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Original Research Article

Investigating Recycling of Chemicals Used in Pre-Hospital Care Based on Decision Support System

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ABSTRACT

Hospital waste is one of the urban wastes produced by hospitals, clinics, medical research centers, and pharmacies. The management of healthcare waste includes production, storage and collection, transportation, processing and disposal, and preventing the production of waste materials and care. After disposal and preliminary treatment, it is one of the characteristics of healthcare waste management, which has been emphasized in these management systems due to the hazardous nature of these materials. This is an important environmental challenge in most developing countries. Failure to properly identify, separate, store and disinfect hazardous hospital waste has caused health problems and environmental pollution. According to the World Health Organization standard, hospital hazardous waste is divided into nine groups, including infectious, pathological, chemical, genotoxic, sharp and sharp, pharmaceutical, heavy metal waste, pressurized and radioactive waste. Waste produced in healthcare centers includes infectious waste, non-infectious solid waste and many dangerous substances. Treatment and disposal of hospital waste is done with the aim of changing the biological characteristics of waste materials in order to eliminate or minimize their ability to cause harm. In the existing laws of the United States of America, 20-25% of infectious hospital waste is meant, and the Center for Disease Control in this country mentions the mentioned amount as 3-5%. In general, the amount of infectious and non-infectious waste in hospitals depends on various factors that need to be investigated on a case-by-case basis to know their exact amount.

Keywords: Recycling of Chemicals, Pre-Hospital Care, DSS, Purification of Chemicals, Environment.

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Introduction

Among the hospital waste control methods are incinerators, which have many advantages over other methods [1]. But have disadvantages that have made this method not very popular in our country. Regarding the burning of hospital waste, currently a limited number of hospitals have active and semi-active waste incinerators, and most of the current hospital waste incinerators have numerous defects, the most important of which are the production of dangerous gas emissions [2-4].

Pre-Hospital Care

Pre-hospital emergency (EMS) is a comprehensive system to respond to the medical needs of patients or injured from accidents who are exposed to life-threatening factors [5-7], which is responsible for preserving the lives of these people outside the medical system until they are transferred to it is in charge of these centers [8-10]. In the pre-hospital emergency system, provision of trained personnel and their regular presence at the place of service, facilities and equipment to provide medical services, coordination and timely transfer of accident victims to medical centers are required indicators [11-13]. Also, the performance of pre-hospital emergency (Figure 1) is based on four principles, which include access to emergency care, care in the community, care on the way, and care of the patient until receiving services in medical centers.

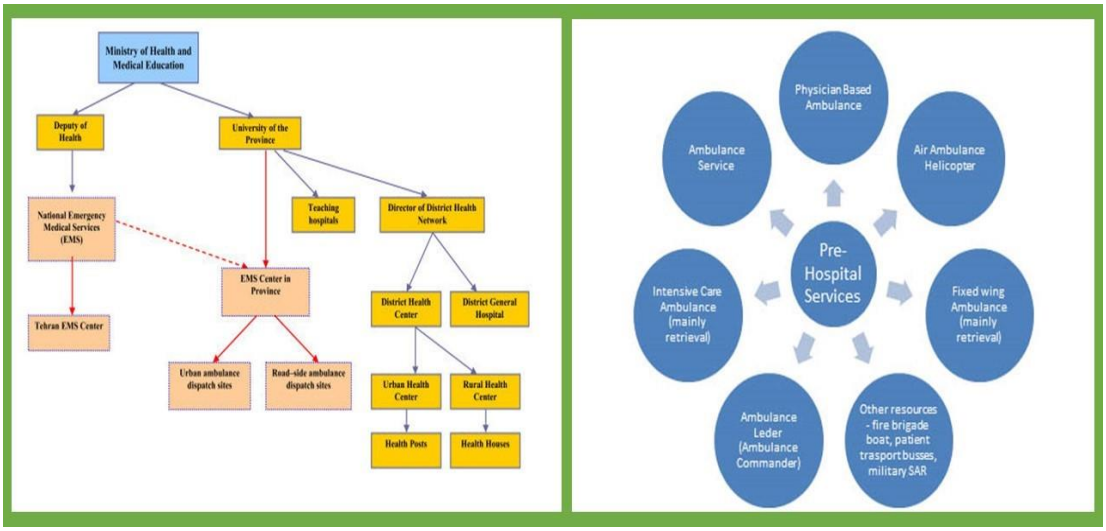


Figure 1. Pre-Hospital Care Based on Decision Support System

The World Health Organization has declared the pre-hospital emergency as an essential and inseparable part of the society and healthcare systems, which is the first point of contact with the

injured, patients and is responsible for preserving their lives until they are transferred to medical centers [14]. Today, in the world, there have been many advances in the field of improving the provision of services by the pre-hospital emergency (Figure 2), which has led to the preservation of the lives of the injured and the improvement of the health and treatment systems, including the provision of medical equipment in the appropriate volume to provide services. emergency in vehicles, as well as the use of controlled drugs such as epinephrine and morphine, and in cases of need, invasive methods such as endotracheal intubation, intravenous injection, etc., to save the lives of patients.

Figure 2. Churchill's Pocketbook of Pre-hospital Care

Based on the above-mentioned materials, pre-hospital emergency care plays a vital role in saving human life. Therefore, the faster, more correct and more suitable these services are provided, the less the lives of patients and injured are at risk [15]. Therefore, it is necessary to adopt a suitable approach to manage the provision of emergency services to the injured [16-18]. Factors causing disability and death in developed countries. In addition to the mental and physical effects on the injured person, accidents impose huge costs on society and families every year. In western countries, deaths from accidents are the third most common after heart diseases and cancers [19-21]. Since traumas mostly affect the young population, it causes more lost working years than other causes. In

different countries, various methods are used to reduce the mortality caused by trauma and its complications.

But the two main methods of this relationship are:

1- Prevention of the occurrence of thermal or severe trauma by using helmets and seat belts;

2- Pre-hospital care, which is carried out systematically and by trained people.

For this purpose, in every country, different groups transport the traumatized person [22-24]. Therefore, evaluating the performance of these groups and training them to provide better services is one of the main pillars of reducing mortality and disability caused by trauma [25]. From things such as the security of the accident area, classification of patients in case of a large number of injured, determining the need for emergency treatment, initial treatment based on a specific protocol, communication with the treatment center and quick transfer of patients and injured to the hospital, etc. It can be mentioned as the principles of pre-hospital care.

In general, the purpose of these cares is to transfer the patients [26]. Another effective measure at the scene of the accident is to classify the patients in case of a large number of injured (Delay Minor, Immediate) [27]. Research results show that the intubation of patients at the scene of the accident and the time of transfer in our country is much less than in developed countries, which can be due to lack of sufficient skills [28-30]. Regarding proper center placement, it is recommended that due to the limited number of suitable treatment centers for trauma patients, patients should be transferred to the most suitable place in the shortest time and not to a nearby treatment center that probably does not have enough facilities for trauma patients. Because the transfer of patients in our country is done by trained groups as well as ordinary people, and also considering that the problems of pre-hospital care in intubation, correct immobilization of the spine and organs and the duration of patient transfer. (According to the results of the study) for this reason, these things can be easily taught to ordinary people. Also, retraining courses for emergency service personnel are necessary in order to provide better care to the injured [31]. In the world, there is no comprehensive pre-hospital emergency model that is used by all countries, and each country has adopted a different model based on geographical, economic, political and social conditions.

Among the existing models, the two Franco-German and Anglo-American models are widely used, which are based on the method of transferring the patient or the injured from the scene of the accident to the treatment center [32]. So, that the basis of the Franco-German model is based on delay and treatment, in which medical services should be provided to the injured or the patient at the scene of the accident, and after the vital condition of the person is confirmed, they are transferred to

the medical center [33]. But the basis of the Anglo-American model is fast transportation, in this model, while on the spot, basic and vital services are provided to the injured or sick, and at the same time, without interruption, the person is transferred to medical centers and other emergency care is performed in medical centers [34].

Another way of classifying pre-hospital emergency models is based on the level of services and the range of actions performed for the injured, which are classified into (Basic Life Support (BLS and ALS) and Advanced Life Support) models [35]. The basis of the BLS model is based on the rapid transport of the patient. In this model, no invasive measures such as drug injection and tracheal intubation are performed, and only non-invasive and supportive services such as cardiopulmonary resuscitation, fixing fractures and oxygen supply. It is done for the injured and they are immediately transferred to the medical center [36]. In the ALS model, it is based on staying and treating in place. In this model, invasive methods such as tracheal intubation, intravenous injection, fluid therapy and drug therapy are used. Each of the mentioned models has advantages and disadvantages that different regions of the world use different types of methods for their pre-hospital emergency system based on their conditions. As mentioned above, the Anglo-American model is one of the most widely used pre-hospital emergency models in large areas of the world.

Considering the many advances in medical science, it is necessary to improve the models used in pre-hospital emergency and to examine their deficiencies and take action to improve them [37]. Based on this, the current study was conducted with the aim of investigating various aspects, advantages and disadvantages of the Anglo-American model in pre-hospital emergency in order to improve the performance of this model by identifying these indicators.

Search strategy and selection of articles

Search in Scopus, Google scholar, PubMed databases and by searching with keywords such as "Covid-19" and "Coronavirus 2019" and "Covid-19 and drugs" to obtain articles related to the selected keywords [38-40]. Case report articles, editorials, and articles that were not published or only an introduction of them were available, as well as summaries of congresses and meetings that were in languages other than English, were ignored. Only the original research articles that evaluated the effectiveness of different drugs in the treatment of COVID-19 using standard methods were studied (figure 3).

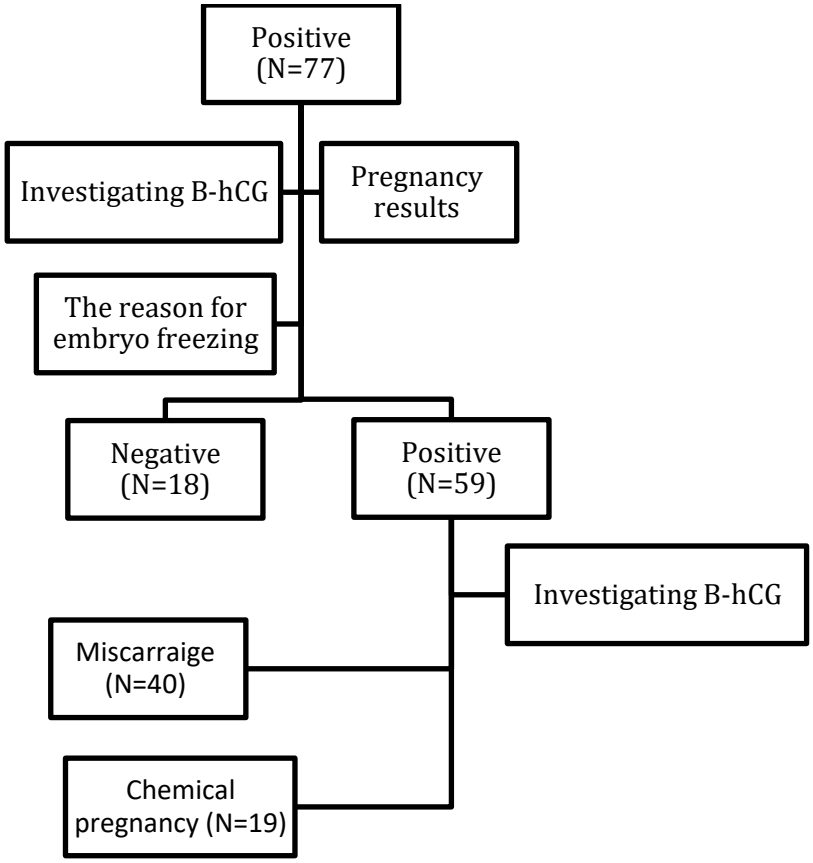


Figure 3. Flow chart of included subjects

Research Methods

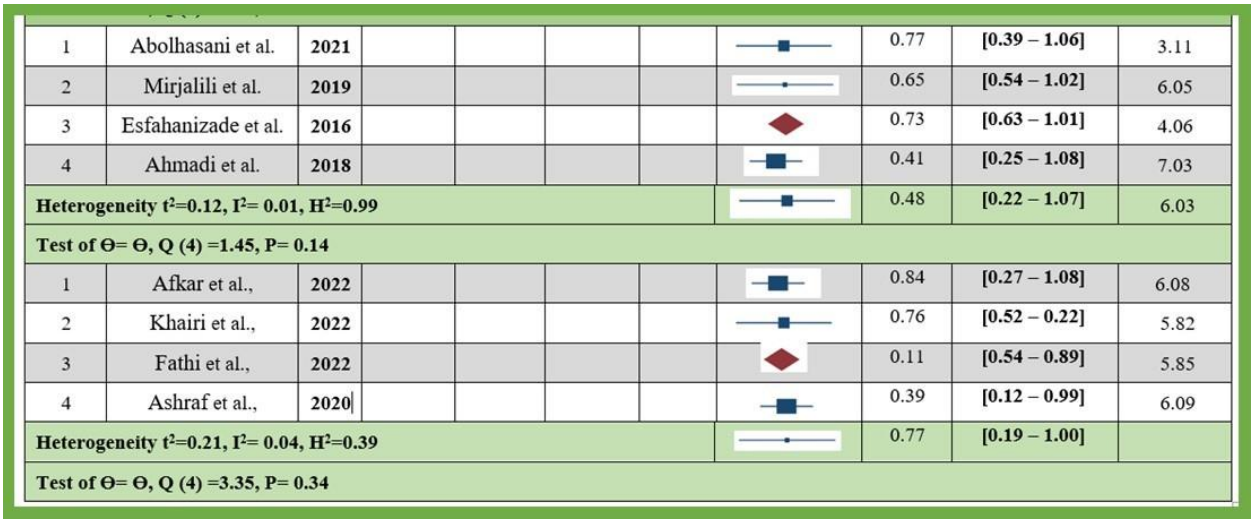
Conventional disinfection and treatment technologies such as burning, autoclave and chemical disinfection are recommended and implemented in many countries of the world. Among the new technologies, we can mention microwave and carbon dioxide supercritical liquid. Adopting the new supercritical liquid carbon dioxide technology in the disinfection of hazardous hospital waste, in addition to being an environmentally friendly method, reduces contact with infectious waste, reduces labor, and reduces costs; Therefore, it has been recommended as an alternative method in recent years. Today in the world, due to the occurrence of accidents and disasters, and many contagious and non-communicable diseases that can endanger human life, pre-hospital emergency is one of the most essential needs of society. In order to manage the proper performance of the emergency department, different approaches are used in different countries, one of the most used of which is the Anglo-American approach, which is based on transporting the patient from the accident site. Based on this, the present study was conducted with the aim of investigating various aspects of the Anglo-

American approach, its advantages and disadvantages in the world in a systematic review. The current study was conducted as a review of the Anglo-American model in the world [41]. Based on this, all articles published in this field from the beginning of 2000 to the end of 2018 were extracted by searching the databases of Web of Science, Pubmed, Scopus, Cochrane Library, Science Direct, Google scholar, Irandoc, Magiran, Medlib and SID.

Articles were searched by two researchers who are proficient in the search method independently. The required information in the articles was extracted using a researcher-made questionnaire. In the Anglo-American model, paramedics can enter the accident site by taking a short pre-hospital preliminary care training course, which leads to a reduction in personnel and equipment costs for pre-hospital services [42].

Reducing Scene Time, increasing access to emergency personnel and vehicles, and placing the pre-hospital care system alongside other relief organizations (including the police, fire department, etc.) as part of the national relief service are other advantages of the Anglo-American model. On the other hand, the absence of a doctor at the scene of the accident, the failure to perform specialized treatment and triage at the scene, the increase in deterioration or death due to the loss of time due to the possible failure to transfer the patient to a suitable specialized center and the increase in the burden of visits to medical centers due to difficulties and disadvantages of this model.

Figure 4. Forest plot showed Heart rate



1	Abolhasani et al.	2021						0.77	[0.39 – 1.06]	3.11
2	Mirjalili et al.	2019						0.65	[0.54 – 1.02]	6.05
3	Esfahanizade et al.	2016						0.73	[0.63 – 1.01]	4.06
4	Ahmadi et al.	2018						0.41	[0.25 – 1.08]	7.03
Heterogeneity t^2=0.12, I^2= 0.01, H^2=0.99								0.48	[0.22 – 1.07]	6.03
Test of Θ= Θ, Q (4) =1.45, P= 0.14										
1	Afkar et al.,	2022						0.84	[0.27 – 1.08]	6.08
2	Khairi et al.,	2022						0.76	[0.52 – 0.22]	5.82
3	Fathi et al.,	2022						0.11	[0.54 – 0.89]	5.85
4	Ashraf et al.,	2020						0.39	[0.12 – 0.99]	6.09
Heterogeneity t^2=0.21, I^2= 0.04, H^2=0.39								0.77	[0.19 – 1.00]	
Test of Θ= Θ, Q (4) =3.35, P= 0.34										

Figure 5. Forest plot showed Body temperature

Decision Support Systems (DSS)

Decision support systems are a subset of business intelligence that aim to help businesses make informed decisions based on large amounts of analyzed data [43]. These interactive information systems analyze large amounts of data to inform business decisions. Decision Support System, known as DSS, is an analytical decision-making system based on a set of information and it is programs. This information is obtained either from data entered by people (mental transactions) or from data analyzed by software (computer transactions). DSS is used to help make a decision to choose the right action or activity and thus improve the efficiency of the system.

The decision support system has three main parts, which are:

1. Management system model

This section stores models that managers can use in their decisions. These models are used in the context of making decisions about the financial and economic health of the organization, as well as forecasting the demand for the type of goods and services [44].

2. User interface

The user interface includes the tools that help the end users of a DSS to navigate the system.

3. Knowledge base

The knowledge base includes information from internal and external sources.

What are the types of decision support systems?

Communication-based decision support system: A communication-based decision support system focuses on interaction, cooperation, and coordination to help people engaged in a common task. This type of DSS allows organizations to support tasks that require more than one person to work on. This section includes integrated tools such as Microsoft SharePoint, Workspace and Google Docs [45].

Model-based decision support system: This type of DSS includes systems that use accounting models, financial models, representation models, and optimization models and emphasize obtaining a model and changing it. Also note that DSS professionals consider some OLAP systems that allow complex data analysis to be hybrid DSS systems.

Knowledge-based decision support system: These systems are called advisory systems or recommendation systems with solutions that they suggest to managers. In fact, the solution of issues and problems, in a specific field and in a specialized manner, is provided by this type of DSS. They are mainly used for activities such as classification, configuration, diagnosis, interpretation, prediction and planning. In most cases, the knowledge-based system is coordinated with data mining so that they can search the database to generate data content relationships [46.

Data-driven decision support system: These systems include management reporting systems, executive information systems, and geographic information systems (GIS). These sections focus on accessing and manipulating large databases, structured data, and external data. At the heart of any decision support system are data and information, so they have a special place in DSS. You can convert your data to backup system through the following features.

The features of Decision Support System are as follows:

1. Collect data and information: A DSS system must be able to collect data and information. In fact, collecting information is the first feature of this system. A decision system is efficient and useful if it does the job of gathering information in the best possible way.

2. Data Management: Once you have the data, you need to be able to manage it. That means, you must be able to save the collected data. In other words, a system that uses DSS must also have a method to manage the collected data.

3. Data Analysis: Raw data and information are not very useful and efficient, so they should be processed and prepared for necessary decisions by doing necessary analysis.

4. Data Presentation: Data presentation is all about how information is presented. In other words, the data presentation feature is like a kind of relationship between data and users. This user interface is displayed in the form of column and pie charts. Remember, how a DSS presents information to users makes all the difference in the usefulness of the decision support system.

What is the purpose of decision support system?

- A decision support system produces accurate and efficient information reports by collecting and analyzing data.
- In an organization, DSS is used by planning departments (such as the operations department). These departments collect the necessary data and prepare reports. The prepared report is used by managers to make decisions.
- In general, the DSS project is used in the field of sales forecasting, inventory announcement, data related to various operations and to provide easy and understandable information to customers [47].
- The use of decision support systems is very wide. These support systems can be used in different fields from an organization to the medical field.
- One of the uses of DSS in the organization is to provide real-time reports. This can be very efficient and effective for organizations that engage in just-in-time (JIT) inventory management.
- In a JIT inventory system, the organization needs real-time data on inventory levels in order to fulfill orders on time and avoid production delays. Therefore, we can say that a DSS is more than a traditional system for a decision-making person or organization.

What are the advantages of decision support system?

- The DSS system can guide the organization's processes towards optimization by using the information entered in the process and performing a set of different operations on the information of other processes (by software systems). In fact, a combination of human and computer capabilities to solve organization problems is one of the capabilities of a DSS.
- The decision support system gives better quality and accuracy to the workflow performed by the BPMS software [48].
- In this system, the user can update the behavior of the system by injecting external parameters into the DSS.
- In DSS system, with the help of web service, you can create faster and easier communication among different processes.
- Using DSS learning systems, you can optimize processes.
- A decision support system supports decision makers by combining human thinking and computer information.
- DSS system programs cover all levels of management, from senior managers to operational managers.
- It is completely flexible and has high risk power.
- DSS system expands the training process in the organization. Because for its implementation and implementation, special skills must be continuously taught to the employees [49].
- The DSS system allocates more time to decision-making by automating monotonous management processes.
- This system improves communication between people in the organization.

What are the disadvantages of decision support system?

- DSS development and implementation costs are a big investment. For this reason, smaller organizations cannot access it.
- Because DSS is integrated into daily decision-making processes to improve efficiency and speed, it can easily make a company dependent on it. Therefore,

managers should not rely too much on this system in order not to lose the subjective aspects of decision making.

- A DSS may lead to information overload. Because an information system tends to consider all aspects of a problem. This confuses users as they are faced with multiple choices.
- Implementation and implementation of DSS can create fear and reaction in lower level employees. Because many of them are not comfortable with new technologies and are afraid of losing their jobs.

What are the reasons for using a decision support system?

- **Ability to make fast calculations:** this system allows the decision maker to process very large amounts of data in a short time and at low cost.
- **Overcoming human limitations:** We all know that the human brain is very limited in calculating, analyzing, remembering and storing information. Also, a person's problem-solving power is limited.
- **Cost Reduction:** Putting together a group of experts and decision makers' costs a lot. The use of DSS system reduces these costs significantly.
- **Technical Support:** Since many organizational decisions require complex calculations and technical support, the possibility of technical support is included in the DSS system.
- **Quality Support:** Computer decision-making systems can improve the quality of decisions made. Investigating methods of recycling hospital materials.

Conclusion

There are different models of pre-hospital emergency systems in the world, and different countries usually use one of these models based on their geography, facilities, equipment, and specialized rescue forces. According to the progress made in the field of ambulance medical equipment, air emergency services and specialized training for paramedics, this model is considered to be one of the most desirable models. It is recommended to carry out more studies on the effectiveness of this model in different countries of the world in order to extract gaps, its weaknesses and strengths in order to improve and strengthen the advantages of this model and try to eliminate and reduce its disadvantages. Pre-hospital care is a subjective, multidimensional, ambiguous concept related to the health care system and diseases, and all over the world, it is focused on its importance and

improvement in burn victims. There are many definitions of emergency pre-hospital care, but still the concept of emergency pre-hospital care is incomprehensible (non-objective), abstract and intangible in nursing practice, and there are many discussions and debates about pre-hospital care in nursing, literature review and analysis. A decision support system (DSS) is a type of information system that supports business or organizational decision-making activities. By providing services to the management, operations, and planning levels of an organization (typically middle management and upper echelons), DSSs help people make decisions about changing and undefined problems. In general, these systems interact with users like a consultant, analyze information, provide managers with options for a decision by processing a large amount of data, and finally support decisions made in different situations. The decision support system supports operations and organizational planning for better decision-making by evaluating the importance or uncertainty of the results and the trade-offs related to making decisions about correct analyses, at the level of efficient management. A decision support system uses a combination of raw data, documents, personal knowledge, or business models to help users make decisions.

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