2024
https://fupress.org/journal

Research on Optimization and Algorithm of Emergency Medical Supplies Logistics Network Based on Artificial Intelligence

Anna Weissberg

PhD Candidate, Department of Industrial Engineering and Business Information Systems, University of Twente, Enschede, Netherlands
* **Corresponding Author:** ann.weissberg.ai@utwente.nl

ARTICLE INFO

Received: 10 Feb 2024
Accepted: 27 Apr 2024

ABSTRACT

Healthcare providers are expected to offer their consumers high-quality medical services. The majority of their expenditures are allocated to high-priced medical equipment and medications, thus streamlining their supply chains are essential if they are to deliver high-quality services at cheaper rates. Medical supply logistics are examined from a materials management and technology viewpoint in this chapter. Several difficulties make managing medical supply chains distinctive, complicated, and demanding. It includes the structure of the medical supply chain. Today's healthcare management difficulties include manufacturing and non-manufacturing expenditures involved with logistical tasks. Hence we proposed the Chaotic Fuzzy Artificial Neural Network (CF-ANN). First, we collected data on medical supply logistics, which was subsequently normalized and optimized using Bio-inspired Discrete Whale Optimization (BDWO) using the recommended CF-ANN (BDWO). The suggested framework is evaluated using the origin tool and compared to existing approaches to illustrate the system's effectiveness.

Keywords: Medical Supply Logistics, Normalization, Chaotic Fuzzy Artificial Neural Network (CF-ANN), Bio-Inspired Discrete Whale Optimization (BDWO).

INTRODUCTION

Medical supply logistics include managing the movement of resources and materials among facilities to facilitate clinical services. Data systems, warehouses, inventories, packing, as well as shipping are just a few of the services that are used throughout this activity. Buying, resources coordination, and control, asset tracking, handling of materials including actual availability of medical supplies, as well as providing relevant, are all included in medical supply logistics. Hospital organizational supply lines are characterized by their difficulty, individuality, as well as challenges, like extremely costly drugs and medical devices used in surgical units, challenging stock monitoring due to urgent therapies, as well as depending on the availability of medical supplies. **Figure 1** depicts the overall framework of logistic management.

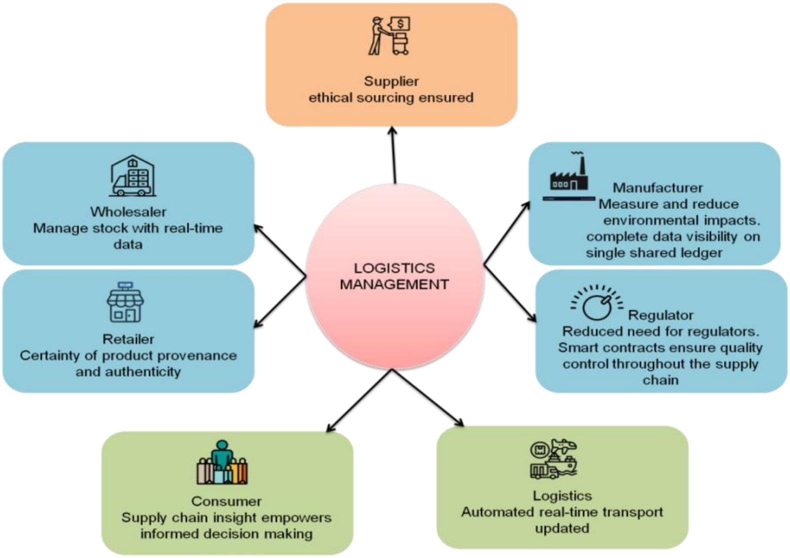

Figure 1. Overall Framework of Logistic Management

Several various kinds of supplies are housed in various storage areas throughout the hospital, as well as a variety of systems work together to provide greater quality of medical care. As more than just a reason, having effective medical supply logistics processes in place at a hospital for managing and delivering goods to medical care units is favorable. Furthermore, in recent years, the cost of logistics services have raised, accounting for 20 percent to 45 percent of total hospital operational costs, owing in part to the significant quantity of trash in current healthcare procedures (Moons, Waeyenbergh, & Pintelon, 2019). The management of the supply chain has experienced an increase in an investigation over the last 10 years. In comparison with other industries, the medical field needs to stand out due to the numerous organizational distribution networks necessary to get a wide variety of products to multiple providers. As mentioned, the supply of products such as medical supplies has developed into a large logistic network of services provided over time (Bélanger, Beaulieu, Landry, & Morales, 2018). A Logistics network is a systematic logistical support initiative in which humidity and highly delicate product are almost always delivered and kept in the environment throughout the entire process, such as space to store, manufacturing, shipping, allocation, and marketing, to make sure health and reliability items, delivery speed, and decrease logistic support stress and strain. Warehousing processing, kept at room temperature shipping as well as distribution, then ultimately sales are the four parts of the logistics network (Yu, Khan, Tianshan, & Sharif, 2018). The negative impact of deceptive medications causes customers' trust in medical organizations, hospital experts, medicines, the pharmaceuticals sector, or governmental regulatory agencies to decrease. A medical sector requires a more dependable as well as protected supply chain that can give medication tracking and tracing to supply chain managing government frameworks (Raj, Rai, & Agarwal, 2019). Models like this one are often used to describe supply chain operations and logistics, although they are not exclusive to any one organization. In the beginning, the medical equipment is supplied to producers by suppliers. Upon completion of the finished product, it is distributed and sold at different retail locations. Consumers may easily purchase the goods from stores directly. **Figure 2** depicts the architecture of Medical supplies logistics.

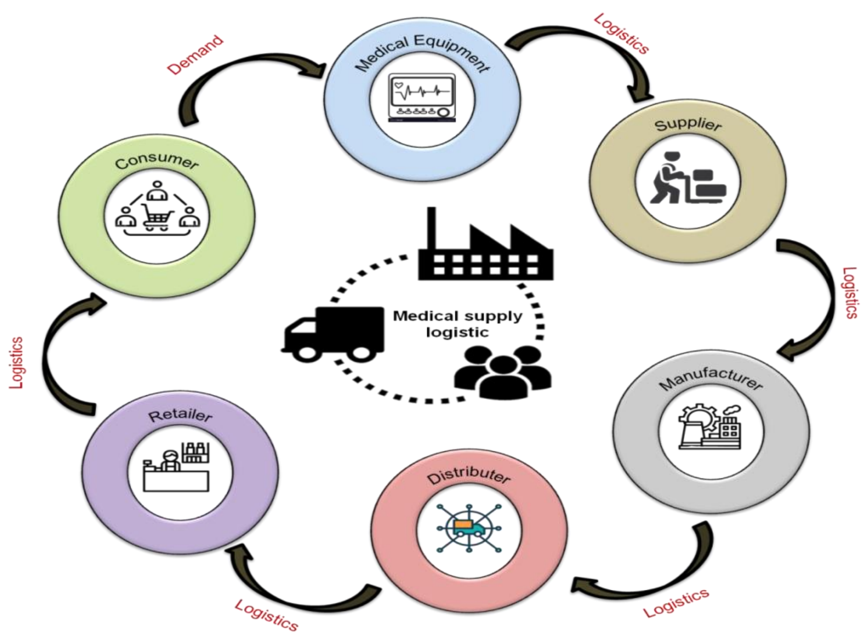

Figure 2. Architecture of Medical Supplies Logistics

Within that connection, the placement of drug distribution in medical supply centers may help to improve patient care while simultaneously lowering supply chain costs. In addition to various benefits, focusing on a supply chain may increase flexibility and bring the issue closer to reality. Concern about social and environmental needs during the COVID-19 pandemic is prompting hospitals and pharmacists to evaluate the social and environmental impacts of sustainable medical logistic network design. A collective justice of personnel (nurses and physicians) at clinics, and pharmacies, including labs, is an important notion in sustainable development. The impact of hospitals, pharmacies, and laboratories on various groups includes workplace health and safety, environmental protection, proper working conditions for individuals, investment promotion, including financial-economic expansion, among other things. Hence we proposed the Chaotic Fuzzy Artificial Neural Network (CF-ANN).

The remainder part of this research is structured as: related works with a problem statement, proposed methodology of this research,result and discussion, and conclusion.

RELATED WORKS

Sharma, Shishodia, Gunasekaran, Min, and Munim (2022) proposed to analyze the recent trends, limitations, and potential possibilities in the area of artificial intelligence (AI) uses in logistics management networks. Using intellectual networking research content analysis, it analysis identified five main topic clusters. The strategic planning process, supplier evaluation, supply chain, production scheduling, and especially sustainable supply chain management have been the topics found.

Madelin and Lahrichi (2021) suggests how to improve the medical center distribution network utilizing modeling as well as optimizations, including how to plan as well as distribute commodities, which things should have been on each truck, and how to control unpredictable usage in the logistic units, etc. They construct a simulation model based on a real-world scenario to evaluate alternative procedures and include an optimization method to discover the optimum distribution routes.

In the study by Euchi (2021), the aim was medical drone production, with a focus on the medical industry's acceptance of the technology to handle logistical challenges in medical at times of critical demand. The goal of the study was to provide an overview of medical drone production, with a focus on its acceptance by the pharmaceutical industry to alleviate logistical issues in healthcare during times of critical need. We also explore the many problems that must be overcome before drones may be used to save human lives and recommend future research possibilities.

In the study by Alizadeh, Makui, and Paydar (2020) the goal was to be applied at hospitals in Tehran's 4th municipal district utilizing the Bounded De Novo Programming technique which first aims to address uncommon causes of the issue. The problem has two sorts of resource and policy restrictions. The policy restrictions of the issue cannot be modified, which is why the bounded De Novo Programming technique is utilized to tackle the problem.

In the study by Eryong and Li (2021), many disorders are characterized by the presence of numerous odontogenic keratocysts. A 12-year-old girl was discovered to have odontogenic keratocysts on her face. A medical issue was not found in any of the further anomalies that were found throughout the examinations, it was found.

In the study by Modi and Bhoosreddy (1995), to discover problems, customized medicine makes use of fine-grained data. To better understand these new data-driven health care methods, engineers turned to Digital Twins. The state of physical things was communicated digitally by tying them to a specific location. Moral differences are implied by data structures and their interpretations. Digital twins are explored in this article. Data-driven healthcare is on the rise. An effective social equalizer might be achieved via the use of this technology.

The study by Garg (2020)showed that a worldwide epidemic of allergic rhinitis would be devastating. The most often recommended therapies in Taiwanese hospitals are traditional Chinese or Chinese-Western drugs. When it came to outpatient Chinese medicine, allergy rhinitis was the most prevalent respiratory ailment to be treated. Asthma sufferers in Taiwan are treated with a combination of Eastern and Western therapy.

In the study by Ahmed and Ali (2020), there is no radioactive element is utilized in HDR brachytherapy, enabling outpatient treatment and faster testing times. Changing the dwell time of a single-step source may increase dosage dispersion. HDR brachytherapy must be performed correctly due to the inability to do error checks due to the shorter processing intervals.

The research by Shahabaz and Afzal (2021) aimed to provide a treatment technique and technology for domestic sewage to enhance rural life. In the study by Li (2022), samples taken from vegetable farms in Zamfara State, Nigeria, have been examined for thermodynamic and organophosphate agrochemicals. It was utilized to assess the testing method and the produced data using QuEChERS with GC-MS.

Salihu and Iyya (2022) suggested the exponential growth in medical waste during epidemics, this study provides an innovative multi-objective, multi-period mixed-integer program for the construction of an efficient reverse logistics network in epidemic outbreaks.

Yu, Sun, Solvang, and Zhao (2020) resolve a post-disaster humanitarian logistics challenge including the deployment of medical care teams and the distribution of relief goods among demand sites. Wang, Liu, Lian, Hong, and Chen (2018) analyze major components of lean in the logistics and healthcare sectors and proposes a lean-TOC methodology. The technique is then evaluated in an individual case study in the Red Cross EMS transport and logistics system in Monterrey, Mexico. As a consequence of the case study, the suggested systematic lean-TOC strategy may be an effective alternative to mathematical modeling, operations research, and simulation methodologies.

Garza-Reyes, Villarreal, Kumar, and Diaz-Ramirez (2019) used complex network theory to design an emergency logistics network and examine the risk-spreading mechanism. The research initially constructs an emergency logistics network using complex network theory. The enhanced epidemic model is then combined to examine risk transmission in the emergency logistics network. Finally, this article examines the methods and processes of emergency logistics risk propagation in terms of network type, material dependability, and rescue speed.

Problem Statement

Information flows may help enhance patient flow in medical procedures. Tools like the electronic patient record help to capture data by giving specific information about the patient's history. They also serve as a link between the organization's services and the partner institutions (laboratory, hospital, blood transfusion center, etc.). Internal-external integration is difficult in hospitals. To industrialize the health industry by implementing lean logistic principles and technologies demands appropriate adaptation time and stakeholder input. Few health care organizations have been able to generalize these strategies across all procedures. Bureaucratization and top management commitment are two barriers to complete industrialization. Hospitals' strategic visions need a strong logistics culture. Moreover, an effective logistic technique is founded on important players' qualifications and talents (purchasers, logistics managers, nurses, etc.). Hospitals should improve this component by focusing on three primary axes: technical, organizational, and human interactions. We have identified numerous difficulties facing hospitals in the next years. The papers in this special issue add to this body of knowledge on healthcare logistics. Global case studies provide a greater knowledge of SCM methods such as SC integration, lean management, distribution network design, and performance.

METHODOLOGY

In this paper, we proposed the Chaotic Fuzzy Artificial Neural Network (CF-ANN). First, we collected data on medical supply logistics, which was subsequently normalized and optimized using Bio-inspired Discrete Whale Optimization (BDWO) using the recommended CF-ANN (BDWO). **Figure 3** depicts the proposed methodology of this research.

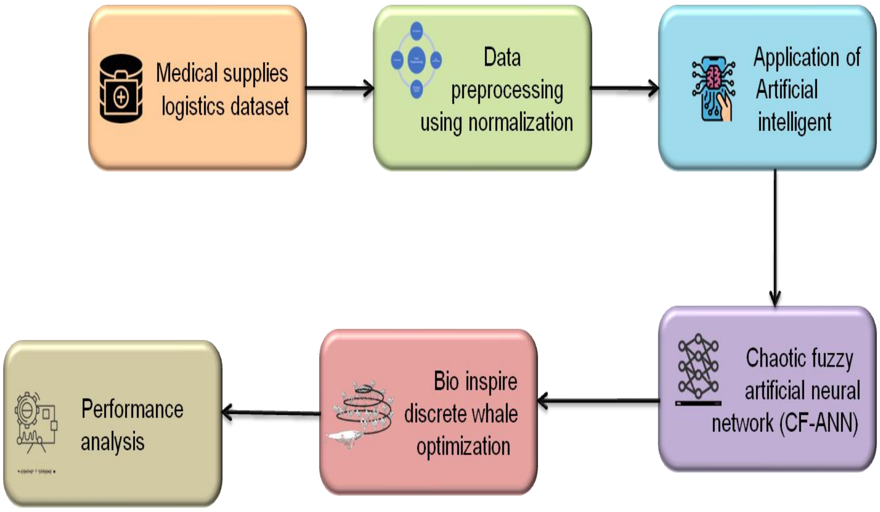

Figure 3. Proposed Methodology of this Research

Medical Supplies Logistic Dataset

The pharmacy, medical supply, and sterile supply warehouses of a Chinese hospital were the focus of our investigation. As a result of this, the hospital maintains three different warehouses for medicines, medical supplies, and sterilized products. In healthcare organizations, patient care materials are given in two ways: by a distributor to the hospital who is responsible for storage and delivery; or directly to patient care units, with no storage required. The data was gathered via a combination of on-the-job observation and interviews with warehouse, headward, and logistic process management experts. Insights about the warehousing and healthcare industries' costs. It was accomplished by keeping an eye on each employee's work. To keep track of each employee's journey from their activity ward workstation to the warehouse and back, we employed a timer to record their journey. Waiting time was not taken into account since the research only looked at service time spent by staff at every level, from the ward to the warehouse (Chen, Wu, Yang, & Cong, 2019).

Data Pre-processing Using Normalization

Before calculating the average, it is usual practice to normalize the values obtained from different scales to a theoretically common unit of measurement. For most ways of normalizing, just a simple rescaling step is needed. When a mistake is discovered, we must change the data settings to correct it. Randomness does not appear in the data, no matter how much effort is put into correcting errors. To normalize a data set, the z-score must first be calculated.

$$X = [(x-\beta)/\sigma_{Sd}] \tag{1}$$

Where β is the mean of the data and σ is the standard deviation of the data. The overall score is calculated from the mean sample and the overall sample variance when the mean results and standard variance are negative.

$$X = \frac{x-\bar{x}}{Sd} \tag{2}$$

where

$\bar{x}$ Denotes the mean of the sample. Sd Denotes the standard deviation of the sample

As a result of this normalization approach, we must change the error function utilizing a regression analysis technique. Begin using the simplest linear regression model to get started,

$$Z = \beta_0 + \beta_1 y + \epsilon \tag{3}$$

The random sample is represented by

$$Z_j = \beta_0 + \beta_1 z_j + \in_i \tag{4}$$

Where$\in_i$ is the errors and it is dependent on the β^2. The residuals are pseudo errors that can be created.

$$\sum_{i=1}^{n} \hat{\in}_i = 0 \tag{5}$$

$$\sum_{i=1}^{n} \hat{\in}_i z = 0 \tag{6}$$

There is also a hat-matrix that may be computed.

$$v = Y * (X^T X)^{-1X^T} \tag{7}$$

The Hat matrix's variance is,

$$Var(\hat{\in}_i) = \beta^2(1 - v_{ii}) \tag{8}$$

$$Var(\hat{\in}_i) = \beta^2(1 - \frac{1}{n} - [(x_i - x^2)/\sum_{i=1}^{j}(x_i - \bar{x}^2)]) \tag{9}$$

Then the residual can be calculated by

$$r_{i=} \frac{\hat{\in}_i}{\bar{\beta}} \sqrt{1 - v_{ii}} \tag{10}$$

Where $\bar{\beta}$ is an estimate if the β

$$\hat{\beta}^2 = \frac{1}{d-p} \sum_{j=1}^{m} \bar{\in}^2{}_j \tag{11}$$

Where n is the number of parameters.

$$\hat{\beta}^2{}_i = \frac{1}{s-p-1} \sum_{j=1_{j\neq1}}^{m} \bar{\in}^2{}_j \tag{12}$$

It is therefore possible to exhibit errors that are different from one another, in the following manner:

$$r_i \sim \sqrt{v} \frac{R}{\sqrt{r^2 + d - 1}} \tag{13}$$

R is the random variable.

The standard deviation is then used to normalize the variable's movement.

$$N = \frac{\mu^m}{o^m} \tag{14}$$

Where N is the moment scale.

$$\beta^n = EH(X - \mu)^\wedge M \tag{15}$$

Where R is a random variable and EH is the expected value

$$o^m = (\sqrt{EH(z - \beta)^\wedge N}\,)^\wedge 2 \tag{16}$$

In the case of a regularly distributed variableβ, the mean is used to normalize the distribution.

$$B_h = \frac{h}{\bar{z}} \tag{17}$$

Where B_h is the co-efficient of the variance.

The feature scaling procedure may then be used to bring all values between 0 and 1 again. The unity-based normalization is the name given to this technique.

$$x' = \frac{(x - x_{min})}{(x_{max} - x_{min})} \tag{18}$$

Application of Artificial Intelligence

Artificial intelligence (AI) is a kind of computer intelligence that may be trained to solve problems by mimicking human behavior and cognition. AI may increase revenues, do sophisticated analyses, produce leads by enhancing the whole thing, and develop effective and correct working methods. AI has had a significant impact on medical equipment, diagnosis, and research, among other areas. One of the most significant factors determining the future of healthcare is artificial intelligence (AI). Stock trading dynamics are the major objective and aim of AI-based financial technologies. Adaptive reasoning, algorithmic trading, and computer vision are all being used in financial operations that make use of different AI technologies.

Chaotic Fuzzy Artificial Neural Network (CF-ANN)

The Chaotic Fuzzy Artificial Neural Network (CF-ANN) has made great development in the domains of Medical supply logistics including management. Artificial neural networks (ANNs) have been able to solve many complex problems that computers could not. The most often utilized neural network models are CF-ANN and their modifications. In this non-linear mapping engine, self-study and fault tolerance are its main advantages. Most often utilized methods include approximation and data compression as well as prediction and estimation. To analyze computer-aided music, one may use a CF-ANN, a neural network that can distinguish the Medical supply logistics include managing.

There are three basic levels in a CF-ANN: i) input layer, ii) hidden layer, and lastly, output layer; the input vector must be in each of these layers.

$$x = \left[x_1, x_2, x_3, \dots x_j, \dots x_m\right], i = 1,2, \dots m \quad (19)$$

This should be the final output vector,

$$y = [y_1, y_2, y_3, \dots y_k, \dots y_o], l = 1,2, \dots o \quad (20)$$

It is essential that neurons in the buried layer get information from other neurons,

$$J^{(1)} = \left[J_1^{(1)}, J_2^{(1)}, J_3^{(1)}, \dots J_k^{(1)}, \dots J_{tn}^{(1)}\right], n = 1,2, \dots tn \quad (21)$$

Tn represents the no of neurons in layer n.

Let $z_{in}^{(g)}$ represented as weight among jth neuron in layer n-n, $D_i^{(n)}$ Denoted as is the threshold value, $m_i^{(n)}$ Indicates the input,

Then:

$$J_i^{(1)} = g\left(m_i^{(n)}\right) \quad (22)$$

$$m_i^{(n)} = \sum_{g=1}^{tn} x_{ig}^{(n)} J_g^{(n-1)} + c_i^{(n)} \quad (23)$$

ANNs are capable of digesting extensive amounts of data, however, and producing predictions that are sometimes unexpectedly correct. Computer intelligence may be a better name to describe these systems since they aren't intelligent in the traditional meaning of the word. There are numerous kinds of neural networks built by now and new ones are produced every week but all may be defined by the transfer functions of their neurons, by the learning rule, and by the connection formula.

Bio-Inspired Discrete Whale Optimization (BDWO)

Bio-inspired Discrete Whale Optimization (BDWO) in search space is used to find the global best solution for a given issue. While hunting is the exploration phase of BDWO, encircling is the exploitation phase, which is why BDWO includes three distinct operations: shrinking and hunting. The kth person in the uth generation's updated approach for the D-dimensional optimization problem is as follows:

Operation of encirclement:

$$z_{ka}(q+1) = z_{*a}(q) - U \,.\, f_{ka}(q) \quad (24)$$

Shrinking: a procedure

$$z_{ka}(q+1) = z_{*a}(q) + g^{sk}.\,COS(2\pi K)\,.\,f'_{ka}(q) \quad (25)$$

A hunting mission:

$$z_{ka}(q+1) = z_{Ra}(q) - U.\, f^{*}_{ka}(q) \quad (26)$$

$$U = 2\left(1 - \frac{q}{q_{max}}\right).\,(2t-1) \quad (27)$$

Random number in the range [0,1], t is the current number of iterations, q_{max} is the maximum number of iterations, and z_{ka} is the position vector of the best solution found so far.

The exploitation phase of the BDWO just learns and replicates the current best solution, reducing population diversity and prone to local optimization. The process of learning from random individuals has some blindness and lacks effective information flow across groups, which impacts the algorithm's convergence rate. To address these issues, a new whale optimization technique called BDWO is presented. The adaptive social learning technique establishes a social network by estimating the individual's social status and impact. This technique is utilized to build the adaptive neighborhood of whales, and a novel strategy based on neighborhood updating is devised to increase population diversity and BDWO computation accuracy.

$$v(|U| \geq 1) = 0 + \int_1^2 \int_{\frac{1}{\tau}}^{1} f\lambda f\tau \approx \frac{0}{.307} \quad (28)$$

Due to BDWO's limited exploration power, the BDWO's searchability is controlled by the probability vt, which rises linearly with iterations |U|, allowing the algorithm to do global exploration in later iterations.

Where

$$0.2 \leq W < 0.5 \quad (29)$$

$$v_t = 0.5 + w \cdot \frac{q}{q_{max}} \quad (30)$$

The algorithm can leap out of local optimization even in the final iteration if the coefficient of q_{max} is smaller than 0.5. The average exploration probability is given by Eq (31)

$$\bar{v}_t = 1 - \frac{1}{q_{max}} \cdot \sum_{q=1}^{q_{max}} \left(0.5 + 0.4 \cdot \frac{q}{q_{max}}\right) = 0.3 - \frac{0.2}{q_{max}} \quad (31)$$

When $q_{max} \geq 2$, p‾r ≥ 0.2 > 0.1535. Thus, adjusting the algorithm's exploitation and exploration may improve its global search capabilities.

RESULTS AND DISCUSSION

This section deals with the investigation of the performance of the proposed AI approach (CF-ANN-BDWO) for the optimization of the emergency medical logistics chain. The performance of the proposed model is compared to the existing models like the Fuzzy C-means technique (FCM), Distribution Robust Optimization (DRO), Deep Learning Algorithm (DLA), and Decentralized Blockchain-Based Solution (DB-BS) (DB-BS). The performance indicators employed for the comparison study include efficiency, transportation time, precision, and cost-efficiency.

Efficiency

Efficiency in medical supply logistics refers to how well a healthcare firm runs its operations. All aspects of the business which includes warehousing, transportation, and distribution in general, are affected by this issue. To make logistics a distinguishing feature in the health business, we must consider these notions since anything that impacts this area will impact the operations of the health sector. **Figure 4** depicts that the efficiency of the medical supplies logistics network optimized by CF-ANN-BDWO was higher than that of the conventional models such as FCM, DRO, DLA, and DB-BS. This indicated that optimization of the medical supplies logistics chain using CF-ANN-BDWO increased the efficiency of the distribution of medical supplies.

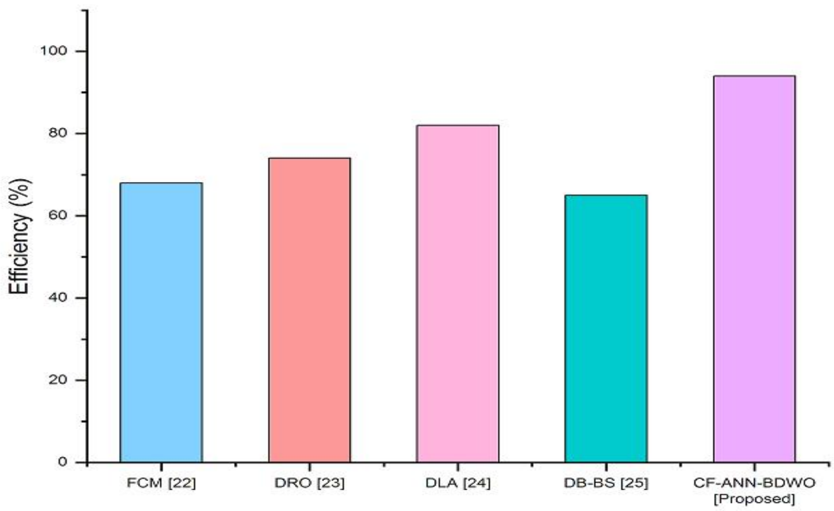

Figure 4. Efficiency of Proposed and Existing Techniques

Transportation Time

When medical products are transported, the length of time it takes is measured in transportation time. The time it takes to go from point A to point B depends on the route and the form of transportation. The intelligent logistics transit decision model is needed to reduce social risk and transportation costs while improving storage and transportation efficiency for medical supplies. It does this by combining various factors that influence transportation decisions in the intelligent logistics network. **Figure 5** shows that the transportation time taken for the distribution of materials in the medical supplies logistic chain optimized by CF-ANN-BDWO was less compared to that of FCM, DRO, DLA, and DB-BS. This proved that the proposed model effectively plans the transportation mode, path, and departure time.

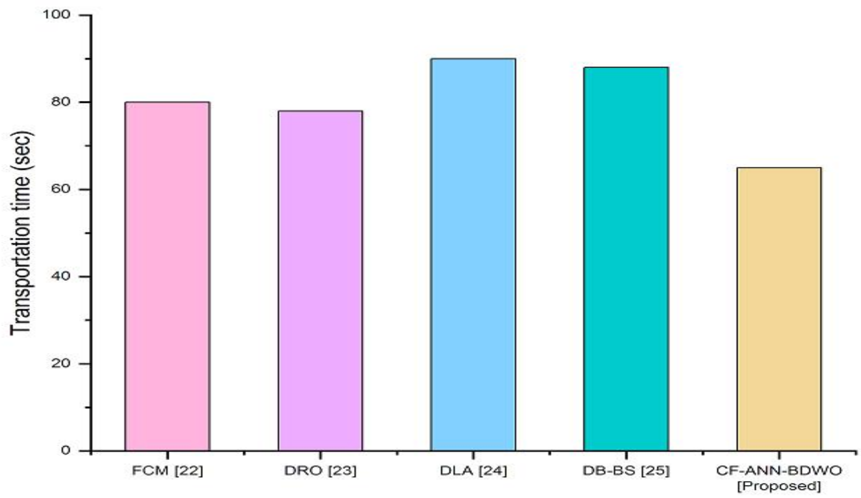

Figure 5. Transportation Time for Proposed and Existing Techniques

Precision

Precision refers to how accurately the model manages the logistic chain in the healthcare sector. It is one of the indicators of the performance of the model is the quality of the positive control and management provided by the model. The comparison of the proposed model's precision with the precision of existing models was provided in **Figure 6**. From **Figure 6**, it is observed that the precision of the proposed model (CF-ANN-BDWO) in the management of medical supplies logistic chain was higher than that of conventional techniques namely FCM, DRO, DLA, and DB-BS.

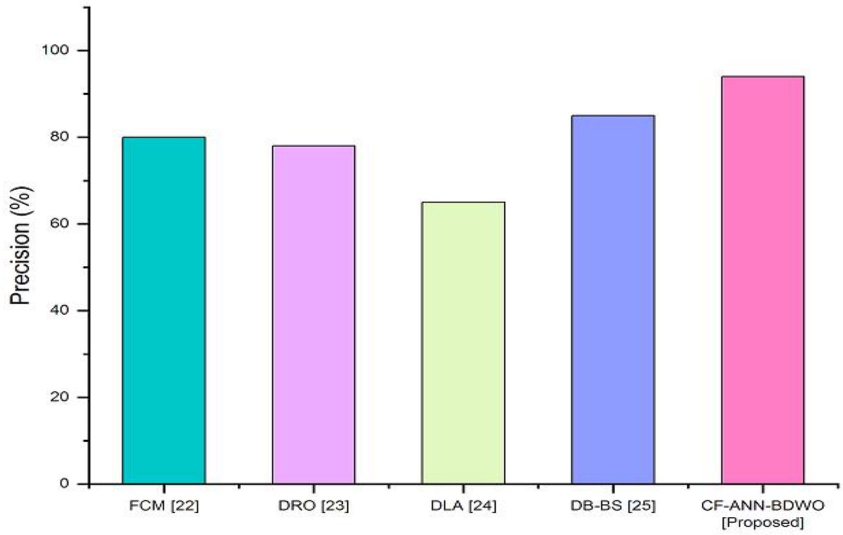

Figure 6. Precision of Proposed and Existing Methodologies

Cost Efficiency

It is the purpose of an effective medical supply logistics network to save money and maximize revenues by reducing the number of steps in the logistic chain. The solution to much more cost-effective operations is the use of smarter procedures. Before commencing any reengineering of logistical systems, medical organizations must be serious about developing more efficient and effective networks. **Figure 7** illustrated that the cost-efficiency exhibited by the medical supplies logistic chain optimized using CF-ANN-BDWO was greater than that attained by existing techniques such as FCM, DRO, DLA, and DB-BS. This confirmed that the proposed method effectively designed the medical supplies logistic chain which in turn efficiently reduced the management cost in medical logistics.

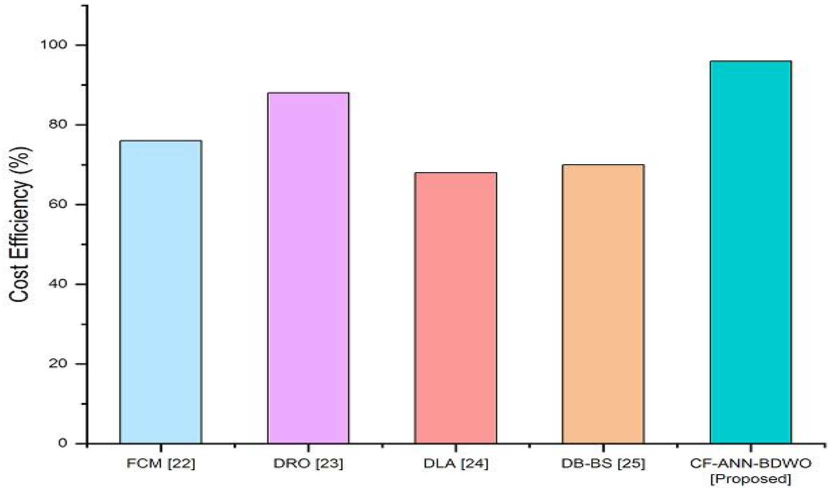

Figure 7. Cost-Efficiency Exhibited by Proposed and Conventional Methods

Processing Percentage

Using financial measures to evaluate the effectiveness of a logistic supply chain performance in the medical sector is important. **Figure 8** shows that the medical supplies logistic chain optimized by CF-ANN-BDWO exhibited lower medical supplies transportation cost, medical logistic administrative cost, medical commercial cost, and medical picking cost compared to other models namely FCM, DRO, DLA, and DB-BS.

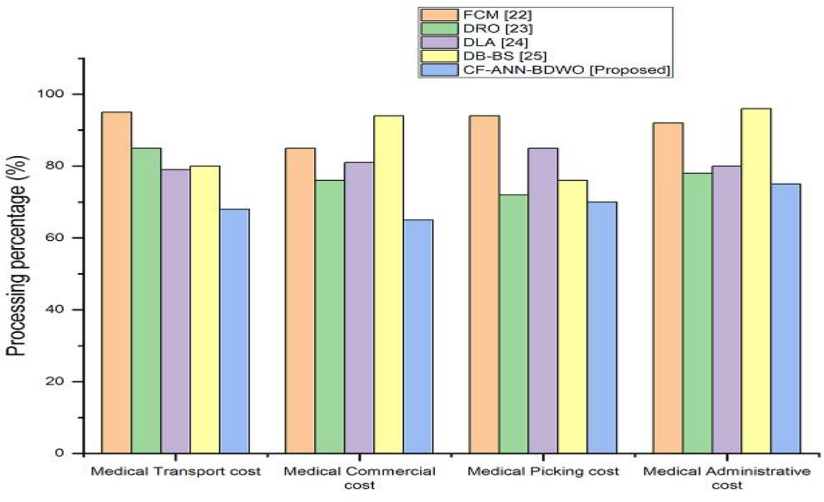

Figure 8. Processing Percentage of Proposed and Conventional Methods

Discussion

In FCM (existing) for large-scale disasters, medical supply logistics are worried about the intermodal conveyance of medical supplies by helicopter and car. FCM with capacity constraints and FCM with number constraints, two balanced FCM methods, are formulated to select emergency distribution centers (EDC) and assign medical aid points, which could construct a balanced 'helicopters and vehicles' intermodal transportation network, to overcome the drawbacks of the use of classic Fuzzy C-Means (FCM) in intermodal transportation optimization. Intermodal routes are then generated by using an optimization model based on clustering and taking into account the time required to fly, transfer and deliver vehicles. In this way of transportation is highly cost. Intermodal transportation performance is examined by the number of EDCs, their transfer efficiency, and other variables via a series of numerical experiments (Govindan, Mina, & Alavi, 2020). In DRO (existing), Emergency Medical Services (EMS) systems that are well-managed may significantly reduce mortality and morbidity in times of widespread catastrophe or common emergencies using DRO. Based on a data-driven approach, this model ensures that maximum concurrent demand can be met by incorporating joint chance limitations and characterizing the projected total cost as a function of moment uncertainty (Ruan, J.H., Wang, X.P., Chan, F.T.S. and Shi, 2016). In DLA (existing) the work was formerly only possible with professional medical equipment, several techniques now strive to employ a smartphone or wearable device with a DLA. However, when compared to the performance of professional medical equipment, these methods frequently fail miserably (Liu, Li, & Zhang, 2019). In DB-BS (existing) the forward supply chain of COVID-19 medical equipment and the waste it generates after use, the majority of today's systems, processes, and technologies are inefficient. They lack traceability, dependability, operational transparency, security, and confidence. There is a risk of a single point of failure since they are centrally located (Ahmed et al., 2021). Hence we proposed a Chaotic Fuzzy Artificial Neural Network (CF-ANN) are indicates the better outcomes in this research.

CONCLUSION

It is necessary to establish best practices in the distribution of medical supplies to improve the healthcare business. Companies in the logistics industry are always looking for new opportunities and ways to improve their business and services. As a means of gaining a competitive advantage, organizations in the medical sector must actively work to maximize the accuracy of the value chain in which they participate as well as their internal operations. Here, we provide a novel method for controlling and improving logistics supply operations in the health care industry using AI. We employed CF-ANN-BDWO for optimizing the logistic network in the medical supplies industry. The results showed that CF-ANN-BDWO enhanced the efficiency of the medical logistic chain compared to the existing models namely FCM, DRO, DLA, and DB-BS. In addition, the medical supplies logistic chain optimized by CF-ANN-BDWO reduced the transportation time and logistic cost. Improved healthcare logistic chain management liberates clinical staff from logistic management anxiety, allowing them to focus on issues that are more personally relevant to them and within their skill set. In the future, the efficiency of the CF-ANN-DBWO model in logistics of other sectors must be studied.

References

Ahmad, R. W., Salah, K., Jayaraman, R., Yaqoob, I., Omar, M., & Ellahham, S. (2021). Blockchain-based forward supply chain and waste management for COVID-19 medical equipment and supplies. *IEEE Access*, *9*, 44905–44927.

Ahmed, B., & Ali, A. (2020). Usage of traditional Chinese medicine, western medicine and integrated Chinese-western medicine for the treatment of allergic rhinitis. *Official Journal of the Zhende Research Group*, *1*(1), 1–9.

Alizadeh, M., Makui, A., & Paydar, M. M. (2020). Forward and reverse supply chain network design for consumer medical supplies considering biological risk. *Computers & Industrial Engineering*, *140*, 106229.

Bélanger, V., Beaulieu, M., Landry, S., & Morales, P. (2018, January). Where to locate medical supplies in nursing units: An exploratory study. *Supply Chain Forum: An International Journal*, *19*(1), 81–89.

Chen, T., Wu, S., Yang, J., & Cong, G. (2019). Risk propagation model and its simulation of emergency logistics network based on material reliability. *International Journal of Environmental Research and Public Health*, *16*(23), 4677.

Eryong, X., & Li, J. (2021). What is the ultimate education task in China? Exploring "strengthen moral education for cultivating people" ("Li De Shu Ren"). *Educational Philosophy and Theory*, *53*(2), 128–139.

Euchi, J. (2021). Do drones have a real place in a pandemic fight for delivering medical supplies in healthcare systems problems? *Chinese Journal of Aeronautics*, *34*(2), 182–190.

Garg, H. (2020). Digital twin technology: Revolutionary to improve personalized healthcare. *Science Progress and Research (SPR)*, *1*(1).

Garza-Reyes, J. A., Villarreal, B., Kumar, V., & Diaz-Ramirez, J. (2019). A lean-TOC approach for improving emergency medical services (EMS) transport and logistics operations. *International Journal of Logistics Research and Applications*, *22*(3), 253–272.

Govindan, K., Mina, H., & Alavi, B. (2020). A decision support system for demand management in healthcare supply chains considering the epidemic outbreaks: A case study of coronavirus disease 2019 (COVID-19). *Transportation Research Part E: Logistics and Transportation Review*, *138*, 101967.

Li, Z. (2022). Treatment and technology of domestic sewage for improvement of rural environment in China-Jiangsu: A research.

Liu, K., Li, Q., & Zhang, Z. H. (2019). Distributionally robust optimization of an emergency medical service station location and sizing problem with joint chance constraints. *Transportation Research Part B: Methodological*, *119*, 79–101.

Madelin, G., & Lahrichi, N. (2021). Modeling and improving the logistic distribution network of a hospital. *International Transactions in Operational Research*, *28*(1), 70–90.

Mody, R. N., & Bhoosreddy, A. R. (1995). Multiple odontogenic keratocysts: A case report. *Annals of Dentistry*, *54*(1–2), 41–43.

Moons, K., Waeyenbergh, G., & Pintelon, L. (2019). Measuring the logistics performance of internal hospital supply chains: A literature study. *Omega*, *82*, 205–217.

Raj, R., Rai, N., & Agarwal, S. (2019, October). Anticounterfeiting in the pharmaceutical supply chain by establishing proof of ownership. In *TENCON 2019 - 2019 IEEE Region 10 Conference (TENCON)* (pp. 1572–1577). IEEE.

Ruan, J. H., Wang, X. P., Chan, F. T. S., & Shi, Y. (2016). Optimizing the intermodal transportation of emergency medical supplies using balanced fuzzy clustering. *International Journal of Production Research*, *54*(14), 4368–4386.

Salihu, S. O., & Iyya, Z. (2022). Assessment of physicochemical parameters and organochlorine pesticide residues in selected vegetable farmlands soil in Zamfara State, Nigeria. *Science Progress and Research (SPR)*, *2*(2).

Shahabaz, A., & Afzal, M. (2021). Implementation of high dose rate brachytherapy in cancer treatment. *Science Progress and Research (SPR)*, 1(3), 77–106.

Sharma, R., Shishodia, A., Gunasekaran, A., Min, H., & Munim, Z. H. (2022). The role of artificial intelligence in supply chain management: Mapping the territory. *International Journal of Production Research*, 1–24.

Wang, S., Liu, F., Lian, L., Hong, Y., & Chen, H. (2018). Integrated post-disaster medical assistance team scheduling and relief supply distribution. *The International Journal of Logistics Management*.

Yu, H., Sun, X., Solvang, W. D., & Zhao, X. (2020). Reverse logistics network design for effective management of medical waste in epidemic outbreaks: Insights from the coronavirus disease 2019 (COVID-19) outbreak in Wuhan (China). *International Journal of Environmental Research and Public Health*, *17*(5), 1770.

Yu, Z., Khan, S. A. R., Tianshan, M., & Sharif, A. (2018). The study on efficient cold chain logistics. In *2nd International Conference on Economic Development and Education Management (ICEDEM 2018), Advances in Social Science, Education, and Humanities Research* (pp. 290–475).