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**THE INTEGRATION OF FUZZY DELPHI AND FUZZY TOPSIS
FOR PHARMACEUTICAL WASTE TREATMENT SELECTION
IN THE CONTEXT OF GREEN PRACTICE**



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Abstrak

Sisa farmaseutikal harus dirawat dengan cara yang terbaik bagi mengelakkan berlakunya kemudaratan terhadap kesihatan orang awam dan alam sekitar. Oleh itu, amalan hijau boleh diguna pakai dalam merawat sisa dengan seefektif yang mungkin. Walau bagaimanapun, penyelidikan mengenai rawatan terbaik dengan ciri hijau hanya dijalankan di negara lain dan tidak boleh menjadi rujukan utama untuk Malaysia kerana perbezaan geografi. Secara praktikalnya, pendekatan untuk memodelkan pembuatan keputusan holistik bagi sisa farmaseutikal dalam konteks Malaysia dan menilai kekukuhan sebuah model adalah amat diperlukan. Oleh itu, kajian ini membangunkan satu model pembuatan keputusan bagi memilih rawatan terbaik untuk sisa farmaseutikal dalam konteks amalan hijau di Malaysia. Dengan menggunakan kajian literatur sistematik dan pendapat pakar, satu senarai komprehensif kriteria, berserta sub-kriteria dan kaedah rawatan telah berjaya dikumpulkan. Pengiraan wajaran untuk kriteria dan sub-kriteria serta pemeringkatan rawatan telah dianalisis melalui kaedah TOPSIS Delphi kabur. Keputusan menunjukkan bahawa imobilisasi sisa (enkapsulasi) telah dipilih sebagai rawatan pelupusan terbaik dan alam sekitar merupakan kriteria terpenting seperti mana dinilai oleh satu panel pakar. Analisis sensitiviti menunjukkan bahawa gabungan kriteria yang berbeza mempengaruhi susunan keutamaan rawatan. Model yang dibangunkan menyumbang kepada pihak pemegang taruh yang berkaitan dengan pengurusan sisa dalam membantu proses pembuatan keputusan. Ia juga memperluaskan pengetahuan pengurusan sisa daripada perspektif amalan hijau dan dihujahkan sebagai satu mekanisma yang boleh dipercayai untuk dilaksanakan di Malaysia.

Kata kunci: Sisa farmaseutikal, Pemilihan rawatan, *Delphi* kabur, *TOPSIS* kabur

Abstract

Pharmaceutical waste should be treated in the best possible manner to avoid harm toward public health and the environment. Thus, green practices can be adopted in treating the waste as effectively as possible. However, research about the best treatment with green features has only been conducted in other countries and cannot be a primary reference for Malaysia due to geographical differences. Practically, an approach to model holistic decision-making for pharmaceutical waste in Malaysia context and evaluate the robustness of the model is essential. Hence, this research develops a decision-making model to select the best treatment for pharmaceutical waste in the context of green practices in Malaysia. By using a systematic literature review and experts' opinions, a comprehensive list of criteria, sub-criteria, and treatments were successfully collected. The computation of weights for criteria and sub-criteria as well as the ranking of treatments were analysed through Fuzzy Delphi TOPSIS. The results revealed that waste immobilisation (encapsulation) is selected as the best treatment and environmental is the most important criterion as evaluated by a panel of experts. The sensitivity analysis indicated that different combinations of criteria could influence the ranking of the treatments. The developed model contributes to the related stakeholders in waste management to assist the decision-making process. It also expands the knowledge of waste treatment in the perspective of green practices and it is argued to be a trustworthy mechanism to be implemented in Malaysia.

Keywords: Pharmaceutical waste, Treatment selection, Fuzzy Delphi, Fuzzy TOPSIS

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List of Abbreviations

| | |
|------------|-----------------------------------------------------------------------|
| AHP | Analytic Hierarchy Process |
| ANP | Analytic Network Process |
| CC | Closeness Coefficient |
| DEMATEL | Decision-Making Trial and Evaluation Laboratory |
| DOE | Department of Environment |
| DM | Delphi Method |
| FD | Fuzzy Delphi |
| FDT | Fuzzy Delphi TOPSIS |
| FNIS | Fuzzy Negative Ideal Solution |
| FPIS | Fuzzy Positive Ideal Solution |
| FT | Fuzzy TOPSIS |
| MCDM | Multi-Criteria Decision-Making |
| MULTIMOORA | Multi-Objective Optimization based on Ratio Analysis |
| MOH | Ministry of Health |
| NIS | Negative Ideal Solution |
| PIS | Positive Ideal Solution |
| TFN | Triangular Fuzzy Number |
| TOPSIS | Technique for Order of Preference by Similarity to the Ideal Solution |
| WHO | World Health Organization |

CHAPTER ONE

INTRODUCTION

1.1 Research Background

The introduction of the green practice policy plays an essential role in treating waste in an environmentally friendly manner, especially for the process of managing hazardous waste, namely, pharmaceuticals, which intends to provide a more effective, safe, and secure system (Courtier, Cadiere, & Roig, 2019). This green policy serves to evidently support environmental preservation in Malaysia, reflecting the government's serious and solemn stance in preserving Malaysia's wildlife and biodiversity (Ministry of Energy, Green Technology and Water Malaysia, 2009).

Nonetheless, Malaysia still faces problems in optimising the best treatment in the context of green practice, especially for pharmaceutical waste, as it involves various treatments, criteria, and sub-criteria that need to undergo thorough considerations. Furthermore, implementing treatment settings that are equipped with the necessary green features still poses a challenge to the relevant agencies due to a lack of knowledge of the green features for such treatments. Hence, the government has sought experts' reviews from various fields of knowledge, such as policymakers and practitioners, for a thorough decision. Unfortunately, the problems mentioned earlier continue to persist since each expert had a distinct perspective relating to this issue in selecting the best treatment for pharmaceutical waste in the context of green practice.

Therefore, a technique is required to put together a solution to ensure all of these experts come to a consensus in making the decision. With the help of a census

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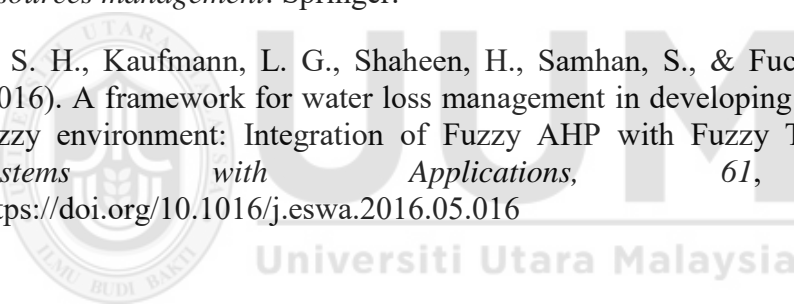
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Appendix A



**SCHOOL OF QUANTITATIVE SCIENCES
COLLEGE OF ARTS AND SCIENCES
UNIVERSITI UTARA MALAYSIA**

**THE INTEGRATION OF FUZZY DELPHI AND FUZZY TOPSIS FOR
PHARMACEUTICAL WASTE TREATMENT SELECTION
IN THE CONTEXT OF GREEN PRACTICE**

Dear Sir/Madam,

I am Nur Hazera Binti Md Radzi, a master's student (Matric Number: 826423) in Decision Science at School of Quantitative Sciences, Universiti Utara Malaysia. Currently, I am conducting research on 'The Integration of Fuzzy Delphi and Fuzzy TOPSIS for Pharmaceutical Waste Treatment Selection in the Context of Green Practice' under the supervision of Dr. Nurakmal Binti Ahmad Mustaffa and Assoc. Prof. Dr. Nerda Zura Binti Zaibidi. In order to complete this research, the following questionnaire have been designed to conduct a survey that can evaluate the green practice for pharmaceutical waste. Therefore, respondents are required to indicate the answer for all the questions in every section based on the scale provided. You are advised to answer the questions sincerely as your opinion is extremely important for my research. Please note that all information is strictly used for the purpose of research and will be kept as private and confidential. Your co-operation to fill up this survey is highly appreciated. If you have any query or interested to know about the result and findings of this research, please do not hesitate to contact me via my email: nur_hazera_md@ahsgs.uum.edu.my or my supervisors, nurakmal@uum.edu.my and nerda@uum.edu.my.

Thank You.

Best Regards,

Nur Hazera Binti Md Radzi

SECTION A: DEMOGRAPHIC INFORMATION

Please indicate your answer by filling in the blank with the appropriate information or putting a check mark (✓) on the space provided as below.

| | | | | | | |
|----|----------------------------------------------------|-------------------------------------------|------------------------------------------|-----------------------------------------------|---------------------------------------------|----------------------------------------------|
| 1. | Gender | | | | | |
| 2. | Organization | | | | | |
| 3. | Department | | | | | |
| 4. | Work Experience related to Waste Management | <input type="checkbox"/> Below 5 years | <input type="checkbox"/> 6 – 10 years | <input type="checkbox"/> 11 – 15 years | <input type="checkbox"/> 16 – 20 years | <input type="checkbox"/> 20 years & above |
| 5. | Level of Education | <input type="checkbox"/> Secondary | <input type="checkbox"/> Diploma | <input type="checkbox"/> Bachelor's Degree | <input type="checkbox"/> Master's Degree | <input type="checkbox"/> Ph.D |

SECTION B: CRITERIA OF TREATMENT SELECTION FOR PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the criteria of pharmaceutical waste treatment. Please select and tick (✓) for each of the criteria that is preferable and can be considered for pharmaceutical waste or indicate your answer if there are any other criteria which have been applied in Malaysia.

| Criteria | |
|---------------|--|
| Economic | |
| Environmental | |
| Social | |
| Technical | |

Please write below if there are any additional criteria:

SECTION C: SUB-CRITERIA OF TREATMENT SELECTION FOR PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the sub-criteria of pharmaceutical waste treatment. Please select and tick (√) for each of the sub-criteria that is preferable and can be considered for pharmaceutical waste or indicate your answer if there are any other sub-criteria which have been applied in Malaysia.

| Criteria | Sub-Criteria | |
|-----------------------------------|-------------------------------------------------------|--|
| Economic | Capital cost | |
| | Disposal cost | |
| | Installation requirements | |
| | Net cost per ton | |
| | Operation and maintenance cost | |
| Environmental | Emission of air and secondary pollution | |
| | Efficacy of microbial inactivation | |
| | Energy consumption per kg of waste | |
| | Extent of use of renewable energy | |
| | Mass and volume reduction | |
| | Material consumption | |
| | Noise | |
| | Odour | |
| | Release with health effects | |
| | Resource recovery capabilities | |
| | Risk level for communities, workers, and environment | |
| | Space requirement | |
| Waste residuals | | |
| Water consumption per kg of waste | | |
| Social | Acceptability of treatment residues by local landfill | |
| | Acceptance cost | |
| | Extent of necessary resettlement of people | |
| | Land requirement | |
| | Policy level | |
| | Public acceptance | |
| | Technology acceptance | |
| | Technology acquisition | |
| Visible or aesthetic impact | | |
| Technical | Ability to treat wide range of infectious waste | |
| | Adaptability to future situations | |

| | | |
|--|---------------------------------------------------------------------------------------|--|
| | Availability of local experts/skilled operators | |
| | Availability of spare parts and usage of local materials or manufactured technologies | |
| | Compatibility with existing technology and natural conditions | |
| | Level of automation/sophistication | |
| | Occupational hazards | |
| | Reliability/Ease of operation | |
| | Security | |
| | Treatment effectiveness/capability | |
| | Track record on performance | |

Please write below if there are any additional sub-criteria:

SECTION D: TREATMENT SELECTION OF PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the treatment of pharmaceutical waste. Please select and tick (✓) for each of the treatment that is preferable and can be considered for pharmaceutical waste or indicate your answer if there is any other treatment which have been practiced in Malaysia.

| Alternative | |
|--------------------------------------|--|
| Incineration | |
| Chemical Disinfection | |
| Waste Immobilisation (Encapsulation) | |
| Waste Immobilisation (Inertisation) | |
| Plasma Pyrolysis | |
| Landfill | |

Please write below if there are any additional alternatives:

Appendix B



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Thank You.

Best Regards,

Nur Hazera Binti Md Radzi

SECTION A: DEMOGRAPHIC INFORMATION

Please indicate your answer by filling in the blank with the appropriate information or putting a check mark (✓) on the space provided as below.

| | | | | | | |
|----|----------------------------------------------------|-------------------------------------------|------------------------------------------|-----------------------------------------------|---------------------------------------------|----------------------------------------------|
| 1. | Gender | | | | | |
| 2. | Organization | | | | | |
| 3. | Department | | | | | |
| 4. | Work Experience related to Waste Management | <input type="checkbox"/> Below 5 years | <input type="checkbox"/> 6 – 10 years | <input type="checkbox"/> 11 – 15 years | <input type="checkbox"/> 16 – 20 years | <input type="checkbox"/> 20 years & above |
| 5. | Level of Education | <input type="checkbox"/> Secondary | <input type="checkbox"/> Diploma | <input type="checkbox"/> Bachelor's Degree | <input type="checkbox"/> Master's Degree | <input type="checkbox"/> Ph.D |

SECTION B: CRITERIA OF TREATMENT SELECTION FOR PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the criteria of pharmaceutical waste treatment selection. Please identify tick (✓) whether the criteria are either benefit or cost criteria. Benefit criteria: Desire the highest value in the criteria. Cost criteria: Desire the lowest value in the criteria.

| Criteria | Benefit | Cost |
|---------------|---------|------|
| Economic | | |
| Environmental | | |
| Social | | |
| Technical | | |

Next, please select and tick (✓) the score for each of the criterion that can be considered for pharmaceutical waste in the context of green practice which have been applied in Malaysia in the space provided by referring to the importance scale in the table below.

| Scale | Explanation |
|-------|-------------------------------------------|
| 1 | Least important (LI) |
| 2 | Least to moderately important (LMI) |
| 3 | Moderately important (MI) |
| 4 | Moderate to strongly important (MSI) |
| 5 | Strongly important (SI) |
| 6 | Strong to very strongly important (SVSI) |
| 7 | Very strongly important (VSI) |
| 8 | Very strong to extremely important (VSEI) |
| 9 | Extremely important (EI) |

| Criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Economic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Environmental | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Social | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Technical | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

SECTION C: SUB-CRITERIA OF TREATMENT SELECTION FOR PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the sub-criteria of pharmaceutical waste treatment selection. Please select and tick (/) the score for each of the sub-criterion that can be considered for pharmaceutical waste in the context of green practice which have been applied in Malaysia in the space provided by referring to the importance scale in the table above.

| Economic | | | | | | | | | |
|--------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sub-criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Capital cost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Disposal cost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Installation requirement | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Net cost per ton | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Operation and maintenance cost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| Environmental | | | | | | | | | |
|------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sub-criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Emission of air and secondary pollution | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Extent of use of renewable energy | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Mass and volume reduction | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Noise | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Odour | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Release with health effects | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Resource recovery capabilities | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Risk level for communities, workers, and environment | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Space requirement | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste residuals | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| Social | | | | | | | | | |
|--------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sub-criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Acceptability of treatment residues by community | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Land requirement | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Acceptance cost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Extent of necessary resettlement of people | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Inclusion of society's wellbeing in waste disposal related policies | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Public's perception on aesthetic impact (i.e.: noise, odor, litter and greasy) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| Technical | | | | | | | | | |
|--------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Sub-criteria | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Category of pharmaceutical waste (i.e.: Class I, Class II and Class III) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Adaptability to future situations | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Availability of local experts/skilled operators | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | | | | | | | | | |
|---------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Availability of spare parts and usage of local materials or manufactured technologies | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Compatibility with existing technology and natural conditions | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Level of automation/sophistication | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Occupational hazard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Track record on performance | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Treatment effectiveness/capability | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste-to-Energy (WtE) requirement | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

SECTION D: TREATMENT SELECTION OF PHARMACEUTICAL WASTE

For this section, respondents are required to answer the following question regarding the treatment of pharmaceutical waste. Please select and tick (/) the score for each of the treatments that are relevant to be used for pharmaceutical waste in the context of green practice which have been applied in Malaysia in the space provided by referring to the relevance scale in the table below.

| Scale | Explanation |
|-------|---------------------------------|
| 1 | Not relevant at all (NR) |
| 2 | Not very much relevant (NVMR) |
| 3 | Not much relevant (NMR) |
| 4 | Not very fairly relevant (NVFR) |
| 5 | Fairly relevant (FR) |
| 6 | Very fairly relevant (VFR) |
| 7 | Much relevant (MR) |
| 8 | Very much relevant (VR) |
| 9 | Exceptionally relevant (ER) |

| Economic | | | | | | | | | |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Treatment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Incineration | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Chemical disinfection | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste immobilisation (encapsulation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Secured landfill | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| Environmental | | | | | | | | | |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Treatment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Incineration | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Chemical disinfection | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste immobilisation (encapsulation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Secured landfill | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| Social | | | | | | | | | |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Treatment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Incineration | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Chemical disinfection | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste immobilisation (encapsulation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Secured landfill | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

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| Technical | | | | | | | | | |
|--------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Treatment | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Incineration | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Chemical disinfection | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Waste immobilisation (encapsulation) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Secured landfill | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |