Treatment Option Selection for Medical Waste Management under Neutrosophic sets

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Abstract

Due to the possible threat, it poses to human health and the ecosystem, healthcare waste (HCW) handling and disposal are of major concern, especially in poor nations. Many countries are now turning to technology innovations as viable waste management solutions. Nevertheless, is still difficult for governments to choose an appropriate technology and an efficient waste management technique for the disposal of HCW. The difficulty of estimating these numbers inaccurately is addressed by using a neutrosophic set. The best alternative to HCW is hard to choose, and the process of doing so may be thought of as a multi-criteria decision-making (MCDM) issue. In this study, we propose a neutrosophic TOPSIS approach for assessing potential HCW alternatives. The weights of the requirements are calculated TOPSIS method. The best HCW alternative is assessed using the suggested approach.

Keywords: MCDM; TOPSIS; Neutrosophic; Medical; Waste Management.

1. **Introduction**

In recent years, waste in the healthcare industry has emerged as a significant problem all over the globe. The term "HCW" refers to any forms of waste that are produced by healthcare-associated environments (HCEs), including viral or noninfectious waste, waste from chemicals, and harmful in addition to non-hazardous items. The potential for HCW to cause hazards to the environment and society is a major cause for concern in nations that are still in the process of growing their economies[1], [2]. A shortage of knowledge between healthcare providers and the population as a whole about the incorrect handling of HCW is one of the main obstacles to sufficient HCWM. Other major obstacles include the lack of a successful regulatory structure and national strategy, as well as financial constraints. All of these factors contribute to an increase in the possible danger associated with environmental and health hazards to the public[3], [4].

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Incineration, microwaving, autoclaving, hydropulping, and compaction are all viable alternatives for treating HCW. Incineration is an ideal disposal option for both hazardous and nonhazardous HCW materials[5], [6]. Over 1800 degrees Fahrenheit is required for combustion. Any potentially dangerous or poisonous substance may be neutralised. The technology achieves the greatest waste reduction efficiency of any other approach, reducing trash by as much as 95%. But incineration has a high initial investment price and may release harmful pollutants[7], [8]. Since microwave ovens don't release any combustion pollutants, they have a smaller environmental footprint than incinerators. It has the potential to cut trash volume by as much as 80 percent. Pathological waste should never be microwaved, and if it is, a thorough monitoring system is required[9]–[11].

Sterilisation of hazardous waste is possible using an autoclave. However, this method is incapable of reducing trash accumulation. This is not acceptable for typical human anatomy. Hydropulping, on the opposite hand, is an oxidation process; it increases weight by increasing the water material, but the resulting volume might be as low as 30% of the initial. There is much debate about the usage of a pulping device for the disposal of medical waste. The trash volume may be decreased by as much as 60% thanks to the compaction mechanism. This approach, however, precludes the possibility of sterilisation. Previous works have provided a detailed overview of technologies, including their advantages and disadvantages, as well as some critical variables for technological choice[12]–[14].

The issue of how to handle HCWs is a critical one that has to be solved in the most effective manner feasible. In this research, an examination of the present HCW leadership structure was carried out. Through the use of knowledgeable judgement, the purpose of this research is to determine which of the HCW approaches to management offers the most efficient solution to the HCW issue. When using a process that relies on expert judgement to make decisions, there is a risk of the evaluation of available options being inaccurate. In order to find a solution to this issue, the study will include the use of the neutrosophic technique. The implementation of the neutrosophic strategy, which is founded on language values suited to thinking by humans, is where this technique makes its contribution. The application of neutrosophic sets offers a solution to the issue of accuracy concerns about the evaluation of HCW administration and therapy. A new development in the process of selecting a therapy for HCW may be seen in the technique that depends on the use of the neutrosophic sets method[15], [16].

Smarandache is the one who first established the concept of NSs, and each NS is denoted by three variables: a truthiness-membership value (T), an indeterminacy-membership value (I), and a falsity-membership value (F). These factors are not related to one another in any way, and the total of all of them falls among 0 and 3[17].

The use of one of the most prominent MCDM approaches known as TOPSIS[18], which relies on neutrosophic sets, is used in this research to evaluate and select the HCW alternatives[19]. In order to accomplish this goal, the TOPSIS technique, which is the distance-based MCDM approach that is employed the most often in the research that has been done on the topic, has been expanded by neutrosophic sets to reflect not only the haziness of the data but also the uncertainty of the agreement among the decision makers[20]. To the best of our understanding, this is the first time that the neutrosophic TOPSIS approach has been utilized for the purpose of evaluating the HCW alternatives[21].

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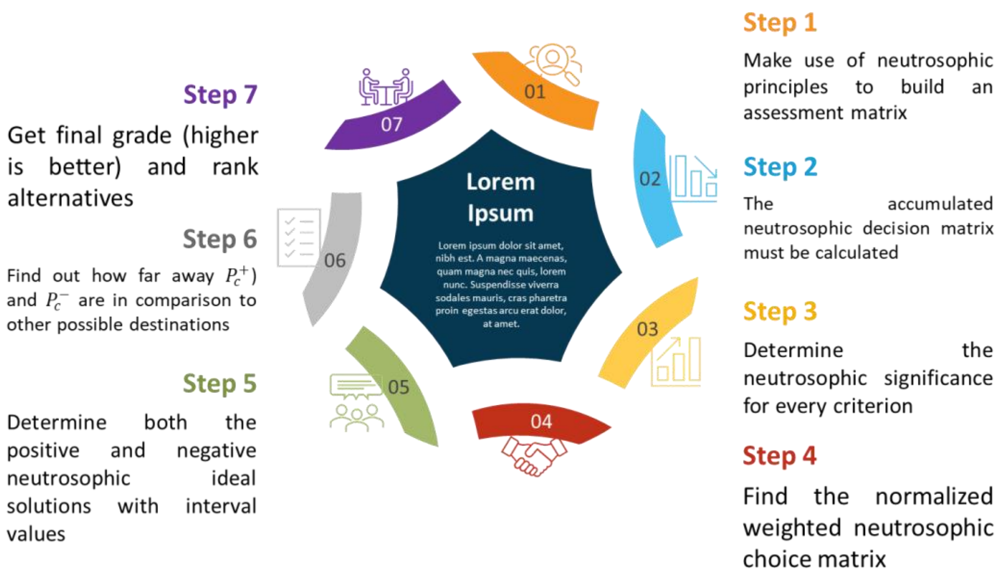

Figure 1: The steps of the neutrosophic TOPSIS method.

2. Neutrosophic TOPSIS Method

In order to choose the best alternative of HCW, this research proposes a TOPSIS technique based on neutrosophic sets[22]. Figure 1 shows the steps of the neutrosophic TOPSIS method.

Step 1: Make use of neutrosophic principles to build an assessment matrix[23] as

$$M[m]_{a\times b} = \begin{pmatrix} m_{11} & \cdots & m_{1b} \\ \vdots & \ddots & \vdots \\ m_{a1} & \cdots & m_{ab} \end{pmatrix} \quad (1)$$

Where $m_{cd} = [T_{cd}^L, T_{cd}^U], [I_{cd}^L, I_{cd}^U], [F_{cd}^L, F_{cd}^U]$ refers to the interval valued neutrosophic sets, and the $i = 1,2,3 \ldots . m$ refers to alternative and $j = 1,2,3 \ldots n$ refers to the criterion

Step 2: The accumulated neutrosophic decision matrix must be calculated as[24]

$$M[m_{cd}]_{a\times b} = \begin{pmatrix} m_{11} & \cdots & m_{1b} \\ \vdots & \ddots & \vdots \\ m_{a1} & \cdots & m_{ab} \end{pmatrix} \quad (2)$$

Step 3: Determine the neutrosophic significance for every criterion as

$$W = [w_d]_{1\times b} \quad (3)$$

Step 4: Find the normalized weighted neutrosophic choice matrix.

$$NN = [nn_{cd}]_{a\times b} \quad (4)$$

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$$n_{cd} = w_d \otimes n_{cd} \quad (5)$$

Step 5: Determine both the positive and negative neutrosophic ideal solutions with interval values.

$$P_c^+ = \left[\max_c(T_c^L), \max_c(T_c^U)\right], \left[\min_c(I_c^L), \min_c(I_c^U)\right], \left[\min_c(F_c^L), \min_c(F_c^U)\right] \quad (6)$$

$$P_c^- = \left[\min_c(T_c^L), \min_c(T_c^U)\right], \left[\max_c(I_c^L), \max_c(I_c^U)\right], \left[\max_c(F_c^L), \max_c(F_c^U)\right] \quad (7)$$

Step 6: Find out how far away P_c^+) and P_c^- are in comparison to other possible destinations.

$$D(f_1.f_2) = \frac{1}{6}\left(\left[T_{f_1}^L - T_{f_2}^L\right] + \left[T_{f_1}^U - T_{f_2}^U\right] + \left[I_{f_1}^L - I_{f_2}^L\right] + \left[I_{f_1}^U - I_{f_2}^U\right] + \left[F_{f_1}^L - F_{f_2}^L\right] + \left[F_{f_1}^U - F_{f_2}^U\right]\right) \quad (8)$$

Step 7: Use the following scale to get final grade (higher is better).

$$S = \frac{DP_c^-}{DP_c^- + DP_c^+} \quad (9)$$

3. Application

This section presented the applied of the neutrosophic TOPSIS method to select and evaluate the alternative of HCW.

The Administration's Public Health Centre collaborated with the expert panel to develop the group. Experts in HCW administration were recruited from a variety of government agencies to serve on the panel. Three specialists were selected for this task force; one each from the Ministry of Health, the Public Health College, and the Ministry of Public Safety. Specialists in the field came up with the standards of assessment and sub-criteria that would be used to all potential solutions. They turned down six high-performing HCW management regimens.

The standards for evaluating these options were developed so that the optimal solution to the HCW administration challenge could be chosen. Every of these requirements consists of many smaller criteria, and there are a total of four primary requirements. The four key considerations are monetary, environmental, technological, and cultural. These standards were developed after reviewing relevant prior research on HCW. Main factors are technological criterion and extended standards for sustainability. Due consideration was given to the stringent restrictions placed on HCW management, and a therapy was chosen accordingly. To ensure that each of the primary criteria received enough consideration, we broke every into three sub-criteria.

Specialists reviewed the standards used to assess the options when they were established. The advantages of the different options for the criterion were examined by specialists during the examination of the Benefit factor. The specialists considered the negative effects of possible substitutes for the Cost criteria while making their decision. The cost criteria will be less favourable if the criterion causes fewer negative outcomes. An alternative's worth rises if it provides more benefit and causes less harm than the status quo for the specific utility criterion.

The purpose of this research was to determine the most effective method of treating HCW. Your response will help the government priorities the procurement of necessary treatment devices. With this gear in place, the harmful effects of HCW on ecosystems and human health may be mitigated.

Step 1: Make use of neutrosophic principles to build an assessment matrix

Three experts used the linguistic term to evaluate the criteria and alternatives to build the decision matrix by using Eq. (1) as shown in Tables 1 and 2 for first and second experts.

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Table 1: The decision matrix by first expert.

	HCW C_1	HCW C_2	HCW C_3	HCW C_4	HCW C_5	HCW C_6	HCW C_7	HCW C_8	HCW C_9	HCW C_{10}	HCW C_{11}	HCW C_{12}
HCW A_1	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>
HCW A_2	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>
HCW A_3	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>
HCW A_4	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>
HCW A_5	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>
HCW A_6	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>
HCW A_7	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>
HCW A_8	<[0.45,	<[0.75,	<[0.25,	<[0.55,	<[0.25,	<[0.55,	<[0.25,	<[0.65,	<[0.35,	<[0.65, 0.8],	<[0.55, 0.7],	<[0.05, 0.2],

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	0.6], [0, 0.2], [0.45, 0.6]>	0.9], [0.3, 0.5], [0.15, 0.3]>	0.4], [0.2, 0.4], [0.65, 0.8]>	0.7], [0.1, 0.3], [0.35, 0.5]>	0.4], [0.2, 0.4], [0.65, 0.8]>	0.7], [0.1, 0.3], [0.35, 0.5]>	0.4], [0.2, 0.4], [0.65, 0.8]>	0.8], [0.2, 0.4], [0.25, 0.4]>	0.5], [0.1, 0.3], [0.55, 0.7]>	[0.2, 0.4], [0.25, 0.4]>	[0.1, 0.3], [0.35, 0.5]>	[0.4, 0.6], [0.85, 1]>
HCW A_9	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>
HCW A_{10}	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>

Table 2: The decision matrix by second expert.

	HCW C_1	HCW C_2	HCW C_3	HCW C_4	HCW C_5	HCW C_6	HCW C_7	HCW C_8	HCW C_9	HCW C_{10}	HCW C_{11}	HCW C_{12}
HCW A_1	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>
HCW A_2	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>
HCW A_3	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>
HCW A_4	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>
HCW A_5	<[0.05, 0.2],	<[0.25, 0.4],	<[0.15, 0.3],	<[0.45, 0.6],	<[0.85, 1], [0.4,	<[0.35, 0.5],	<[0.85, 1], [0.4,	<[0.15, 0.3],	<[0.35, 0.5],	<[0.25, 0.4], [0.2,	<[0.35, 0.5], [0.1,	<[0.45, 0.6], [0,

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	[0.4, 0.6], [0.85, 1]>	[0.2, 0.4], [0.65, 0.8]>	[0.3, 0.5], [0.75, 0.9]>	[0, 0.2], [0.45, 0.6]>	0.6], [0.05, 0.2]>	[0.1, 0.3], [0.55, 0.7]>	0.6], [0.05, 0.2]>	[0.3, 0.5], [0.75, 0.9]>	[0.1, 0.3], [0.55, 0.7]>	0.4], [0.65, 0.8]>	0.3], [0.55, 0.7]>	0.2], [0.45, 0.6]>
HCWA$_{6}$	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>
HCWA$_{7}$	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>
HCWA$_{8}$	<[0.45, 0.6], [0, 0.2], [0.45, 0.6]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>
HCWA$_{9}$	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.75, 0.9], [0.3, 0.5], [0.15, 0.3]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.55, 0.7], [0.1, 0.3], [0.35, 0.5]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.35, 0.5], [0.1, 0.3], [0.55, 0.7]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>
HCWA$_{10}$	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.25, 0.4], [0.2, 0.4], [0.65, 0.8]>	<[0.15, 0.3], [0.3, 0.5], [0.75, 0.9]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>	<[0.65, 0.8], [0.2, 0.4], [0.25, 0.4]>	<[0.85, 1], [0.4, 0.6], [0.05, 0.2]>	<[0.05, 0.2], [0.4, 0.6], [0.85, 1]>

Step 2: The accumulated neutrosophic decision matrix must be calculated

Then combined the valued of the three experts into one matrix by using Eq. (2) as shown in Table 3.

Table 3: The combined values of three experts.

	HCWC$_{1}$	HCWC$_{2}$	HCWC$_{3}$	HCWC$_{4}$	HCWC$_{5}$	HCWC$_{6}$	HCWC$_{7}$	HCWC$_{8}$	HCWC$_{9}$	HCWC$_{10}$	HCWC$_{11}$	HCWC$_{12}$
HCWA$_{1}$	0.3	0.22625	0.265417	0.2	0.1425	0.20125	0.09375	0.2325	0.265417	0.335833	0.2325	0.19375
HCWA$_{2}$	0.1425	0.39	0.27	0.39375	0.39	0.27	0.27	0.34875	0.27	0.34875	0.27	0.271667
HCWA$_{3}$	0.09375	0.1425	0.39375	0.09375	0.2325	0.4125	0.1425	0.27	0.4125	0.1425	0.41125	0.1425

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HCWA$_{4}$	0.4125	0.39	0.27	0.39	0.27	0.39375	0.3	0.37	0.39125	0.19375	0.39	0.3
HCWA$_{5}$	0.09375	0.20125	0.1425	0.34875	0.36375	0.27	0.265417	0.1425	0.27	0.20125	0.27	0.37
HCWA$_{6}$	0.265417	0.27	0.405417	0.41125	0.1425	0.4125	0.405833	0.37	0.4125	0.22625	0.41125	0.22625
HCWA$_{7}$	0.39	0.09375	0.411667	0.2	0.4125	0.09375	0.40625	0.09375	0.39125	0.09375	0.27	0.271667
HCWA$_{8}$	0.37	0.4125	0.271667	0.39125	0.271667	0.39	0.335833	0.41125	0.27	0.411667	0.39125	0.19375
HCWA$_{9}$	0.265417	0.27	0.4125	0.4125	0.271667	0.27	0.4125	0.20125	0.39	0.265417	0.3175	0.2325
HCWA$_{10}$	0.22625	0.09375	0.22625	0.09375	0.2325	0.09375	0.20125	0.1425	0.2	0.41125	0.22625	0.09375

Step 3: Determine the neutrosophic significance for every criterion as

Then compute the weights of criteria by using Eq. (3). The weights of criteria are shown in Figure 2.

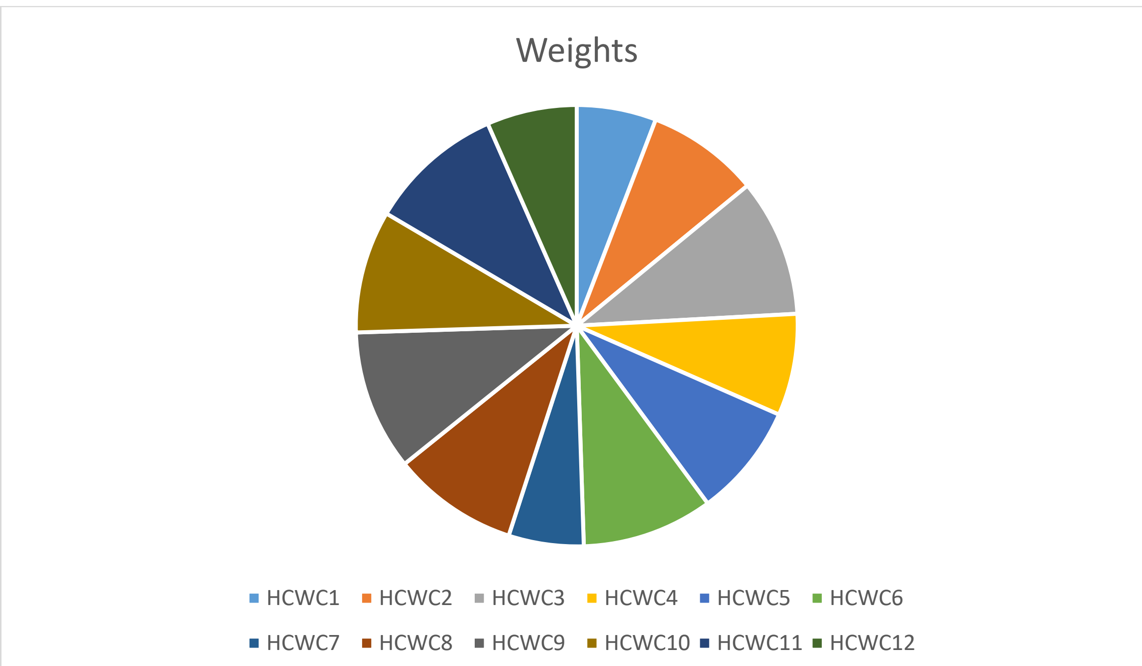

Figure 2: The weights of criteria.

Step 4: Find the normalized weighted neutrosophic choice matrix.

Then use the Eqs. (4 and 5) to obtain the normalization and weighted normalized decision matrix. Tables 4, 5 show the normalization and weighted normalized decision matrix.

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Table 4: The normalization decision matrix.

	HCW C_1	HCW C_2	HCW C_3	HCW C_4	HCW C_5	HCW C_6	HCW C_7	HCW C_8	HCW C_9	HCW C_{10}	HCW C_{11}	HCW C_{12}
HCW A_1	0.339875	0.261298	0.262728	0.198156	0.157001	0.209337	0.097974	0.263016	0.249936	0.375057	0.224958	0.25355
HCW A_2	0.16144	0.450414	0.267265	0.390119	0.429688	0.280849	0.282166	0.394525	0.254252	0.389482	0.261241	0.355515
HCW A_3	0.106211	0.164574	0.389761	0.092885	0.25616	0.429075	0.148921	0.305438	0.388441	0.159143	0.397909	0.186482
HCW A_4	0.467327	0.450414	0.267265	0.386403	0.297476	0.409572	0.313518	0.418564	0.36843	0.216379	0.377348	0.392593
HCW A_5	0.106211	0.232425	0.141057	0.345534	0.400767	0.280849	0.277377	0.161204	0.254252	0.224755	0.261241	0.484199
HCW A_6	0.300695	0.311825	0.40131	0.407457	0.157001	0.429075	0.424121	0.418564	0.388441	0.252675	0.397909	0.296081
HCW A_7	0.441837	0.108273	0.407497	0.198156	0.454478	0.097517	0.424556	0.106055	0.36843	0.104699	0.261241	0.355515
HCW A_8	0.419179	0.476399	0.268915	0.387642	0.299313	0.405671	0.350966	0.465228	0.254252	0.459747	0.378558	0.25355
HCW A_9	0.300695	0.311825	0.408321	0.408696	0.299313	0.280849	0.431088	0.227665	0.367253	0.296416	0.3072	0.30426
HCW A_{10}	0.256322	0.108273	0.223958	0.092885	0.25616	0.097517	0.210319	0.161204	0.188335	0.459281	0.21891	0.122685

Table 5: The weighted normalized decision matrix.

	HCW C_1	HCW C_2	HCW C_3	HCW C_4	HCW C_5	HCW C_6	HCW C_7	HCW C_8	HCW C_9	HCW C_{10}	HCW C_{11}	HCW C_{12}
HCW A_1	0.019779	0.021516	0.026493	0.014784	0.013034	0.020077	0.005383	0.024298	0.025711	0.033664	0.022308	0.016728
HCW A_2	0.009395	0.037088	0.02695	0.029107	0.035673	0.026936	0.015502	0.036446	0.026155	0.034959	0.025906	0.023455
HCW A_3	0.006181	0.013551	0.039302	0.00693	0.021267	0.041152	0.008182	0.028217	0.039959	0.014284	0.039458	0.012303
HCW A_4	0.027196	0.037088	0.02695	0.02883	0.024697	0.039281	0.017225	0.038667	0.037901	0.019422	0.037419	0.025901
HCW A_5	0.006181	0.019138	0.014224	0.02578	0.033272	0.026936	0.015239	0.014892	0.026155	0.020174	0.025906	0.031944
HCW A_6	0.017499	0.025676	0.040467	0.0304	0.013034	0.041152	0.023301	0.038667	0.039959	0.02268	0.039458	0.019533
HCW A_7	0.025713	0.008915	0.041091	0.014784	0.037731	0.009353	0.023325	0.009797	0.037901	0.009398	0.025906	0.023455
HCW A_8	0.024394	0.039228	0.027116	0.028922	0.024849	0.038907	0.019282	0.042978	0.026155	0.041266	0.037539	0.016728
HCW A_9	0.017499	0.025676	0.041174	0.030493	0.024849	0.026936	0.023684	0.021032	0.03778	0.026606	0.030463	0.020073
HCW A_{10}	0.014917	0.008915	0.022583	0.00693	0.021267	0.009353	0.011555	0.014892	0.019374	0.041224	0.021708	0.008094

Step 5: Determine both the positive and negative neutrosophic ideal solutions with interval values.

Then used the Eqs. (6 and 7) to compute the positive and negative ideal solution.

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Step 6: Find out how far away P_c^+) and P_c^- are in comparison to other possible destinations.

Then compute the distance from each alternative to positive an negative ideal solution by using Eq. (8).

Step 7: Use the following scale to get your final grade (higher is better).

Then used Eq. (9) to compute the final score and rank the alternatives as shown in Figure 3.

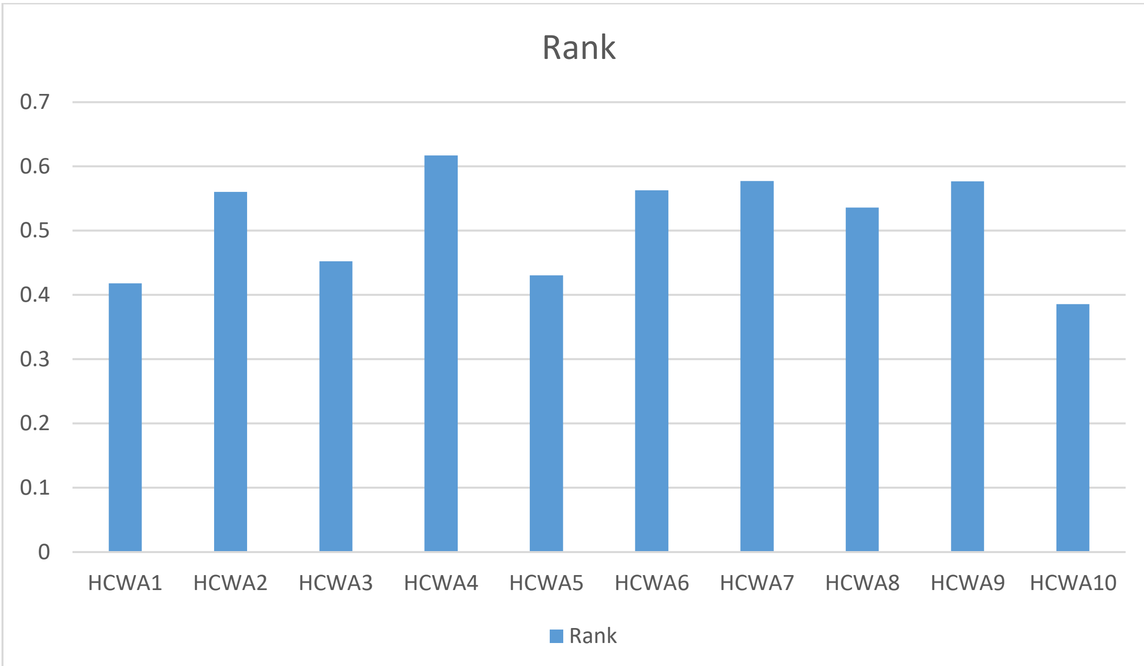

Figure 3: The rank of HCW alternatives.

4. Conclusions

There has been a rise in the quantity of trash generated by hospitals and patients alike. It is imperative that all nations, particularly emerging ones, work tirelessly to address the issue of HCW control. The purpose of this research was to choose a therapy for HCW control that would allow for effective administration. The best method of HCW administration may be affected by several variables. Decision-making employing numerous parameters for evaluating various possibilities is used in the assessment of the HCW therapy. Using MCDM techniques, we can effectively address this dilemma. In this study, we used the interval-valued neutrosophic TOPSIS approach to compare and contrast various alternatives of HCW according to parameters established via the reviews of subject matter experts. Scales of language are used to assign relative importance to criteria and generate decision matrices. After that, the interval-valued neutrosophic numbers that correspond to these values and matrices are derived. The program chooses $HCWA_4$ as the superior option since it has the finest properties, and $HCWA_{10}$ is the lowest alternative.

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