inanimate objects to eliminate microbes and help control diseases. Examples of their use are in sterilization of the skin before undertaking surgical operations in the case of humans. Drugs that are applied in the body include antibiotics and anti-fungal.

Amoxicillin: This is a commonly used antimicrobial medication that belongs to the class of antibiotics known as Penicillins.

Tetracyclines: This is another widely used antimicrobial medicine that forms the group known as Tetracycline. These drugs operate through a variety of inhibitory mechanisms, including; cell wall synthesis, DNA/RNA synthesis, ribosome synthesis, and folate synthesis[43,44].

What one must realize is that there are several ways through which drugs can slow the growth of microbes, but it must be taken into account that the use of antimicrobial agents can only be employed under strict medical advice and prescription to prevent the development of resistance among the microorganisms. Besides, the proper prescription of antibacterial drugs can minimize threats and enhance the efficiency of therapy. The main medications that are used as Antimicrobials are Amoxicillin, Tetracyclines, Azithromycin, Clindamycin, Cleocin, Doxycycline, Amikacin, Macrolides, and Ampicillin[45].

There are various routes interfered, in which drugs work against microbes i.e., the integrity of plasma membrane, formation of the cell wall, DNA/RNA production, functioning of the ribosome as well as folate syntheseis[46]. The inhibition of the synthesis of the cell wall is achieved via ß-lactams i.e., cephalosporins, that stop the polymerization of peptidoglycans as well as via vancomycin that attaches with the substrates of the cell wall to stop its synthesis. Other drugs like Polymyxins are used that break the cell membrane causing cell leakage. Similarly, amphotericin acts against fungal cell membranes. The production of DNA is inhibited by stopping its replication via Quinolones that bind to the DNA-DNA gyrase complex in bacteria. Other drugs like Rifampin inhibit the synthesis of RNA by binding to RNA polymerase and blocking its activity. Some drugs block the activity of ribosomes i.e., erythromycin, tetracycline, and clindamycin. Also, folate which is needed for the replication of DNA is blocked for synthesis via Sulfonamides[47].

6.11. Bronchodilators

As the name describes, the drugs that are used to dilate/relax the bronchial muscles so that the airway becomes wide to make breathing easy are called bronchodilators. These drugs are given to the patients brought to the ER having issues in breathing due to allergic reactions or any other obstruction in the airway. These medications are prescribed for a long time in case of chronic condition of the patient.

In some patients, the bronchi become narrow for a longer period and with time the bronchi also become inflamed i.e., asthma, chronic obstructive pulmonary disease, or a complex group of lung diseases mostly caused by excessive smoking that slowly narrows the bronchi and causes breathing difficulties.

These drugs may be:

- Short-acting: to give instant relief during sudden cases of breathing difficulties.
- Long-acting: in cases of chronic and long-term illnesses like COPD[48].

The common drugs administered by Bronchodilators are Formoterol, Albuterol, Salmeterol, Spiriva, ANORO Ellipta, Ipratropium bromide, STIOLTO Respimat, Theophylline and Levalbuterol.

Bronchodilators mainly work by affecting beta-receptors present in the bronchi. Once this receptor is stimulated to be active, it affects the bronchial muscles and causes them to relax which makes breathing easy.

For patients who have constant breathing issues due to constricted bronchi, the medicine is prescribed for a long period but this reduces the efficiency of the drug as, after a long time, this receptor is downregulated in the bronchi. This is why, over time, the dosage of the drug is increased to achieve the results. The drugs are metabolized by the digestive system

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via cytochrome enzymes and all of the metabolized drug is excreted out via feces and urine[49].

Other drugs like Anticholinergics work by targeting receptors of the parasympathetic nervous system present in bronchi and stop their function. As the parasympathetic nervous system is related directly to the constriction of bronchi, so, if the action of this is reversed, it will relax the bronchi[49].

6.12. Vasopressors and Inotropes

Vasopressors are an example of a potent pharmacological class that causes vessels to constrict, hence increasing the mean arterial pressure (MAP). Vasopressors should be distinguished from inotropes, the drugs enhancing cardiac contractility; still, the majority of these agents exhibit both vasopressor and inotropic actions. Inotropes are different drugs in comparison to vasopressors as they can induce elevated contractility of the heart, however in many cases, a drug may have both the qualities of inotropes and vasopressors[50]. Key medications used as Vasopressors and Inotropes are Salmeterol, Albuterol, ANORO Ellipta, Formoterol, Ipratropium bromide, Spiriva, Levalbuterol and Theophylline[51].

The main mechanism of action for these drugs working for this are:

6.12.1. Catecholamines

Commonly used medicines that are catecholamine-active include epinephrine, norepinephrine as well as dopamine. As for adrenergic receptors, the most important concerning vasopressor activity is the alpha 1-, beta 1- and beta 2-adrenergic receptors and dopamine receptors. Alpha-1 adrenoceptors, present on the walls of blood vessels, elicit highly contractile effects. There are also some alpha-1 adrenergic receptors in the heart, which enhance the duration of contraction without enhancing chronotropy. While beta-1 adrenergic receptors are predominantly present in the heart, they promote inotropy and chronotropic effects but have fewer vasoconstriction implications. In the blood vessels vasodilation is caused by stimulation of beta-2 adrenergic receptors[52].

6.12.2. Vasopressin

It imitates the action of antidiuretic hormone (ADH) type vasopressin on the receptors of the renal tubule. Vasopressin also contains a stronger vasopressive capability by acting on the V1 vascular receptor. The V1 vascular receptors are largely present in vascular smooth muscle, and the V2 receptors in the renal-collecting ducts act to increase water reabsorption. De to this, it has been used in managing vasodilatory shock in patients with septic and cardiogenic causes. This infusion is used in the management of vasodilating agents and during its administration, it quickly raises the mean arterial pressure[53].

6.12.3 Dosages and Administration

Protocols are made about how, when and which medicine should be administered in a specific kind of emergency case by the Emergency Drug Administration (EDA). These protocols make sure that the procedure being followed is standard and efficient health care is being provided. For example, if a patient comes into the ER with cardiac arrest, it's on the doctors to decide whether they should administer amiodarone or epinephrine depending on the patient's condition and the rhythm of the heart[54].

With specialized prior training encompassing EM or critical care, pharmacists can help propose the best practices as well as ensure medication. In 2012, the medical director of the EMS division of the Vermont Department of Health asked an EM pharmacist at the Vermont Academic Medical Center to critique the 92 drafts of the new standard of care protocols for the statewide pre-hospital emergency services, the 62 out of the 92 drafts, were related to medication use.

The pharmacist offered over 700 suggestions on 33 protocols, which included (1) evidence-based suggestions for the use of vasopressor agents for septic shock, (2) suggestions to consider the use of the protocol for ordering and preparing medications in the pre-hospital setting, (3) suggestions for pre-hospital treatment management of pediatric shock and chemical restraints and (4) suggestions to enhance the usage of smart infusion pumps for pre-hospital care of patients by EMS personnel. Each of the referred protocols was considered and integrated with the help of the pharmacist and the alteration to their final version was set in March of 2014[55].

The key components of this protocol are following that must be followed for the medicine being used as an explanation with details of how the drug has been administered, including a nursing assessment of the patient and a comprehensive physiologic analysis of the drug and the patient., (Table 1) the contingency under which the drug shall be given, the route that should be used in administering the drug for instance tablet, injection, etc, the method through which the drug shall be administered, frequency and amount of the drug that is going to be administered, the dose, the number of doses, or the length of the course of the therapy, information about drugs to which the patient is allergic, medicines that should be taken with caution, and possible adverse effects[56]. The information

Table 1. Key components of protocol for administration of drugs in the ER

Indication of medicine	**Specific use of the medicine in the ER**
Method of administration of the medicine	Standard protocols are utilized for the administration of drugs, along with the specific equipment and location for the administration of medicine.
Dosage of the medicine used	Dosing the medicine to a patient according to their condition, age, and weight.
Precautionary measures	Sometimes the recommended medicine is not the one that should be administered and thus it should be adjusted accordingly by taking in the specific condition the patient might have i.e., allergies or medical history.

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they contain is also useful for the identification of medication and drug interactions.

7. CHALLENGES AND CONTROVERSIES

7.1. Drug Interactions and Complications

Medicines are prescribed to a patient for the betterment of his health, but in some cases, the interaction of drugs proves to be harmful rather than beneficial. These interactions of drugs may be:

7.1.1. Among drugs:

When there is a reaction among two or more medicines that are being taken at the same time. It is also easier to anticipate the occurrence of drug interactions in the primary care practice since they are quite frequent. To reduce patient risk, determining crucial and pharmacologically significant interfaces in primary care is a crucial task. Knowing the risk factors for drug-drug interactions include the following: The first action plan to avoid drug-drug interactions is limiting the number of medications administered; the second action plan is to review the treatment regimen often; the third action plan involves considering whether there is an alternative therapy; the fourth action plan is monitoring for signs and symptoms of toxicity or ineffectiveness; the fifth action plan is to ensure appropriate dosing of the medications[57].

7.1.2. Between food and drugs:

When there is a reaction of the drug being taken and the food or drink in the stomach. Pharmacological interactions occur with a variety of substances and potential or actual issues that may arise with patients on parenteral nutrition (PN). Patients who need PN also need treatment with medications that help to reduce the symptoms of the disease from which the need for PN originated. For such patients, antibiotics, painkillers, gastrointestinal and cardiovascular drugs including single electrolyte is used quite frequently[58].

7.1.3. Between drug and a medical condition:

When the prescribed drug interacts with the patient already present medical condition. For instance, if a person takes any decongestant of the nose, in case of high blood pressure there may be some unwanted reaction[59]. Drug-disease interactions (DDSIs) are complex conditions wherein the drug that is prescribed for managing a certain disease has an adverse effect on another disease in the same patient. Under these conditions, drugs must not be administered or are contraindicated and in other cases have to be dosed differently and require further monitoring. DDSIs are not rare; a study reported a prevalence rate of 13. An alert was triggered by a DDSI for 9% of the total prescriptions dispensed at the community pharmacy. It was also found that in elderly patients, only 15% – 16% of the patients had at least one drug-disease interaction. DDSI is suspected to cause serious harm or death and therefore its management is recommended[60].

Side effects produced due to any of these interactions are widely varying, out of which some are rather small whereas some can be severe and fatal. Some of the common symptoms of the side effects are Dizziness, Drowsiness, Diarrhea, Nausea, Depression, Muscle aches, Abnormal heart rate, Increased bruising, Skin rash, and anxiety. In case of any side effects, a doctor must be consulted to be safe[61].

Through the studies of the molecular networks of human diseases, chemical compound similarity networks, and protein-drug association networks, the system biologist has pioneered the field of system pharmacology or network pharmacology. As for the functional network analysis of biomolecular and chemical entities, drug developers can comprehend how a drug works in an integrated molecular system-based model, predict the safety concerns of a drug, detect ADR events as early as possible, and develop diagnostic biomarkers for personalizing treatments[62].

8. REGULATORY ISSUES AND GUIDELINES

Due to the growing scientific research and discoveries, comprehensive disease etiologies, and mounting expectations that patients expect fast, accurate, and efficient treatment, physicians have had to look for effective ways to provide optimal medical care to clients. In the specialty of emergency medicine, these pressures are undoubtedly more than in other areas. These demands have led many EMPs to seek well-trodden paths such as protocols, algorithms, and guidelines to help manage the complex diagnostic and therapeutic decision-making processes. Clinical practice guidelines are ''statements derived through a process that aims to provide recommendations on the appropriate action clinicians should take in regards to patient diagnosis and treatment. '' Effective implementation of clinical practice guidelines is considered an important means to enhance the quality of patient care and minimize unexpected changes in practice across different clinicians, and to facilitate the translation of effective, evidence-based interventions in actual practice[63].

While the concept of following such medical clinical practice guidelines should not be considered as they are compulsory choices, there has been increasing pressure from the regulatory authorities to make doctors and hospitals follow them. Failure and healthcare costs have been a problem since the 1970s, and resolving these problems assigned different governmental organizations with the improvement of quality and the standardization of healthcare. In the 1980s particularly around 1986, Peer Review Organizations which were later called Quality Improvement Organizations were developed to address several medical conditions that mostly affected the Medicare population preferably conditions such as acute myocardial infarctions, pneumonia, heart failure, and stroke[64]. They were expected to prove the efficacy for these and several other conditions by establishing quantifiable outcome enhancements to create single treatment protocols. As the principal surveyor of quality in the healthcare sector, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) was set up to oversee quality in US hospitals and to set rudimentary guidelines that hospitals must follow. Even today, the Joint Commission continues to go out and conduct random

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assessments with the health care organizations to make sure they are meeting those bare minimums and to ensure that the health care centers are not only waking up knowing they can do better but that they have to do better. Joint Commission standards are applicable based on the type of healthcare facility; however, hospitals and other healthcare facilities aiming for Joint Commission accreditation must meet at least 20 key performance measures and hospital quality measures. The departments of Public Health and other state and local governing bodies award hospitals using similar grading systems. As an additional incentive, the authorities overseeing Social Security demand that hospitals comply with the standards set by the Joint Commission to receive governmental funding for Medicare and Medicaid[64].

Policies that are made for the practitioner in the emergency room are made on both regulatory and legislative levels. This is why, regulatory advocacy works as a tool that can produce a change. These agencies are made for regulation, and present with laws that are legislated. For example, the Food and Drug Administration (FDA) as well as the Center for Medicare and Medicaid Services (CMS). Legislation works by giving directions to a specific agency to make a protocol, these protocols provided by the agency are then implemented as regulations in the emergency department. Regulations are thus those laws that are implemented to be in action so that the procedures are carried out according to the given laws. The process of regulation and the rules that are under process are more detailed and explained in nature in comparison to the legislation upon which these regulations are made[65].

As the regulatory rules are extremely important, there are specific regulatory agencies to keep check on the regulatory processes, and their staffing is thus made in a way that the staff is not working actively as a health care professional so he/she can be unbiased. The regulatory staff is trained to define the rules of a procedure as well as address any issue in a way that is suitable for the specific medical emergency according to the patient's condition.

There are two stages in which a proposed regulation is approved i.e.(1) Before the rule is made and (2) Public hearings. Before a rule is made, a draft of the rule is formulated within the regulatory agency based on approved legislation as well as the agenda of the administration. During the next phase, various organizations and citizen can advocate their agenda accordingly in the public hearings so that the final regulation can be influenced[66].

9. TECHNOLOGICAL ADVANCEMENTS IN EMERGENCY MEDICATIONS

9.1. Innovative Drug Delivery Systems

A drug delivery system also known as a controlled release system is a formulation or a device that helps in the delivery of drugs and the release of the drug substance in the desired site of the body at the appropriate rate and time. This process involves the application of the therapeutic product, the dissolution of the active ingredients in the product, and their diffusion across the biological membranes at the point of utilization. Another definition of the term therapeutic substance is an agent like gene therapy, which when administered, will stimulate the in vivo synthesis of the actual therapeutic agent[67].

9.2. Oral Drug Delivery Systems

Of the various routes, the oral route is still the most popular and favored mainly because of its ease of use, adhesion to the prescriptions, and non-intrusive nature. New advancements in oral drug delivery systems include approaches directed at addressing issues such as inconsistent absorption, degradation in the gastric environment, and the need for multiple administrations per day.

- Enteric-Coated Formulations: They do not dissolve in the stomach to enable drug release in the intestines. This is particularly important with drugs that are affected by gastric acidity and or enzymes. This in turn enhances the absorption and therapeutic value of the drug by minimizing the vulnerability of the drugs to degradation[68].
- Gastroretentive Systems: They are designed to provide controlled release in the stomach by increasing its passive retention time. Floating and mucoadhesive systems are common techniques used by this system. These systems assist in improving the adsorption of drugs, particularly those that possess an adsorption window in certain segments of GIT[69].

9.3. Injectable Drug Delivery Systems:

This is used in especially cases where serious medication is to be administered through the body since injectable drug delivery systems are fast and accurate. Development in this area involves targeting the controlled-release formulations, biodegradable polymers, and injection mold as a means of improving the safety of the formulations and compliance of the patient.

- Controlled-Release Formulations: This is the main idea behind controlled-release formulations since the principle of operation is to prolong the process of drug release, which in turn minimizes the number of injections. This is especially the case in chronic diseases, since the conditions are long-standing, the symptoms may worsen or new health complications arise. These formulations use mechanisms of diffusion-controlled, osmotically controlled, and matrix-controlled in releasing therapeutic concentrations[70].
- Biodegradable Polymers: These are very essential in injectable systems for drug delivery. These polymers degrade into environmentally friendly products after medication release hence; they do not require removal or getting extracted from the body. Microspheres and implants made of biodegradable polymers are employed for drug delivery which release drugs for a considerable time without negative impacts[71].

9.4. Transdermal Drug Delivery:

Transdermal drug delivery systems are non-invasive and present a controlled technique for the delivery of drugs which bypasses the first line of metabolic defense encountered during the oral delivery route. These systems gradually release

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the drug through the skin hence contributing to the sustained therapeutic provision of the drug.

- Transdermal Patches: They are adhesive systems that incorporate substances that are administered gradually to the body through the skin. These patches are simple, giving sustained release of the drug and minimum side effects. They are usually prescribed for the treatment of pain, hormonal treatment, and for the treatment of smoking habit [72].
- Microneedle Patches: These are transdermal delivery systems blended with the features of microneedle systems. These patches have a small number of needles that do not hurt to inject drugs through the skin for example macromolecules which could not otherwise be transmitted through a standard trans dermal patch[73].

9.5. Inhalation Drug Delivery Systems

- Pulmonary or systemic diseases are treatable through inhalation drug delivery because they provide immediate uptake of the active ingredient into the lung. New developments in inhalation drug delivery are directed toward improving the technology of delivery devices and the processing of several respiratory drugs.
- Metered-Dose Inhalers (MDIs): MDIs release a predetermined amount of medication in the form of an aerosol, in which the patient can inhale the medicine into the lungs. Propellant-based MDIs are widely used for bronchodilators and anti-inflammatory medicinal aerosols due to the following reasons. Efforts made towards the development of propulsion-less technologies are said to have a more positive impact on the environment[74].
- Dry Powder Inhalers (DPIs): DPIs dispense unit doses of powder, which are then activated by the act of inhalation from the patient. These devices are considered suitable due to factors for ease of use, and absence of propellants. DPIs are appropriate for all types of drugs that can be inhaled, such as corticosteroids, bronchodilators, etc.
- Nebulizers: Nebulizers use liquid medications that are transformed into a mist; the patients then breathe in these mists using a face mask or a mouthpiece. These devices are sometimes prescribed for COPD and other severe respiratory disease patients who might have problems using MDIs or DPIs. Developments of nebulizers are actively progressing to optimize the process of delivering the medication75.

10. NANOTECHNOLOGY IN EMERGENCY MEDICINE

10.1. Nanodiagnostics:

In emergency medical care, the personnel, working as emergency medicine specialists, need to test and implement different approaches to facilitate decision-making and resource allocation, which is highly effective in the emergency room and has a positive impact on the results of emergency medical treatment. This includes testing of electrolytes, glucose, blood oxygen, renal function, pregnancy, infection, and cardiac enzymes[76].

10.2. Pharmacotherapy via nanotechnology

Several approaches to improving the efficacy of pharmacotherapy have been expanded through the use of nanotechnology in nanomedicine. For instance, the use of liposomes in the delivery of insoluble medications helps in the enhancement of the solubility of drugs in the bloodstream[77]. Liposomes make a structure similar to cells that are hydrophobic from the inside whereas its outer structure is hydrophilic. Also, liposomal bodies work as a shield encapsulating those medicines that are prone to an immune response and in this way, these medicines are not degraded quickly by the process of phagocytosis[78]. Similar results are also possible if materials are conjugated with site-specific antibodies or if artificial proteins and small medicines are encapsulated, which have minimal side effects[79].

10.3. Telemedicine and Remote Medication Management

Telehealth has been identified as an essential solution that has appeared during the COVID-19 pandemic. Before the COVID-19 outbreak, telehealth services were scarce, with only 13000 telehealth centers. Nevertheless, the conditions of quarantine due to the COVID-19 pandemic restricted the patient's ability to transfer to the emergency room, thus increasing the popularity of telehealth. Within a week, 1.7 million facilities started providing telehealth services.

Despite the expectation that the use of telehealth would reduce once the emergency was over and everything went back to normal, telehealth facilities are still popular[80]. This is because telemedicine has been a great help not only to healthcare professionals but also to patients, especially in emergency medicine both in the city and in the rural communities. Telemedicine has been especially useful in medications for cases where patients are given specific drugs in emergent cases. These patients may end up using the emergency medication continually since they cannot access follow-up care which will have negative impacts on their health. Telehealth facilities have helped patients to be able to receive constant care and management of their medications irrespective of the availability of medical facilities.

Similarly, telepharmacy is also making its way into the delivery of pharmaceutical services in telehealth facilities. This approach dispenses medications and extends medical care and other health-related services to patients in distant places. This system makes it possible for patients to receive the recommended medications on time thereby improving access and compliance[81].

11. EMERGENCY MEDICATIONS IN SPECIAL POPULATIONS

11.1. Pediatric Emergency Medications

More pediatric medical facilities are required in emergencies because of increased health complications caused by low-quality diets and poor hygiene. EM has been greatly adaptable in the pediatric field, enhancing the treatment approaches to

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pediatric cardiac arrest scenarios. There is also an understanding of the pathophysiologic events, that take place during and after the occurrence of a pediatric myocardial infarction as a result of improvement in emergency health care[82]. Such findings reveal a need for dedicated emergency care for children to improve the stability of pharmacotherapy and the quality of emergency pediatric care. This makes it easy for medical staff to take care of severely ill or injured children since they have the necessary skills to deal with pediatric patients.

It is therefore quite important for pediatric emergency medicine to stay abreast of different trends in medical practice, such as dosages. The change in drug and dosage types and the cessation of older drugs put forward problems for both the practitioners and the consumers, hence the relevance of this department[83].

11.2. Geriatric Considerations

In one way or the other, people develop multiple health complications related to growing age although they may be fit for some activities. Common side effects of medications in older patients are new signs and symptoms that are different from acute diseases. Thus, to reduce the probability of adverse drug interactions, it is important to conduct medication reconciliation and avoid the usage of medications that may harmfully interact. It is therefore important for elderly patients to make routine appointments with their doctors.

The elderly population is likely to experience sensory deficits (hearing and vision), mood swings, and problems with cognition. Because of these, several things have to be considered when managing elderly patients in the ER, and, therefore, such patients require the extra care of medical practitioners[84].

Moreover, some of the internal diseases are more frequent in elderly patients such as arthritis or osteoporosis which can lead to a decreased ability to move, and the elderly can also have urinary incontinence. Elderly patients who are admitted to the ER should undergo a thorough medical history assessment to identify their medical history before giving the necessary treatment for their emergency. Appropriate foods and the right medication concerning their health information must be offered to them[85].

11.3. Pregnancy and Lactation

Pregnant or feeding mothers need special need of healthcare in emergencies as any medication which is not safe can put the health of both the mother and child in danger. This is why the use of diagnostic imaging in the ER has proved to be extremely important. Due to this, there is an increased necessity for radiological medical practitioners in the ER so that they can provide proper testing of such patients before their treatment. This helps the patients by reducing the risk of any medical dangers along with management of the condition promptly[86].

It is very common for pregnant women to come into the ER during and after the pregnancy in case of emergency or any doubting conditions they might be feeling. Due to these frequent visits, the number of patients in the ER increases from 20-50%. It is also very important for the healthcare providers to coordinate with obstetric medical staff to check for any assessment of risk factors along with analysis of any warning signs that the patient might present followed by a safe medical treatment for those patients. The pregnant women may come to the ER very early on to establish the pregnancy to be positive and then proceed with the establishment of a pre-natal health care relationship or they might visit for early pregnancy complications like nausea, vomiting abortions, or any other symptoms of ectopic pregnancy. Once this relationship has been established, these patients might also visit the ER for other medical conditions that are not directly related to their pregnancy like appendicitis, etc.

In case a hospital doesn't have an obstetric facility, the patients might be analyzed for issues that are associated with labor i.e., contraction, etc. If the patient brought to the ER is suffering from critical complications i.e., hemorrhage, seizures, trauma, etc., the patient might be at risk along with danger to the fetal health and the need for special care also increases. After childbirth, 5-12% of mothers come to the ER within 6 weeks postpartum due to various complications like; infections, bleeding, hypertension post-partum depression, etc[87].

12. FUTURE TRENDS IN EMERGENCY MEDICATIONS

EM has the key responsibility of making sure that all emergency patients have better chances of survival than they would have had if they were not attended to by EM. Considering that the field of medicine continually expands with more enhanced technologies and resources, there is a need for EM to acknowledge and incorporate new advancements in the medical environment. Some of the emerging trends in EM include:

12.1.Telemedicine and Personalized Medicine

Technological developments make it possible for emergency rooms to offer medical services where they are not available, a development that has taken root in the past few years. Telemedicine is expected to remain a crucial component of EM as technology advances in the future. This will enable healthcare professionals to take their consultations to distant areas by offering medical services to the people living in such regions[88]. Another major development for the improvement of healthcare is the introduction of tailor-made treatments meant for specific patients. Realizing the fact that every patient has his or her genetic makeup and exposure to the environment, personalized emergency medical care increases effectiveness and reduces side effects. Personalized medicine enables doctors to give targeted therapies that allow patients to recover with faster rates of healing. These trends reflect the continuous changes in emergency medicine and call for the specialty to constantly adapt to advancing technologies and medical advancements to address the needs of every patient who seeks its services[89].

12.2. Artificial Intelligence (AI) and Remote Monitoring

A survey of literature on technology, especially in artificial intelligence (AI), has shown that it has revolutionized

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different fields like medical, emergency medical, and intensive healthcare. There are various uses of emergency AI algorithms in diagnosing and also in forecasting the possible outcome of the patient to ensure the course of treatment to be followed[90]. Another revolutionary innovation in the field of medicine is remote monitoring which may prove to be invaluable for the growth of EM. This includes; wearable devices such as the monitory watches containing sensors that monitor physiological parameters and other health features. These devices allow doctors to follow patient's conditions from a distance and intervene in case of urgent situations if necessary[91].

12.3. Precision Medicine in Emergency Care

The emergency care facilities that use precision EM effectively utilize information and technology in an efficient way that delivers healthcare to each patient and their community individually. A closer examination of how emergency care facilities can use EM reveals that such healthcare delivery systems capitalize on information and technology to provide customized patient care. This approach entails several processes that are different for each patient and thus achieve the desired objectives. Certain factors cause Precision EM to change, which include advancements in technology, changes in the conditions of patients, and changes in the demands of consumers. It intends to help doctors and the healthcare industry in general to stop approaching diseases as conditions that have to be managed in the same way, regardless of the patient. This method enhances the handling of patient information as there is enhancement and personalization of services offered to patients[92]. When applied and adopted with precision, EM can provide timely and improved diagnosis and personalized treatment. This has a positive impact on overall health care and puts the individual in a better position to make informed decisions[93].

13. INTEGRATION OF ARTIFICIAL INTELLIGENCE IN MEDICATION DECISION-MAKING

Traditionally, decision-making within the healthcare sector especially within the ERs has been heavily centralized with the medical teams. This is mainly caused by the observation that most patients suffer from some lack of information on the subject and may not be in a position to make any decision for themselves. Therefore, clients are sometimes forced to rely on the medical staff to make significant life decisions for them.

Often patients are challenged in providing instructions on how their treatment should proceed in the future, or when they are unable to comprehend potential outcomes of their recovery, it becomes hard for them to express their desired intent or they might have unrealistic expectations from the decisions made by their caregivers. Moreover, during emergencies, relatives and friends of the patient can be incredibly stressed, leaving them unable to make proper decisions for the patient's well-being. The foregoing scenarios present some of the challenges in healthcare delivery due to hesitation or inability in decision-making processes[94]. One of the most viable approaches is the adoption of artificial intelligence (AI) in making decisions. AI is capable of determining the best decision considering different possibilities in certain circumstances. As a result, it is transforming the medical field by helping in diagnosis, treatment planning and prognosis, and population health management[95].

CONCLUSION

Emergency medicine is one of the essential branches of medicine as it focuses on life-threatening cases most of the time. This field prides itself in the quality of services it offers and must grow along with progress in medicine. Technological developments have been seen to be positive since they make work easier for both doctors and patients. These advancements have been very helpful in saving many lives and this is why the need for better technology persists. It is therefore important to incorporate the technological advancement factor into the medical field to enhance its growth over time.

CONFLICT OF INTEREST

None

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